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TASMANIA.

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COAL FIELDS.

REPORT OF THE GOVERNMENT GEOLOGIST.

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August 20, 1861.



*Geological Survey Office, Hobart Town, 25th March, 1861.*

SIR,

I HAVE the honor to inform you that, in accordance with your desire, I have engaged myself in the examination of the Coal Fields existing in the Break-o'-Day Valley, and upon a portion of the East Coast; the results of which I beg to forward in the accompanying Report, illustrated by the necessary Maps and Sections.

The desire expressed by the Government for early information respecting the Coal Fields of the Colony has led me to hasten the completion of the present Maps, in anticipation of those which are preparing for the illustration of the General Survey, and to restrict the observations included in the Report to that section of the Geological history of the District which is specially connected with the subject it is devoted to.

I have the honor to remain,

Sir,

Your very obedient Servant,

CHARLES GOULD.

*The Hon. the Colonial Secretary.*

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## R E P O R T.

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THE formations treated of in the present section of the Report upon the Geological structure of the Fingal District, are the Upper Palæozoic marine deposits and the Coal-measures; the apparent conformability of the two formations, and their intimate connection, serving to render their consideration inseparable.

The nature and extent of the other formations existing in this portion of the Colony, together with their general relations and the marked degree in which their development has originated or modified the most prominent natural features of the District, will be the subject for separate consideration.

### THE UPPER PALÆOZOIC FORMATION.

In the vicinity of Fingal, this formation rests unconformably upon granite or upon the edges of the highly inclined Palæozoic slaty deposits, and projects in fringe-like expansions from beneath the Coal-measures, and the greenstones associated with them. It comprises a series of beds, differing considerably in lithological character. The lowermost ones are principally arenaceous, and the upper ones calcareous; the former consisting of sandstones and conglomerates, the latter of limestones, shales, and marls.

This composition remains uniform over a considerable area, the only variation obtaining in different localities being in the relative proportions, and not in the character of the constituents.

The base of the series is generally a conglomerate; among the materials composing which are quartz, sandstone, grit, clay slate, mica slate, and granite. In some localities, and more especially in the south-western portion of the district, this is replaced in part by a brecciated mass of the same constituents, including angular fragments of very considerable size.

It is noticeable, in reference to the question regarding the age of the greenstone, that no evidences in favour of its pre-existence are afforded by this portion of formation; whereas we ought to find pebbles of that rock associated with the others forming the conglomerates, had it been in existence prior to their deposition.

The thickness of this bed is generally inconsiderable; but in some positions upon the northern face of St. Paul's Dome it reaches as much as from 15 to 20 feet; and, in consequence of the pebbles being closely cemented together by a hard and ferruginous matrix, projects in large and prominent masses from beneath the softer and more destructible sandstones above it.

The lowest beds, and their junction with the older schists, are well exhibited in many of the sections of the series, from the limestone downwards, afforded by the cliffs overhanging the road upon the northern face of St. Paul's Dome, and upon the summits of the spurs radiating from that mountain: and resulting from the extent of the denudation to which this formation has been subjected, it happens frequently that small outlying patches of the lowest beds are met with at the termination of these spurs, producing, in conjunction with the almost vertical and jointed slaty deposits supporting them, isolated and conspicuous rocks, as remarkable both for their boldness and singular outline, as for the geological interest attached to their structure.

The most accessible example of this, is the groups of rocks known as the Sisters, situated a few miles distant from the Township of Avoca, and observable, even from that point, projecting conspicuously from amidst the foliage of the forest surrounding them.

In these rocks, a thickness of 20 feet of buff-coloured sandstone is succeeded by a conglomerate which, passing downwards into a coarse breccia, rests in broken isolated patches upon the irregular surface of the edges of layers of hard micaceous sandstone and clay slates, which are intersected by quartz veins and split up by numerous joints.

The figure in the Plate represents another instance which occurs at the termination of one of the spurs upon the south-east flank of Ben Lomond, where the only relic of the Upper Palæozoic deposits (originally extending across this portion of the valley) consists of a rhomboidal block of sandstones, a few yards in length, resting horizontally upon a low pillar formed by a projecting mass of the nearly vertical slate rocks below it.

The general character of the series may be inferred from the sections taken in any of the cliffs above mentioned, near Avoca.

The highest beds usually exhibited are limestones, succeeded by a thickness of about 150 feet of calcareous sandstones, sandstones, and shales; below which are about 100 feet more of buff-coloured sandstones terminating in conglomerate.

The limestones occur in beds of varying purity, and form a total thickness of from 30 to 40 feet. They are associated with claystones, marls, and calcareous shales; and the interval existing between them and the base of the Coal-measures, is occupied by a mixture of fossiliferous, sandy, and argillaceous deposits.

The percolation of water charged with carbonic acid through the limestone bed has originated, in many places, a series of tufaceous deposits at a lower level, in which are embedded the remains of existing land shells and plants. These deposits are in some instances of sufficient extent to acquire an economic value.

An efflorescence of alum also takes place from some of the sandstones and shales of this series; and it occasionally occurs in abundance, coating cavities in the rock and the interstices between the different layers.

#### THE COAL MEASURES.

The whole of the series of beds in this district, between the marine Upper Palæozoic deposits and the older trap rocks, are so similar in general character that it is hardly practicable to draw any lines of division within it.

Dr. Milligan, in his Report upon the Coal Fields of the East Coast, points out an apparent want of conformability between the upper and the lower portions of the formation, and divides it, for convenience, into an "upper brown sandstone series," and a lower "Coal-measure series."

The evidences in support of this opinion are, I think, inconclusive; and my own investigation of the Coal-measures in this locality has convinced me that great difficulties would be experienced in attempting to draw the line of separation suggested.

In most instances the formation is concealed beneath a great thickness of greenstone drift, derived from the extensive masses of that rock situated at higher levels, so that sections are only exposed at intervals and of inconsiderable depth; and wherever closer examination is permitted, we obtain evidences of the existence of faults and dykes which interrupt it to a rather considerable extent.

As, moreover, beds of similar character recur throughout the formation, it is obvious that extreme caution would be requisite in the determination of the position of beds exhibited in isolated and distant sections.

The total thickness of the formation is not easily ascertained, since the junction of the upper bed with the greenstone is ill defined, and indeed, in most instances, merely suggested by the prominence of certain natural features. It probably attains its maximum in the Mount Nicholas Range, of which I estimated that a thickness of about 900 feet is occupied by these deposits.

It is composed, in very large proportion, of thickly-bedded sandstones, readily distinguishable from those of the underlying marine deposits by their variegated or speckled appearance, due to their consisting of a mixture of various-coloured constituents. The general tint varies from a yellowish or greenish grey to brown, the latter colour being more affected by the upper than by the lower beds. False bedding is frequent.

Alternating with the sandstones, are clays and shale, usually blue or greenish grey, sometimes white, and occasionally yellow mottled with red. The bedding of these is very irregular, and their thicknesses liable to considerable variation in short distances.

Thin layers of dark earthy Coal and bituminous shales occur at intervals throughout the series.

The principal seams of Coal appear to exist within moderate distances of each other, and at an horizon varying from five to six hundred feet above the base.

The general relations of the Coal-measures in this district to the marine deposits supporting them, as far as regards their dip, distribution, &c., are in favour of their being perfectly conformable with them.

Although the Coal-measures exist, to a greater or less extent, along the entire face of the Fingal Tier, they are so sparingly developed upon the west of the Township that it is unnecessary, in the present Report, to do more than refer to the fact of their existence there at a considerable elevation above the valley, and concealed beneath a great thickness of broken greenstone; especially as, in most instances, it is doubtful whether more than the lowest portions of the formation remain, the rest having apparently been removed by denudation previous to the outburst and overflow of the greenstone.

At some height above the picturesque natural section of the inferior marine deposits, known as the Cartland Crag, I found a series of shales and clays, which appeared to be some of the lowest beds of the formation; and, at the foot of the steep escarpment of greenstone behind the Township of Fingal, beds of variegated sandstone crop out, which are considerably higher in the series; and it is, therefore, not unlikely that the outcrop of seams may exist there, although hitherto undiscovered, from their being concealed partially or entirely beneath drift.

The Coal-measures occupy a considerably greater elevation at Tower Hill, and are probably continuous entirely round the eastern face of Ben Lomond, commencing immediately beneath the vertical face of the Greenstone Summit; although in many places completely concealed by the talus derived from it. The slopes of that portion of the tier, which is east of the Township of Fingal, as well as of those of the range upon the northern side of the Break-o'-Day Valley, being less encumbered with drift, and more abundantly intersected by streams, furnish evidences of the existence of several seams; the most important of which crops out in the immediate vicinity of Fingal, and at two points upon the slopes of the Mount Nicholas range, and in all probability extends over a very considerable area. The particulars of its thickness, character, position, and general relations in the former position, have already been given in considerable detail in the Reports of Messrs. Milligan and Selwyn; it will therefore be unnecessary for me to dwell upon more than the essential particulars.

It crops out in the branches of a small creek, at a point about two miles east of the centre of the Township, and is intermediate to two others, of which the uppermost is three feet, and the under one two feet six inches in thickness; the first being separated from it by about one hundred feet of sandstone and shale, the other by about forty feet of sandstone, and consisting merely of alternate layers of shale and Coal. The section of the main seam was ill exposed at the time of my visit, in consequence of the amount of water in the creek, and the extent to which it was covered with greenstone drift. These circumstances precluded me from examining more than about seven feet of its thickness, the total amount of which is stated to be twelve. This portion I found to consist of eighteen

inches of Coal, succeeded by about eleven inches of soft shaly Coal with several clay partings, below which was a more compact bed about four feet in thickness. It is impossible to derive a fair opinion as to the value of this Coal from samples taken from the weathered surface exposed in this creek. It appears, however, to possess a more shaly structure, to contain more ash, and to be, on the whole, inferior in quality to that contained in the continuation of the same seam upon the opposite side of the valley; but, in the latter instance, a rather considerable amount of the surface Coal has been removed at different times, which renders the comparison imperfect; and it is not unlikely that the quality of the Coal near Fingal would also be found to improve materially in samples taken at a distance from the crop. The dip is about  $10^{\circ}$ , and varies from  $E\ 10^{\circ}\ S.$  to  $E.\ 10^{\circ}\ N.$

At the head of the creek the Coal-measures are overlaid by massive greenstone; and upon the west they are cut off by a dyke of the same rock, which occupies the bed of the Fingal rivulet, and about a quarter of a mile of the course of the first and most important tributary on the east; in which also they reappear, and are opposed on the one side of the creek to a thickness of many hundred feet of trap-rock which occupy the other. In a small watercourse upon the north side, four seams of Coal crop out within a thickness of one hundred and sixty-feet. Of the upper one, a few feet only are visible; and it is impossible to form any opinion from that section as to its quality or total thickness.

There is an interval of about one hundred feet between this and the succeeding seam occupied by variegated sandstones, clays, shales, and a few thin bituminous bands. The second seam is only eighteen inches in thickness; but consists of a tolerably uniform, hard, rather slaty coal dipping,  $5^{\circ}$  to  $W.\ 20^{\circ}\ N.$  The third is only separated from this one by ten feet of clay and shale: it is five feet thick, and consists of a hard, compact, lustrous, bituminous Coal, with few partings. The fracture of the more jet-like portions is conchoidal: thirty or thirty-five feet of blueish-grey sandstone succeed, resting on a seam two feet six inches in thickness, consisting of eighteen inches of soft and shaly Coal, and one foot of hard, bright, and splintery. The flooring is of blueish-grey clay, which is visible to a depth of nearly ten-feet.

In the creek adjoining, and at a short distance from the above section, two seams of Coal crop out; of which the uppermost appears to correspond with the fourth one in the section above described. It is two feet nine inches in thickness, is overlaid by sandstone and separated by a small thickness of clay from the one below it. The latter is very imperfectly exhibited; but, from its apparent thickness and general character, I am under the impression that it is identical with the twelve-foot seam outcropping in the adjoining gully.

Although nearly every watercourse along the range east of this point affords some indication of the existence of the Coal-measures, either in the form of Coal-measure sandstone or of thin seams of Coal, none of those which I have had the opportunity of examining in detail appear to contain the outcrops of any of the most important seams. This may be attributed to the fact of the sections exposed being very partial, and to the interruption of the series by faults and dykes.

Thus, in tracing up the bed of the most important creeks,—which are the Lightwood Rivulet and the one to the east of it—we find carboniferous sandstone appearing at intervals to a very considerable elevation in the tier.

In the former, thin layers of Coal and bituminous shale appear at several points and in a side-branch of the latter a seam of bituminous Coal crops out 3 feet 6 inches in thickness. This is at an elevation of about 200 feet above the valley: the bed of the creek below is occupied by greenstone, and a dyke of that rock, commencing half a mile above it, completely cuts off the Coal-measures higher up the stream, which thus appear entirely surrounded by it. In this position in a recess of the tier and 400 feet above the valley, Coal is again met with cropping out in the creek with a visible thickness of about 1 foot. The particulars of the seam mentioned above, and of the beds immediately associated with it, are as follow:—

Yellow and buff-coloured sandy clay, pipe clay, &c. ....	3 feet.
Coal .....	8 inches
White clay.....	3 to 4 inches
Coal .....	17 inches.
White clayey band.....	2 inches.
Coal .....	9 to 12 inches
Clay passing into bluish-grey sandstone .....	8 feet.

dipping rather sharply to  $N.\ 20^{\circ}\ E.$

The quality of the Coal much resembles that of the other seams in the neighbourhood: it is partly hard, compact, and lustrous; but contains a large proportion with a shaly structure and an evidently large amount of ash.

The thick Coal seam, to which attention has so frequently been directed, and which is identical with that existing in the vicinity of Fingal, crops out on the northern side of the valley, at two points upon the slopes of Mount Nicholas.

That range is composed of a narrow capping of greenstone, supported upon an outlying mass of the Coal-measures, about 6 miles in length and 2 in breadth. It has an east and west direction, and the average elevation of the plateau on its summit is about 2500 feet. At a little more than a mile from its western extremity, the range is broken by a gap or saddle into two portions. It is probable that the lowest points of this saddle is on a level with the junction of the two formations.

The seam appears in the beds of two creeks descending the range about a quarter of a mile apart: it is on Crown Land immediately north of the Killymoon Estate. In the easternmost of these two Creeks, it occurs at an elevation of 500 feet above the Plain. It consists of Coal and clay partings, as follows:—

	<i>Feet.</i>	<i>Inches.</i>
Coal .....	1	0
White clay .....	0	4
Coal .....		
White clay .....	2	5
Coal .....		
White pipe-clay parting .....	0	2½ to 5
Coal .....	0	9
Sandstone .....	0	0½
Coal .....	3	7
Clay parting .....	0	3
Coal .....		
Clayey parting .....	0	3 to 5
Coal .....	1	4
Fire-clay .....	1	4*

Dip (W. 7° N.) 3°.

Nearly 60 feet below it, is a layer of bituminous shale one foot in thickness; and, at a further distance of 240 feet, a thin bed of bituminous shale, sandstone, and coal. The interval is occupied by grey and yellow sandstone and clay.

Most of the Creeks descending from the range contain the outcrops of one or more seams. In none, however, with the exception of those mentioned above, is there any exposure of this—the largest and most important one.

In a Creek immediately west of the land, which is the property of Mr. Archdale, about 600 feet of the Coal-measures are exposed, consisting principally of sandstone, and containing the outcrop of three or four seams, varying in thickness from 7 inches to nearly 4 feet. The lowermost is dipping to S. 20° W., at an angle of about 9 degrees.

The section in which it occurs is as follows:—

	<i>Feet.</i>	<i>Inches.</i>
Shales .....	4	0
Soft yellowish-grey sandstone .....	1	0
Bituminous dark shale .....	0	6
Soft felspathic micaceous sandstone .....	1	0
Bituminous shale or shaly Coal .....	0	8
Grey clay .....	0	8
Coal .....	2	2

Two seams, 60 feet apart and 3½ feet and 4 feet in thickness, respectively, crop out in the creek about 250 feet above it. They are nearly horizontal.

The creek east of the same property furnishes evidence of the existence of a fault, with a considerable upthrow on the east, which causes compact dark blue angitic basalt, and nearly horizontal beds of fossiliferous clayey sandstone to abut against blue and purple quartziferous grits; the fault being especially obvious at the north-east corner of Hutton's grant, where it coincides with the bed of the Creek; the whole of the east bank of which is occupied by the grits overlaid at a considerable height by conglomerate beds inferior in position to the fossiliferous deposits occupying the western bank of the Creek at a lower level.

The line of fault, as far as Mr. Archdale's, appears to be nearly north and south; from thence it runs south-easterly to the boundary of St. Mary's Township, which it crosses at nearly the same point as the road. A quarry close to this point, upon the west side of the fault, exhibits white and buff-coloured sandstone, dipping slightly to S. 50° or 55° E.; immediately to the east of which appear sections of slates and quartziferous grits.

The continuation of this fault to the south east is evidenced at several points between this and Mount Logie, upon the sides of which limestone occurs in a position actually superior to that of the

\* Nine inches below this, there is said to be another fifteen inches of Coal.

Coal-measures further west. The direction of the fault cannot, however, be traced with much accuracy for a distance of more than two or three miles.

In the cases hitherto mentioned, the position of the seams described has been considerably above the level of the Plain; and the evidences afforded by the various sections enumerated, tend to show that the most productive portion of the formation is at a distance of some hundred feet above its base.

It is therefore interesting to acquire evidence of the existence of other seams at an apparently much lower level.

In the branches of a creek about two miles north of Killymoon-house, a three-feet seam is exposed at several points: it is associated with blue or greenish-grey sandstones, and dips upon the whole slightly towards the Plain. There is, however, considerable variation, both in the amount and direction of the dip, the latter being at one point W 10° S. while higher up it is nearly S.E.

It is succeeded by a second one, of which two feet only are exposed, at the distance of a few hundred yards higher up the creek. The elevation of these seams above the Plain is very trifling; and in the latter, within the distance of about three-quarters of a mile, horizontal beds of limestone occur, appearing occasionally from beneath the drift of greenstone and thick alluvial deposits with which they are overstrewn.

In several of the small creeks descending from the western portion of the range, Coal seams also crop out within a comparatively trifling distance of the junction with the underlying marine formation; there is generally but a slight thickness exhibited, and the quality of the Coal is in all instances very inferior.

The examination of the Coal-measures upon the northern face of the Mount Nicholas range is attended with difficulty, in consequence of the heavy scrub which occupies it to the east of the Huntsman's Cap. I was enabled, however, to ascertain their perfect correspondence, both in dip and general character, with those upon the south; and by a detailed examination of the beds of the various creeks falling from it in succession, to discover, at several points, the outcrops of seams which, if not themselves of any great thickness, served at least to indicate the horizon in which the thicker and more important might be sought for.

About half way between the Trigonometrical Station and the conspicuous sugar-loaf-like projection at the eastern termination of the range, two seams crop out in the several branches of a small creek. One of them is very obscurely shewn, and though apparently of some thickness, consists of a very earthy shaly Coal; which, even in a more advantageous position, would possess but little value. The other, laying about five-and-twenty feet below it, is from five to six feet in thickness; but is, unfortunately, equally valueless in consequence of the large amount of shaly matter with which it is intermixed. Great thickness of clay, shale, and Coal-measure sandstone occur both above and below these sections. Just on the north of the eastern angle of the range the Coal-measures are cut off by an intrusive mass of basalt, which it is not unlikely may have been erupted from the same source as that which exists upon the south at Mr. Archdale's.

About two hundred yards from their junction with the basalt, the latter is excavated into a horse-shoe-shaped bason of one hundred yards in diameter, into which the water of two creeks empties itself, falling nearly perpendicularly about one hundred and twenty feet.

The basalt at the foot of the falls is dark blue, compact, and excessively hard: higher up it passes through a series of slightly varying tints to a dark green rock, in which are partial cavities, enclosing either brown hematite alone or a crust of that mineral, investing rhombohedral crystals of calc spar or quartz. A few small grains of a greenish mineral (which is probably olivin) are here and there interspersed, and the basalt throughout is impregnated with calcareous matter. A small patch of basaltic rock of similar character exists upon the eastern face of the range, where it forms a rich-soiled flat-topped piece of land, heavily scrubbed, of small extent, and existing at so great an elevation, and in such a position as to be, for purposes of occupation, inaccessible.

The creek flowing northwards from the saddle west of the Trigonometrical Station affords evidence of the existence of the Coal-measures within one hundred and fifty feet of its highest point; and about one hundred and seventy feet lower a small seam is exposed, succeeded by sandstones and shales, which, with considerable interruption from the amount of fallen greenstone resting upon them, may be traced to their junction with the lower series, the limestones belonging to which crop out in the same creek, about seven hundred and fifty feet below.

In the creek flowing north-westerly from the angle between the Huntsman's Cap and the main range, there appear bands of bituminous shale, a seam of Coal four feet in thickness, and another nearly as much as five; the two latter are five and thirty feet apart. The largest consists of—

Coal .....	2 feet.
Shale and clay band .....	1 foot.

Coal .....	8 inches.
Shale .....	2 feet.
Coal .....	6 inches.
Shale .....	3 feet.
Coal .....	2 inches.

Other seams of small thickness also crop out in some of the creeks west of the point; and there is every reason for believing that the entire series of the Coal-measures are represented completely upon the northern equally as on the southern face of the range.

In the north and south range, (Mount Logie) which blocks up the eastern end of the Break-o'-Day Valley, but little opportunity is afforded of ascertaining what thickness of the Coal-measures may exist in it. Upon the seaward side, the conglomerate and freestones of the succeeding formation form a kind of projecting plateau, supported upon the granite, which is about equal in elevation to the flooring of the valley adjoining.

Rising from this plateau are the limestones and their associated deposits, succeeded in ascending order by the bottom bed of the Coal-measure sandstones. But above this, the examination into the structure of the range is prohibited by the extent of the overlying drift of greenstone, which renders it impossible to ascertain the thickness of the Coal deposits between the highest point where they have been observed, and the base of the layer of greenstone resting on them.

South of the range, there is a general dip of all the formation towards the sea, and the junctions of the granite, slates, upper Palæozoic deposits, and Coal-measures gradually approach and strike the coast line in succession.

Both in the middle barway and in the several branches of Picanini Creek, the junction of the upper palæozoic beds with the older slates is clearly defined. As is the case with the former formation in other localities, the base consists of a thin conglomeritic deposit, overlaid by sandstones and alternations of sandstone with clays, to a thickness of about one hundred feet; above which occur compact blue fossiliferous limestone, and beds, consisting of a mixture of clay with arenaceous and calcareous matter; ferruginous and yellowish sandy clays, containing an abundance of impressions of several species of fenestellæ continue for a thickness of about 200 feet more, when a sharp sandstone commences, containing a few large rounded pebbles of quartz and clay slates, which is apparently the junction bed with the Coal measure series above; since immediately over it is a section exhibiting blueish flakey clay, perfectly similar in character to that which occurs at many horizons in the latter formation.

Associated with the fossiliferous limestones in this locality, are deposits of a species of chert, ordinarily of a dull white colour and semi opaque; but also veined with grey, yellow, and occasionally blue streaks: it breaks with a rather flat fracture, and contains the remains of corals, fenestellæ, &c. Among other fossils obtained in this locality were specimens of *Spirifer subradiata*, worthy of notice upon account of the beautiful state of preservation of the spiral lamellæ. The beds of these creeks (below the limestones) are thickly coated with a deposit of calcareous tufa containing impressions of the forms of ferns, leaves, sticks, &c.

In the upper portion of the main branch of Picanini Creek a considerable thickness of the Coal-measures is exposed, including an apparently gradual passage into the lower beds.

At an elevation of nearly 1000 feet above the sea, a seam occurs showing a thickness of about two feet of shaly Coal: another, of greater thickness and better quality, is said to have appeared formerly cropping in the same creek. It is, however, no longer visible, and has probably become covered up again with drifted materials or with dense vegetation.

A fault occurs in one of the branches of this creek, upon the banks of which a considerable portion of the Upper Palæozoic beds are seen to abut against the older slates. The direction of the line of fault is N. 30° W. or N. 35° W., and the upthrow 100 feet upon the western side.

In the immediate vicinity of the fault, the former beds dip away from it at an angle of about 55 degrees, the normal dip at a short distance south being only 5 or 6 degrees in the direction E. 30° S. Some of the beds of argillaceous sandstone are here perfectly intersected by two systems of joints at right angles, which cut the large flat surfaces exposed in the bed of the creek into the form of a brick pavement.

The disappearance of the mass of the Coal-measures towards Doctor's Creek is probably caused by the continuation of this fault, which appears to strike the coast line in the southern angle of Long Point, cutting out a large portion of the Coal-measures and the whole of the Upper Palæozoic series. The lower beds of the latter show themselves near Picanini Point, in a reef projecting into the sea in the direction of the strike, and dipping at an angle considerably opposed to that of the measure upon the western side of the fault, viz., of 4° to S. 40° W.

Sharp sandstone of a buff or yellow colour, striped horizontally with white and red, resting on



conglomerates, occupy nearly the whole of the flat country extending westerly from this to the tier. Quarries have been opened in the sandstones and very excellent building stone obtained.

Drifted sand conceals the line of termination of these beds upon the south ; but it probably occurs somewhere on the neck of Long Point, the whole of the strip of low country intervening between the tier and the coast being henceforward occupied by Coal-measure sandstone as far as Bicheno, forming a Coal Field with a superficial area of about 16 square miles. For the purpose of conveying a correct impression with regard to the position of the various seams contained in which, it will be necessary to describe in some detail the most important sections exhibiting them.

The coast line itself furnishes but little information, since it merely shews, at intervals, masses of Coal-measure sandstone, without any very determinate dip or characteristic lithological distinctions. Upon the north side of the mouth of Douglas River, yellowish-brown and greenish-grey sandstones appear upon the beach, apparently almost horizontal, but possibly dipping slightly to 25° N. of W. and extending to within half a mile of Long Point.

At the rocks called the Porches, upon the south side of the river, yellow and grey sandstones form a low cliff, eroded into shallow caves by the action of the water, and containing rather abundantly fossilized wood and other vegetable remains. These are in some instances silicified, and in others converted into dark black carbonaceous material, which may be readily mistaken for coal.

Certain occasional concurrences of wind and tide are stated to strip off the sand from the beach above the Porches at rare intervals ; upon which occasions the outcrop of a seam is exposed, containing bituminous Coal of very fair quality. I caused several holes to be sunk in the vicinity of the spot where it was indicated to exist, but was unable to discover it.

In the Doctor's Creek, about 100 feet of the upper Coal-measure sandstone occupy a mile and a half of its course, dipping easterly at an angle of from 4° to 6° ; the rest of it is through massive greenstone coinciding in dip with that of the stratified beds, and reaching at its lowest point to within 150 feet of the level of the sea.

#### THE DOUGLAS RIVER.

In this river sections are exposed, at intervals, of brown, yellowish, drab-coloured, greenish-grey sandstones, rising, for short distances, into cliffs and steep banks overhanging the river, and occasionally stretching across in broad ledges and forming its bed.

In the lower parts of the river the amount of dip is inconsiderable, and its direction is obscured by the existence of false bedding : higher up it reaches as much as five or six degrees, with a direction varying from S. 20° E., to a little W. of S.

The sandstones are sometimes varied by the intermixture in irregular patches of arenaceous clay, containing wood partially silicified and partially converted into a substance resembling Coal, and of beds varying from a few inches to several feet in thickness, composed of rounded pebbles of greenish micaceous sandstone, claystone, and, less frequently, of quartz. Here, as in other localities, it contains, at many horizons, impressions of plants and thin streaks or layers of Coal. At a distance of between three and four miles from the mouth of the river, the rise of the beds, assisted by a fault with an upthrow to the west, has caused the exposure of a seam of Coal overlaid by beds of a rather hard and compact greyish-white sandstone, dipping at an angle of 5° to E. 20° S. The seam is broken about the middle of the section by a small fault ; and within the distance of a few yards is, for a third time, interrupted by an upthrow in the same direction as the previous two, bringing into vertical contact with it, beds of the inferior sandstone, and carrying it to an unseen height above the level of the stream. An anticlinal axis must cross the river a little above this point, since the same seam re-appears, dipping in the reverse direction about six hundred yards higher up. In this section the entire thickness of the seam is exhibited, and a face of Coal displayed for about twenty-five yards along the south-western bank of the river, and extending across it.

The thickness of the seam is about eight feet : it consists of alternations of a laminated dull Coal with brilliant jet-like layers, possessing a conchoidal fracture. There are several partings ; but their aggregate amount does not exceed seven or eight inches.

The composition of the seam varies slightly, even in the short interval existing between the two points of its outcrop, as will be perceived from the sections of it in the respective situations.

#### Highest Section.

	<i>feet.</i>	<i>inches.</i>
Greenish-white sandstone, uniformly dull, black, shaly		
Coal, fracture uneven	0	10½ to 13¾
Sandy parting	0	0½
Alternations of dull black Coal with brilliant jet-like layers		
in which the fracture is conchoidal.	2	0

	<i>Feet.</i>	<i>Inches.</i>
Parting . . . . .	0	0½ to 1
Coal . . . . .	0	3½
Foliations of grey clay and bituminous matter . . . . .	0	5 to 9
Coal like No. 2 . . . . .	1	6 or 7
Parting . . . . .	0	1
Silky black Coal with jet layers . . . . . 6 inches	2	0
Shaly Coal . . . . . 4 ditto		
Dull compact Coal . . . . . 14 ditto		
Parting . . . . .	0	0½
Coal containing much jet . . . . .	0	5
Averaging about . . . . .	8	0
Greenish-grey clay . . . . .	4	0

Dip N. 30° W. 4°

*Lower Section.*

	<i>Feet.</i>	<i>Inches.</i>
Coal . . . . .	0	10½
Thin parting. . . . .		
Coal . . . . .	0	10
Thin parting. . . . .		
Coal . . . . .	0	8
Coal . . . . .	1	3
Clay parting . . . . .	0	1
Coal . . . . .	0	3½
Clay . . . . .	0	4
Coal and stone . . . . .	0	4
Clean Coal . . . . .	1	3
Parting . . . . .	0	0½
Coal . . . . .	2	1½
Averaging about . . . . .	8	0
Fire-clay . . . . .	0	6

Dip 5° E. 20° S.

Overlying the seam, are sandstones which rise into cliffs of nearly a hundred feet in height upon the northern bank of the stream immediately above the upper section, and through these the river cuts its way in a succession of chines, ravines, and falls, which render it an impossibility, for a short distance, to follow up its course.

The apposition of a massive sandstone with sandstone in layers, exhibited at this point, presents the greatest approach to unconformability afforded by any of the sections I have examined.

The position, unfortunately, precludes a perfect examination from being made; and additional difficulty is experienced upon account of the apparent junction being confounded with the face of a joint. It is, however, I imagine, nothing more than an example of false bedding, upon a larger and more distinct scale than usual.

About one hundred and fifty yards higher up, a dyke of hornblendic trap traverses the sandstones, deranging the dip, and throwing them off sharply in the direction S. 10° E. It is only a few yards in width, and courses from S. W. to N. E. Traversing it, in the direction of its length, are several veins of crystallised calc spar, nowhere exceeding a few inches in thickness. Above this again, drab-coloured and grey sandstones are passed over, dipping slightly to the south east, and traversed within a short distance by a dyke parallel to, and more narrow than the first one.

A second seam of Coal, inferior both in quality and in thickness to the one just described, crops out in the river bank about half a mile above it. The seam is overhung by a cliff of yellow, white, and grey sandstones, nearly seventy feet in height, the debris resulting from which almost entirely conceals it.

The outcrop may be traced into a tributary creek upon the left, where, at a distance of one hundred and fifty yards from the river, the following section is met with:—

Coarse brown and grey sandstones.

	<i>Inches.</i>
Coal, rather shaly, with a moderate proportion of shining jet-like bands . . . . .	10
Parting, sandy . . . . .	2
Coal . . . . .	4
Parting, clay . . . . .	5
Coal, bottom not observed . . . . .	6 + ?

This Coal contains a large proportion of earthy matter ; it is bituminous, but non-caking. It is unlikely ever to prove of much value.

In ascending this creek, sections are obtained of the upper portion of the formation, which serve to show its general identity in lithological composition with the lower and more productive beds. After passing over a considerable thickness of sandstones, including a pebble bed about 3 feet in thickness, composed of fragments of granite, quartz, and clay slate, we met with alternations of blue and white clays with sandstones, shales, bituminous shales, and seams of Coal ; the latter, however, not exceeding 5 or 6 inches in thickness. The average dip is about 4° to S.S.W.

In the river itself similar sections are exhibited. About 600 yards above the junction with the creek, the action of the water has hollowed out a cave in the sandstone some 20 feet deep, the flooring of which consists of dark brown sandstone with pebbles and large rounded masses of grit. An irregular seam or patch of a dark greenish-grey compact, poor clay ironstone, swelling in some places to a thickness of 2 feet, and diminishing at others to a few inches, is intercalated among the sandstones, and like them, contains, rather abundantly, plant remains. Above this, bituminous shales and sandstones occur, which are probably identical with some of those observed in the tributary creek ; and, at a further distance of about half a mile, the evidences are met with of an extensive dislocation, in which the downthrow is apparently towards the south, and the direction transverse to that of the creek or about W. 15° N. (*Vide* plate 1, figure 3.)

The enormous size and number of the blocks of fallen greenstone which now choke up the bed of the river, render any further minute examination of it impossible ; but sandstones, clays, and bituminous shales, may be traced at intervals to an elevation of at least 900 feet above the level of the sea.

In addition to the points already mentioned, the upper and smaller of the two seams crop out in one of the creeks which empties itself into the river, considerably below the exposure of the large seam. In this instance, there is exhibited a remarkable derangement of the strata, in consequence of which the seam is abruptly terminated, or, as miners express it, nipped out, by the intercalation of thick masses of clay. In fact, at this point, both the seam itself and the beds immediately associated with it are extremely variable ; the following section exhibits their average composition :—

	<i>Feet.</i>	<i>Inches.</i>
Grey sandstone . . . . .	20	0
Sandstone, with thin irregular lamina of Coal . . . . .	1	0
Grey micaceous clay and sand, (this bed varies in a short distance from a few inches to several feet) . . . . .	2	0
<i>Seam.</i>		
Coal and white clay, (alternating), 2 bands of each . . . . .	0	6
Coal . . . . .	0	3
Coal (inferior) . . . . .	0	3
Clay . . . . .	0	2 to 1½
Coal, with bright bands . . . . .	0	4
Coal, bright. . . . .	0	7
Fire-clay . . . . .	0	6
Greenish-grey clay . . . . .	3 or 4 feet.	

The interruption of the seam is represented in the plate 1, figure 4 ; in which it will be seen that it splits into thin beds, and terminates beneath a mass of clay which is thrust, as it were, between the flooring and the roof.

The dip is about 6° to S., 10° E., and the elevation above the sea about 240 feet.

#### THE DENISON RIVULET.

In the Denison Rivulet, sections are exposed of seams apparently distinct from those which were the subject of the Douglas River Coal Company's operations, as well as from those which have been described as cropping in the Douglas River.

A little below the north-west corner of the Company's land, a bank section exhibits blueish-grey clay and shale, with a few inches of Coal dipping slightly down the stream to E. 15° N. A shaft sunk upon the northern side of the stream, near this point, to the depth of 50 feet, is stated to have passed through as many as 5 or 6 different but unimportant layers of Coal.

At a distance of three-quarters of a mile above this point, the upper portion of a seam is exposed, consisting of about 15 inches of a bright lustrous Coal with a somewhat conchoidal fracture, succeeded by a 6-inch parting of clay and bituminous shale, with apparently, at least, one more foot of Coal below.

The seam is overlaid by about 35 feet of greenish-grey sandstone, the bottom 14 feet of which, contain occasional pebbles, and thin streaks of carbonaceous matter.

The Coal is bituminous, ignites freely with a strong flame, and leaves a black cinder. The thick bed of sandstone forming the roof, lying upon it somewhat unevenly, and there being but a small face of it exposed, it is impossible to ascertain the dip, which is apparently to the south.

One hundred and fifty yards higher up the stream we find, succeeding the above in ascending order, a series of alternations of Coal with black shales, clays, &c., as follows:—

	Feet.	Inches.	
Seam No. 1.—Coal . . . . .	1	5	
Unseen . . . . .	7	10	
Black bituminous shale and sandy shale . . . . .	1	3	
White clay . . . . .	0	2	
Black bituminous clay . . . . .	0	5	
Whitish-grey, hard, sandy clay . . . . .	0	3	
Bituminous shale . . . . .	0	3	
Dark bituminous sandstone . . . . .	1	0	
White fire-clay . . . . .	0	11	
	Feet.	Inches.	
Seam No. 2 consisting of—	{ Coal . . . . . 1 0 } { White parting . . . . . 0 2 } { Coal . . . . . 1 8 } { White parting . . . . . 0 2 }		2 10
Greenish-grey clay, with impressions of leaves, &c. . . . .	0	9	
Coal . . . . .	0	2	
Hard, dark, claystone rock . . . . .	0	7½	
White clay . . . . .	0	6½	
Hard, firm, greyish-white sandstone . . . . .	1	8	
White clay with thin streak of Coal . . . . .	0	7	
Bituminous shale, stony Coal, and Coal . . . . .	0	6	
Clay parting . . . . .	0	2½	
Dull Coal with thin shiny streaks and 2 or 3 streaks of sandstone . . . . .	0	11	
White clay . . . . .	0	4	
	Feet.	Inches.	
Seam No. 3 consisting of—	{ Coal . . . . . 0 11 } { Thin parting . . . . . 0 8½ } { Coal . . . . . 0 3 } { Thin parting . . . . . 0 3 }		1 10½

Seam No. 2 presents, upon fracture, alternate layers of dull and brilliant jet-like Coal breaking readily into flakes; while No. 3 is more compact and duller, the fracture being semi-conchoidal. It is succeeded by several feet in thickness of grey clay, and the whole dip at an angle of 3° or 4° to S. 20° W.

The elevation of No. 3 seam above the level of the sea may be stated approximately at two hundred and sixty feet.

I am indebted for my information as to the upper seventeen-inch seam, No. 1, to Mr. J. Lyne, who describes the Coal as burning less freely than that from the other two.

No other sections of Coal occur above this; but Coal-measure sandstone shows itself occasionally up to the elevation of about four hundred and fifty feet: when dark crystalline, subprismatic solid greenstone commences, and is continued to the summit of the tier. A break exists between the Coal-measures above the Company's land and those beneath, through the eruption of a dyke of dark hornblende trap rock. In the creek itself, it is dark and compact; but passes upwards through the ordinary form of the greenstones of the district, into varieties, in which the felspar predominates, and into a greenstone porphyry, with a felspathic base and very distinct crystals of hornblende.

A stream section also affords the evidences of a dislocation, existing immediately east of the shaft alluded to above. The upthrow is probably upon the seaward side.

#### THE DOUGLAS RIVER COAL COMPANY'S ESTATE.

The land which was the subject of this Company's operations lies in the southern extremity of the Douglas River Coal Field. The major part of it consists of flat or gently sloping ground, intercepted between the coast, and a moderately lofty tier running along its western boundary.

The workings were, in the first instance, undertaken in the N.W. corner of the grant; and from the Report of the Directors, it appears that two seams were intersected by the shafts, at the depth of ninety-two feet and one hundred and sixty-five feet respectively. It was at first anticipated that a large proportion of the Coal in the top seam would be available for extraction; but experience served to show that the separation of the several beds, by partings of shale and bass, rendered it impossible to extract, profitably, more than about four feet; which is stated in the Report to be arranged in two layers of about two feet seven inches, and one foot five inches respectively.

The seams dip at an angle of about  $1\frac{3}{4}^{\circ}$  to the S.W., and are cut off within fifty yards of the shafts, by a fault running in a north and south direction, which may possibly be a continuation of the one exposed in the Denison Rivulet.

The second or lower seam is over five feet in thickness; and in the Report, the quality of the Coal is stated to have been superior to that in the upper seam, and the quantity of Coal clean or free from bands, greater.

It is greatly to be regretted that detailed sections of the seams, the strata passed through in the various shafts, and the results of all the borings, were not prepared during the progress of the operations, and preserved among the Company's records; since, in consequence of the interval which has elapsed since their close, and the absence from the Colony of those persons best acquainted with them, it is now impossible to obtain information of the same authenticity as would have been derived from any preserved on regular mining plans and sections of the character described.

I am indebted to two of the Directors, Messrs. Barnard and J. Lyne, for the particulars of several of the sections prepared by one of the earlier Managers of the Company; among which are the following of the two seams:—

*Section of Top Seam, Inner Mines, Douglas River Coal Company.*

	<i>Feet.</i>	<i>Inches.</i>
Soft fire clay . . . . .	0	8
Black bass . . . . .	0	10
Clean Coal . . . . .	1	1
Brown band . . . . .	0	$7\frac{1}{2}$
Clean Coal . . . . .	0	8
Brown rib . . . . .	0	1
Clean Coal . . . . .	0	5
Brown rib . . . . .	0	3
Black bass . . . . .	0	10
Brown stone . . . . .	0	3
Clean Coal . . . . .	1	0
Brown stone . . . . .	0	3
Clean Coal . . . . .	1	2
	<hr/> 8	<hr/> $1\frac{1}{2}$ <hr/>

*Section of Bottom Seam, Inner Mines, Douglas River Coal Company.*

	<i>Feet.</i>	<i>Inches.</i>
Upper gas Coal . . . . .	1	3
Soft band . . . . .	0	$3\frac{1}{2}$
Coal . . . . .	1	4
Black band . . . . .	0	5
Clean Coal . . . . .	1	0
Band of Coal with stone . . . . .	1	0
	<hr/> 5	<hr/> $3\frac{1}{2}$ <hr/>

The outcrop of the uppermost of these two seams, is stated to have been proved at several points in the interval between the shafts and the Denison Rivulet, and upon the slopes of the hills upon the east of the workings cropping out in positions consistent with those which would be indicated by the amount and direction of the dip, and by the form of the ground.

In a shaft sunk by Mr. Lyne near Badger's Bridge, a seam was struck by him which differed in detail from either of those which had been the subject of the previous operations; more so indeed, it appears to me, than would be likely to happen within so short a distance in the same seam.

The section was as follows:—

	<i>Feet.</i>	<i>Inches.</i>
Yellow clay . . . . .	10	6
Coal-measures . . . . .	4	0
Inferior Coal . . . . .	0	4
Pipe clay . . . . .	0	1
Inferior Coal . . . . .	0	6
Pipe clay . . . . .	0	$0\frac{1}{2}$
Brown stone . . . . .	0	4
Pipeclay . . . . .	0	10
Brown stone . . . . .	0	4
Good Coal . . . . .	0	6
Stone band . . . . .	0	$0\frac{1}{2}$
Good Coal . . . . .	1	1
Pipeclay . . . . .	0	2
Coal . . . . .	0	$2\frac{1}{2}$

A shaft sunk in the gully, a little above this one, proved to be exactly on the back of a fault, and another in the head of the creek, about 400 yards still higher up, passed through 25 feet of clay, shale, bituminous shale, and dark earthy Coal.

The borings executed by the Company served to demonstrate the existence of Coal-seams over a large proportion of the area granted to them. In consequence, however, of the absence of any authentic plan of the position of the bore holes, in connection with the details of the strata passed through, the information afforded by these, although intelligible to the conductors of the operations at the time, is no longer of any assistance to our consideration of the relation existing between the seams thus indicated and those occurring in the shaft.

After extracting about 800 tons of Coal from the old shafts, the Company were forced, by the expense of cartage and land carriage, to abandon that portion, and sink new shafts nearer to the harbour.

The dip of the strata was here found to be reversed, and amounted to about  $3^{\circ}$  in a north-easterly direction. At a depth of 90 feet from the surface a small seam was met with, which is variously stated as having been 3 inches and 2 feet in thickness; and 102 feet below this, a second, which was the one from which the Coal subsequently supplied by the Company was extracted.

The details of this seam are given by Mr. Selwyn in his Report upon the Coal Fields of the coast. It appears from the Report of the Directors, that these seams were considered to be identical with those that had been cut at the old shafts or inner mines. There is, however, such a discrepancy between the sections of the two seams at the inner, and those at the outer mines, especially of the upper one, which in the one instance is a few inches, and in the other as much as eight feet in thickness, as also in the relative distance of the two seams, that I consider it unlikely they can be the equivalent of each other. A further depth of 168 feet was proved, by a boring from the bottom of the shaft passing through sandstone the entire distance, which, of course, puts out of question the possibility of the second 8-feet seam of the outer mine being the equivalent of the top or 6-feet seam of the inner: nor can I readily identify any of these seams with those occurring in the Denison Rivulet. Of all the seams worked by the Company, the second or lower seam of the inner mines appears to have been the most promising. The quality of the coal is reported to have been superior to that of either of the other seams; and it is much to be regretted that the non-completion of the tramway to that point prevented this one from receiving so fair a trial as its indication appeared to merit. With regard to its quality the Directors state:—

“It was tried at Mr. Walker’s establishment in Barrack-street, and Mr. Robert Walker states, that with this Coal the boiler was heated forty minutes sooner than had been usual. It was tried at Mr. Davidson’s foundry, in the smelting furnace where the tilt-hammer is worked, for which a strong heat and much flame are essential; and it was considered to be superior in heating power to some English Coal which they had been using, and for which they had paid 35s. per ton. Messrs. Easby & Robertson gave an equally favourable account of the behaviour of the Coal at their establishment; where, after being tried in the forge, it was used to heat the furnace for working their steam engine. (Report of the Douglas River Coal Company, 1850, p. 24.)”

The facilities of working this in connexion with the upper or 8-feet seam, would possibly have rendered both remunerative; while neither might have repaid the expense requisite for the erection of the machinery necessary for itself singly.

The increased depth of the lower seam renders a larger area available for extraction than there is of the upper, between the bottom of the shaft and the outcrop, or the crest of the anticlinal existing between the two workings.

It is questionable whether the upper seam may not fall over and re-enter the Company’s land upon the eastern side of the anticlinal; and whether the indications of seams afforded in the cutting for the tramway south of the new shafts, and upon the coast nearly opposite to it, may not be continuations of some of those observable in the ranges upon the west.

Upon the south east, the Company’s land extends to the edge of the Coal Field, and the measures overlapping the marine deposits rest directly upon granite; that rock appearing upon the coast close to the corner of the Company’s land, rises at a short distance back from it into hills, and is overlaid by greenstone, which, in continuing westward, extends across the Coal-measures also, leaving, however, a gap uncovered, by which a direct connection is maintained between the Coal formations of the Douglas River and those existing in the valley of the Apsley.

Having thus taken into consideration the principal sections from which information may be derived with regard to the general character of the Coal deposits, and the number and position of the seams existing in them, I shall proceed to point out the measures by which that information may be supplemented, and the steps which should be taken for the practical determination of the most important ones.

It will be desirable, before commencing, to give a brief résumé of the principal facts which have been ascertained. By glancing at the map, it will be perceived that, for all purposes of practical consideration, the Coal-measures of this district may be regarded as constituting two distinct fields:

the one of which might be termed the Mount Nicholas Coal Field, comprehending the separate portions developed upon either side of the Break-o'-Day Valley; while to the other, the term Douglas River Coal Field might be applied as indicating the area occupied by the carboniferous formation between Long Point and Bichenno.

In the first, the position of the principal seams of Coal, although highly advantageous to their being worked, is at an elevation of from 1200 to 1500 feet above the sea. In the latter, they are either actually below the level of the sea, or crop out in positions but little above it.

Although no doubt can be entertained that a close correspondence exists between the various seams outcropping near the coast, and those showing themselves in the Mount Nicholas Coal Field; yet, the absence of sections of the formation in the intervening distance, and of a sufficiency of evidence to enable us to ascertain a perfect sequence in either case, renders it a matter of extreme difficulty to identify the seams occurring in the respective localities; and, as the circumstances of shipment, &c., are very different in the two instances, it will be preferable to consider them separately.

I shall detail elsewhere the reasons which have led me to conclude that the greenstone associated with the Coal-measures is of posterior date; a point of great importance as regards the probable extent of the area occupied by the latter.

Assuming, therefore, that the eruption of that rock took place subsequently to the deposition of the Coal-bearing strata, it is probable that it occurred at a number of distinct and distant points; and that the extended masses which form the summits of all the important ranges in the district, conceal beneath them a far more considerable area of the Coal-measures than is at present exposed; in which case there would be no difficulty in following the Coal beneath the overlying formation.

I have pointed out the existence of at least 6 distinct seams in the Mount Nicholas Coal Field; one of these is superior in quality to the rest, and as much as 12 feet in thickness; being, moreover, equally or more favourably situated for being worked, and for transportment to a shipping place, it will be sufficient to take that one into consideration alone.

In spite of occasional interruptions by faults, &c., it is probable that it crops out all along the southern face of the Mount Nicholas range; and that, in accordance with the opinion which I have stated above, it may pass beneath and underlay the massive greenstone capping on the summit. The distance in plan of the outcrop of the large seam from the junction of the Coal-measures with the greenstone, is between half and three quarters of a mile, and, at many points, would be even in excess of that amount. A very extended area of this seam might, therefore, confidently be reckoned upon, independent of the possibility of its being further increased to a large amount by the restriction of the greenstone in depth to a dyke or vent of relatively inconsiderable extent.

The general tendency of the dip of the strata in the Mount Nicholas range appears, though slight, to be from east and west towards the centre. There also appears to be a slight flexure to the south along the edge of the range. It is, certainly, never into the hill for any considerable distance. It is impossible to anticipate to what extent the exploration of this seam might be affected by the discovery of faults, or of local disturbances coincident with the progress of the work; but, so far as it is possible to form an opinion, without further experimental research, it appears that the circumstances attending its dip, position, and general relations, could hardly be more favourable for it being worked to advantage than they are at the point at which I have described its outcrop.

Headings driven into the face of the hill would serve at once as adit levels and main galleries for the ventilation of the mine, and for the extraction of the Coal; and the heavy expenses ordinarily attendant upon the unwatering of a mine, and upon the elevation of the mineral extracted to the surface, would be almost entirely obviated. The seam itself is of such considerable thickness that the upper bed of Coal could well be spared to serve as a roof, in the event of the sandstone (?) immediately above it (not exposed in the sections) proving ill-adapted for that purpose.

The separation of the main portion of the seams by partings would probably prove advantageous, rather than otherwise, in facilitating its extraction. By a reference to the section, it will be seen that the Coal is divided into as many as 6 distinct layers; but that 2 of them, Nos. 2 and 4, possess a thickness of 2 feet 5 inches, and 3 feet 7 inches, respectively.

From the analysis of specimens of this Coal made by the late Sir H. T. De La Beche, it would appear that the proportion of ash is very much more considerable in the seam in the vicinity of Fingal, than it is under Mount Nicholas. It is not improbable, however, that specimens taken from different portions of the seam in either locality, would exhibit an equal variation; and it would be absolutely requisite to make a careful selection of a large series of samples of the Coal from corresponding portions of the seam, before admitting a conclusion of such great importance as that which is indicated by the different results of the analysis alluded to. Assuming, however, for the convenience of making an approximate calculation, that the per centage of ash in the Coal in the latter position is 8.67, and the mean specific gravity of Coals containing that amount of ash is 1.33, it follows that every cubic yard of Coal would yield about a ton in weight.

At the most moderate computation, we might anticipate being able to extract the whole of the middle beds yielding a thickness of over 6 feet, ample allowance being made for losses of every description; and every square 100 yards of this seam would, on this calculation, yield over 20,000 tons of Coal. But it is likely that a considerably larger proportion of the whole amount (viz. 10 feet 7 inches) of the Coal contained in the seam might be profitably extracted; in which case the average of the yield would be proportionably increased.

The facilities for working the Coal being thus great, and the amount available so considerable, it only remains to take into consideration its economic character, and the difficulty lying in the way of its shipment.

Ever since the first discovery of the seam, experiments have been made, from time to time, which, though amply sufficient to prove the value of the Coal for domestic purposes, and for application to the several branches of manufacture, have been upon too limited a scale to permit of the determination of its value as a steam fuel.

The amount of capital which would be requisite for the construction of a tramway to any shipping place is so great, that only a very extensive consumption of the Coal could render the undertaking remunerative; and it is questionable whether one of sufficient steadiness and extent would be secured, without the value of the Coal for the purposes of steam navigation having been in the first instance fully determined.

In the Appendix, I have given copies of the reports of some experiments made by competent authorities, both in the Colony and in Victoria, together with certain suggestions which were made by the Chamber of Commerce in Melbourne, for the purpose of causing others to be conducted upon a larger and more satisfactory scale. I consider that no course would be so likely to lead to a practical solution of this important question, as that which is contained in the latter. Data of the most positive and satisfactory character would be requisite; before any calculations could be made of sufficient accuracy to inspire the confidence of capitalists in embarking in an undertaking of such great magnitude. And the opinion of individuals, the analysis of small samples, and the results of experimental trials upon a limited scale, would probably always prove insufficient for that purpose: no more effectual plan could therefore be adopted, than that of ascertaining the commercial value of the Coal, both positive, and relatively to that of other Coals which might be brought into competition with it, in the market which is likely to offer the largest and the most permanent demand for it.

I have mentioned, in an earlier page, the existence of the Coal-measures upon the northern face of the range, and described the indications which I met with of the probable continuation into that locality of the seams which are more clearly exhibited upon the south.

Among other propositions for the development of this Coal Field, it has been suggested that a more direct route could be secured from the north side of the range to George's Bay; and that a large amount of hard carriage might thus be obviated.

A very detailed and careful examination of the country intervening, by a professional engineer, would be necessary for the determination of this question. The impression which I, myself, derived from my own more general observations is, that great difficulty would be experienced in securing an easy descent in that direction; as, moreover, a considerable outlay would be necessary for the purpose of conducting preliminary boring operations, it would be desirable, in the first instance at least, to restrict any explorations undertaken for the purpose of proving the commercial value of the Coal to the ascertained points of outcrop of the large seam upon the southern flank of the range.

The question as to the point of shipment for the Coal in the valley, is limited by the deficiency of harbours upon the coast; the only one making any pretension to offer secure anchorage being that of George's Bay, which is distant about twelve miles north from Falmouth. I feel myself incompetent to offer any opinion as to the feasibility of the project for diverting the waters of the Scamander into Henderson's Lagoon, for the purpose of cleaning the entrance of the latter, and converting it into a harbour.

As much information relative to the probable cost of the construction of a tramway, and the suitability of the harbour at George's Bay for a shipping place, are contained in a Report by Major Cotton, formerly Deputy Surveyor-General, and in a letter addressed by His Excellency Sir William Denison to F. L. Stiegtlitz, Esquire; and as much weight must necessarily attach itself to the opinions of these gentlemen, I have deemed it desirable to enclose them with the other documents in the Appendix: and for further information upon this point, I would also refer to the Estimates contained in a Report upon the Coal formations of Tasmania, by J. Milligan, Esquire.

\* In speaking of the results of the investigations of the British Commission into the value of different Coals for steam purposes, Messrs. Ronalds and Richardson observe—"The relation between the composition of the Coal, as ascertained by analysis, and its value for producing steam, is not by any means very clearly brought out by the experiments which, indeed, prove that the only trustworthy mode of determining the value of a fuel, especially for steam purposes, is that of practical use under the boiler, where several tons, and not lbs., are consumed."—*Chemical Technology*, page 333.



It is, perhaps, questionable whether any arrangement could be adopted for the conversion of Long Point into a safe and convenient shipping place. It is desirable, however, not to overlook the possibility of such a project, which, if feasible, would afford an opportunity for shortening the distance of the land carriage of the Coal by a very considerable amount, by the construction of a tramway from the seams upon the southern side of the valley at least, passing over the low saddle between the south end of Mount Logie, and the north-east termination of the Fingal Tier, and reaching the shipping place by a gradual descent in a distance of from ten to twelve miles.

The other seams of Coal in this field, although consisting, like the larger one, of bituminous non-caking coal of fair quality, are all of insufficient magnitude to render it probable that they could be worked remuneratively at present; excepting, perhaps, in connexion with the larger one, or in the event of the establishment of manufactures in the district.

But the combination of advantages possessed by the latter, as regards its thickness, extent, the ascertained quality of the Coal, and the reasonable cost at which it might be worked, are probably unequalled by any other in the Colony; and it is, therefore, unquestionably deserving of especial consideration, in the event of the appropriation at any time of sums of public money for the purpose of exploring the Coal Fields of the Colony: and, for the furtherance of this object, I would venture to suggest that the most practical results would probably be obtained by the adoption of a series of measures as follow:—

1. The extraction of 150 or 200 tons, for the purpose of securing an adequate trial of the Coal in some of the large ocean steamers, and of permitting a series of experiments to be made upon it by Engineers and Manufacturers in this Colony and in Victoria.
2. The expenditure of a moderate sum in proving the seam by boring and driving upon the southern flank of Mount Nicholas.
3. The survey, by a competent Engineer, of the several routes suggested for a tramway, and the collection of carefully prepared estimates as to the cost of its construction, of the carriage of the Coal, and at the price per ton, at which the latter might probably be extracted.

The principal points to which attention should be directed in the Douglas River Coal Field are, the determination of the extent of the 8-feet seam in the Douglas River itself, and of that of the seams outcropping in the Denison Rivulet above the Company's land:

The first consists of a bituminous, free-burning, non-caking Coal, evolving great heat, and a considerable amount of gas; it burns with a strong flame, and leaves a rather large amount of residual white ash. It is a Coal well adapted for all domestic purposes, and for the manufacture of gas; and appears to correspond closely with the 12-feet seam under Mount Nicholas, of which it is most probably the continuation. In the upper position, it could be very economically worked by means of adit level; and the length of tramway requisite for conveying it to the harbour at Bicheno, would certainly not exceed from 12 to 13 miles. The preliminary outlay of a few hundred pounds would be sufficient for the determination, whether a sufficiently extensive and unbroken area of Coal exists there to warrant the construction of a tramway. A gallery driven in the Coal itself, and rising gently upon the strike on either bank of the stream, or upon both, would enable the freedom from interruption by faults or otherwise, to be ascertained for a few hundred yards in either direction; and this information, in combination with that which might be derived from borings executed upon the rise of the Coal, would permit of the available area being calculated with considerable certainty.

Assuming that six feet only could be extracted, there would be a yield of twenty thousand tons in every hundred yards square. There appear to be no difficulties in the way of constructing a tram-road.

It would also be desirable to ascertain, by boring, the depth at which the same seam exists under the flat land immediately north and south of the mouth of the river. The maximum depth at which it has been calculated that it might exist in that situation is as much as 1400 feet. My own impression is, that it lays considerably nearer the surface, and that the amount of general dip has been over estimated; this seam probably underlies the whole of the country from the Doctor's Creek to nearly as far as the Denison Rivulet; but I feel doubtful as to its existence beneath the land south of the latter, since the general tendency of the sections in the Douglas and adjoining rivers is such as to convey the impression that the eight-feet seam is superior to those worked by the Company, and to suggest that a rather considerable fault must exist at a short distance north of the Denison Rivulet.

It would be of importance to ascertain the thickness and quality of the seam described as cropping on the shore near the porches, as it is possible that this is the source from whence the fragments of Coal thrown up on the beach at Long Point have been derived. A few borings, judiciously executed in the locality, would probably afford valuable information, both as to the position of the large seam and the general sequence of the formation.

Another situation in which experimental research might be advantageously conducted, is on the

Denison Rivulet, at the upper section of Coal, about a mile above the Company's land, in which two beds exist, separated by about four feet and a half of measures, and yielding about thirty and twenty inches of Coal, respectively. The latter is of fair quality, and burns freely; and it would be very desirable to extract a sufficiently large amount to permit of a thorough trial being made of the proportion of gas contained, and its value as a steam fuel. A very trifling expense would also be sufficient for opening the seam imperfectly shown at a short distance down the river, which consists of a free-burning bituminous Coal, likely to prove of considerable value in the event of the seam being of a tolerable thickness. With regard to the land formerly occupied by the Douglas River Coal Company, I am inclined to consider that the most eligible points for exploration would be the five-feet seam spoken of so favourably by the Directors, and the determination, by further borings, of the nature of any seam which may exist in the north-eastern portion of the land. The proximity of the southern half of the grant at least, to the edge of the Coal bason, renders it unadvisable to execute any deep sinking, upon the chance of discovering remunerative seams below those already worked; while the ground appears to have been sufficiently proved, to a considerable depth, by the detailed series of sinkings already executed under the Company's direction.

APPENDIX No. 1.

ANALYSES of COAL from Tasmania, by the late Sir H. T. DE LA BECHE.

Coal from	Carbon.	Hydrogen.	Ash.	Sulphur.	Nitrogen.	Oxygen.	Remarks.
Mount Nicholas, Break-o'-Day .....	57.38	3.93	27.55	0.90	1.15	9.09	Quality, very indifferent, carbon poor.*
Fingal .....	57.21	3.40	29.10	1.32	1.20	7.77	Same quality as last.
Douglas River .....	70.44	4.20	14.50	0.70	1.12	9.04	Good quality, like Newcastle, but large quantity of ash.

\* NOTE.—Dr. Milligan is of opinion that some error had occurred in the transmission of this sample, and that the remarks apply to a sample of the Adventure Bay Coal which accompanied it.

APPENDIX No. 2.

ELEVATIONS of some important points determined by Observations with an Aneroid Barometer, by the under-mentioned Observers.

	Mr. Sprent, late Surveyor-General.	Major Cotton.	Mr. Surveyor Thompson.	Mr. Gould.
Trigonometrical Station, Mount Nicholas	2812	2806	—	—
Saddle west of the summit of ditto .....	—	1784	—	1765
Thick or upper seam of Coal .....	—	1371	1294	1400
Saddle of St. Mary's Pass .....	—	1008	967	970
Mr. Ransom's gate, road to Falmouth ..	—	—	763	—
Killymoon .....	—	669	—	—
St. Patrick's Head .....	2227	—	—	—
Killymoon Bridge .....	—	—	—	708

APPENDIX No. 3.

Gas Company's Office, Hobart Town, 26th November, 1857.

SIR,  
I HAVE the honor to inform you, that I, yesterday, tried one ton and a half, (1½ ton) of your Fingal Coal, in the retorts at this gas work, and found it to yield, per ton, only 300 feet less than Agricultural Company's Coal. The coke from the Fingal Coal is inferior to, and lighter than, the coke from Sydney Coal, and resembles more the coke obtained from Scottish cannel.

The result of this trial is beyond my expectations; and the result very favourable, considering that the sample tried was taken from the surface, where it had been long exposed to the weather.

Should the Fingal seam of coal improve when taken from the dip, and at a greater depth, in the same ratio as English Coal, I have no doubt but it will turn out a valuable Coal Mine, and a great acquisition to the Colony.

I am,  
Sir,

Your most obedient Servant,

W. R. FALCONER, *Engineer to the Hobart Town Gas Company.*

F. L. STIEGLITZ, *Esq.*,  
*Killymoon.*

NOTE.—Produce per ton, by Mr. M'Naughtan's letter to me from Mr. Falconer's Report to him, five thousand three hundred (5300) cubic feet of gas from Fingal surface coal; five thousand eight hundred (5800) feet from Sydney Coal.

J. GRANT.

## APPENDIX No. 4.

*REPORT of Van Diemen's Land COAL, addressed to F. L. STIEGLITZ, Esquire, on board the Steamer Vista, 21st October, 1857.*

THE quantity tried, and the time taken to try them, were too limited to give a very positive statement as to the actual merits or demerits of the coal; but, as far as we could ascertain, they seem rather a superior sample. There is very little bituminous matter, and consequently little or no smoke; a very small proportion of clinker, and the residue in the ash-pit small. With a good draught, which they must have, they throw off a great heat. In the *Vesta* they did not generate steam quite so fast as the Colonial Newcastle; but this, I imagine, was owing to the fire-bars being too close (as adapted for the small Newcastle) as well as the stokers not being accustomed to fire with that description. The consumption was the same as the Newcastle in the same boat.

R. G. GILMORE for E. W. COLE.

## APPENDIX No. 5.

*Fulton Foundry, Melbourne, 22nd October, 1857.*

WE have tried some coal sent by Mr. Stieglitz, per *Iris*, to Messrs. Neuhauss, Haller, & Co., and found the same to be fair average quality, and suitable for the market.

THOMAS FULTON, *Engineer.*

## APPENDIX No. 6.

F. L. STIEGLITZ, Esq., having sent to us a quantity of coal from a seam on his estate, we have submitted the same for trial to Messrs. Thomas Fulton & Co., ironfounders and engineers of this place; and also to Captain Cole, who employs a number of steamers as tow-boats. The result has been favourable, as will be seen by the accompanying certificates; but it appears that the coal is more suitable for steam than for smiths' purposes. Both the above-named parties pronounce it to be superior to any Tasmanian coal they have hitherto seen.

To establish the character of the coal, it is necessary that a hundred to a hundred and fifty tons should be sent over; of which a sufficient quantity would be given to several of the Indian Mail Steamers, and to other parties, with the request to furnish reports of the results obtained by trial. If these reports should concur in a favourable estimate of the coal, it would remain for Tasmania to decide whether the Coal Field could be profitably worked.

Tasmania has to compete with Newcastle. The coals from the latter place cannot be brought here under 35s. per ton; and selling prices range during the year from 35s. to 60s., according to season and supply. This Colony is most anxious that the Indian Mail Steamers shall stop at Melbourne instead of Sydney; but this can only be accomplished by our being able to furnish coal in sufficient quantity, and as moderately as Sydney. Victoria therefore looks to Tasmania as the Colony most likely to supply the want, and she could take some three thousand tons per month. The advantage which Tasmania generally would reap from the export and certain sale of so large a quantity, leaves no room to doubt that the citizens of Hobart Town and Launceston will manifest their usual patriotic spirit, and be ready to aid in opening up any new Coal Mine which, upon investigation, shall promise a suitable return.

NEUHAUSS, HALLER & CO.

*Melbourne, 28th October, 1857.*

## APPENDIX No. 7.

*EXTRACT of a Letter from Sir W. DENISON to F. L. STIEGLITZ, Esq.*

"I am fully convinced, however, of the practicability of the suggestions I made to you a few months back. A capital, say £30,000 might perhaps be required; but the demand for coal is so certain to increase, that the interest on £30,000, when spread over the quantity of coal which you are sure to find a market for, will be as nothing. For instance—5 per cent would be merely a shilling per ton on 30,000 tons, and for this quantity you would have a demand at once. The cost of moving the coal on the railway, when once made, and of shipping it, would be very trifling—from a penny to twopence per ton per mile would be an ample allowance. Three shillings per ton would be the maximum cost of moving the coal when once got out of the mine; and as, from the thickness of your seam, the waggons which convey the coal to the shipping port could be got into the level, the whole cost of sifting, pumping, purchasing steam-engine, &c., would be saved. For instance—at Douglas River, and at the Mersey, engines of from 15 to 20 horse-power will be wanted to pump and to lift the coal: with you nothing of the kind will be wanted. The cost of the engine and building will be £1200 to £1500; then it consumes coal, requires an engineer to work it, and stokers to look after fire. Its annual repairing comes to 10 per cent. on its cost; and the interest of the money expended cannot be put at less than 10 per cent. in order to cover the cost of repairing engine when necessary. In fact the cost of an engine of 20 horse-power cannot be put at less than £700 per annum, which is a saving to you on the cost of winning the coal."

## APPENDIX No. 8.

*REPORT by Major COTTON.*

*Deputy Surveyor's Office, June, 1853.*

SIR,

THE instructions conveyed to me in the Colonial Secretary's letter of the 6th ultimo, to your address, requires me—

1st. To examine the ground from the bottom of St. Mary's Pass to the opening of George's Bay, with reference to the facilities which it offers for the construction of a railway.

2nd. To examine and report on the state of the anchorage between Rabbit Island and the main land, and of the coast opposite the island; and the means which might be adopted to facilitate the shipment of coal and other produce there.

3rd. To examine the entrance to George's Bay, and afford information as to the depth of water, inside, outside, and on the bar, the width of the bar, and its nature, whether shifting or permanent.

4th. To determine by barometric observations the relative levels of the upper coal seam on Mr. Stieglitz's property, and the lowest point of the saddle of St. Mary's Pass.

I have, accordingly, visited Mount Nicholas, (on the southern face of which the seam of coal referred to is found), St. Mary's Pass, George's Bay, and the line of coast from Falmouth to the Bay.

Accompanying, is a tracing from the map of that part of the country, on a small scale, and one of George's Bay, on a larger scale, explanatory of the following remarks.

1st. With respect to the first-mentioned object, I find that the line of country between the front of the Pass and George's Bay, affords every advantage for the construction of a railway, taking the direction of the dotted line in the tracing from the foot of the Pass to the coast. Some difficulties seem, in first leaving the ravine down which the Pass is made; but when the Plains are reached, the only obstacle worth mentioning is the Scamander. The roadway would run along sound ground; generally immediately in rear of the sand hillocks which stretch along the whole line of coast, with the exception of some few undulations in passing from flat to flat, where the sand-hills extend inward from the coast.

The Falmouth backwater is not a watercourse of any importance, and can be easily passed, as it is merely effected by the tide, which rises there 3 or 4 feet only. The Scamander would be passed near the mouth by a Pile Bridge, where the depth of water never exceeds 10 or 12 feet; and the other streams shown on the tracing are all unimportant. The best shipping point in the bay, as I will explain afterwards, is at the point where the old Military Barracks stands; but vessels can come close to the shore along the front of the solid lots further up the bay, and a road can as easily reach that point. I have sketched both lines on the tracings.

2nd. As I had not the means of getting off shore, I could not take soundings round the Island; but I think I have obtained all necessary information. Vessels of all classes can, and do, shelter behind the Island, in contrary winds or rough weather; and, if necessary, a breakwater could probably be run out to the reef of rocks on the south side to improve the shelter; but of this I cannot speak positively. The shore opposite the

Island is very slightly sheltered by the Island when the wind is on the shore ; but the point of least effect will, of course, vary with the wind, a roll of the sea, and in general there is still a heavy surf throughout.

The distance from the shore to the Island is, at the nearest point, not less than  $1\frac{1}{4}$  mile ; the coast is rather bold, but not rocky ; vessels could lie near, but there are no points where safe arrangements could be made for the shipment of coal.

3rd. I had a good opportunity of examining the bar at the entrance of the bay, and the anchorage inside.

In the tracings, I have entered the soundings I took ; and it will be observed, that *the least depth* of the water *on the Bar* is *about*  $7\frac{1}{2}$  feet, and *the greatest*  $13\frac{1}{2}$  feet ; the width of the channel of that depth not less than 200 yards ; and there is deep water both within and without. The deep channel in the bay follows the course of the dotted line on the tracing, and forms a free passage for any vessel that can enter. It runs close to the shore at the Barrack, which is on the Crown Reservation, and after sweeping the opposite shore in a similar way, meets the east branch again, where several lots of land of 100 acres have been purchased from the crown. At the Barrack is the most favourable shipping place ; but vessels can run in even to the inner bay called Medeas Cove, up to which Captain Bateman, I believe, took a vessel of 250 tons. The whole bay is a secure harbour. Outside the bar also is safe anchorage at all times, except when the weather is heavy from the north east ; and at such times the Island called St. Hellen's (as well as Mouroward and Rabbit Islands) afford an effectual refuge ; so that vessels having too great depth for the state of the tide, on making the Bay, will be able to wait, in security, for high water at the anchorage under St. Hellen's Point or behind Rabbit Island.

The bar appears to be permanent. The present state accords with that entered on the charts in this Office, and I see nothing to indicate its shifting. It might be expected to undergo some change from northerly gales ; but it is evident that the flux and afflux of the tide is sufficient to keep the passage open. The flood of the river must be considered quite insignificant.

4th. With respect to the relative levels of the coal seams and the saddle of St. Mary's Pass, I took the following levels, carefully, by means of two Aniroid Barometers ; and I think they may be depended on to 10 or 15 feet.

	<i>Feet above the sea.</i>
Saddle of St. Mary's Pass .....	1008
Thick or upper seam of coal .....	1371
Killymoon .....	669
Saddle west of the summit of Mount Nicholas .....	1784
Trigonometrical Station on Mount Nicholas .....	2806

In conclusion, I may remark that it is probable coal will be found ; and it was intimated to me that it does exist on the north-east face of Mount Nicholas, and probably at a corresponding level with the seam on the south side ; in which case the distance to the Scamander would be much less, and the descent regular and, I think, not difficult.

I have, &c.,

H. C. COTTON.

*The Honourable the Colonial Secretary.*