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Report - Prospects of Obtaining  
Coal from the Dalmayne Colliery

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REPORT  
PROSPECTS OF OBTAINING COAL  
FROM THE  
DALMAYNE COLLIERY, TAS

Dalmayne Colliery (2 copies).

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21-9-20.

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REPORT on the Prospects of Obtaining COAL from the  
DALMAYNE COLLIERY, TASMANIA, and on its Value  
relatively to Newcastle Coal.

*W. A. Hargreaves*  
**LIBRARIAN** 21-9-20

Under instructions contained in S.T.B. 433/18, the writers visited the Dalmayne Colliery with the object of ascertaining (1) the ability of the Dalmayne Colliery Company to fulfil a proposed contract for the delivery of 150,000 tons per annum for two years at Port Adelaide at 23/- per ton, and (2) the quality of the coal and its value relatively to that of a standard New South Wales coal (the Maitland coals).

The property was not examined with a view to its valuation as this was beyond the scope of our instructions and would have involved a week at least spent upon the ground, but only so far as to render it certain that the seam was capable of yielding the stipulated quantity.

The mine is located on the eastern coastal range of Tasmania,  $3\frac{1}{4}$  miles inland and 1049 feet above sea level. The area held by the Dalmayne Company consists of eight leases of which six are held for coal and two for limestone - for a possible cement works.

The coal leases are :-

6435 M.	197	acres
6436 M.	198	"
6840 M.	100	"
6841 M.	197	"
6842 M.	320	"
6843 M.	320	"
	<u>1332</u>	acres

and the limestone leases :-

8135 M.	320	acres
8328 M.	200	"
	<u>520</u>	acres

In addition there is an easement covering the ground beneath the aerial ropeway from the mine to Picanini Point.  
Geology. The formations visible from sea level to the crest of the plateau in ascending order are -

- (1) Granite.
- (2) Sandstone and shales

- (3). Marine Limestone (Permo-carboniferous).
- (4). Coal measures (Jurassic).
- (5). Capping or sill of diabase (Cretaceous ? ).

Some four or five seams are known to exist on the property, but only one has been opened to the point of production. As far as the limited workings - covering about three acres - extend, there is a complete absence of faulting of the seam, and no igneous dykes are visible. The same series of coal-bearing rocks at Mount Nicholas Range Collieries are faulted. Two dykes of diabase were seen, one between St. Marys and the mine, and the other between the mine and the coast. Similar dykes have probably been the channels of effusion for the diabase forming the sill overlying the coal measures some distance to the west. While such dykes do not appear to be numerous in the vicinity of the workings, there is always the possibility of this occurrence penetrating the coal measures. They and the possibility of faulting are not, however, more than a normal mining risk.

The main seam which is that developed, consists of an upper and a lower coal separated by a thick band of shale containing coal bands. The lower portion averages about 4'9" and is very free from bands, none large enough to be excluded in sampling ( $\frac{1}{2}$ " or over) being noted. The development has been done in this portion of the seam with the exception of rises to test the overlying portion. These rises show that there is over four feet of shale with coaly bands near the entrance, but that as the seam is followed south-west, the band thins to thirty inches. Conversely the overlying coal increases from between four to five feet to eight feet (less a 2" parting) near the face of the heading. The seam rises very slightly in the heading, but a slight roll is showing in the face, and the mine is free of water and of gas. The floor is fairly hard while the roof consists of sandstone, and the conditions lend themselves to cheap mining. The coal, though hard, has a well-defined "cleat", and breaks away freely and in large pieces.

So far only the narrow work of the pillar and staff system of mining has been done, a main heading 12 feet wide driven about 12 chains south-west, and a parallel ventilating heading a somewhat lesser distance. Several stalls have been opened on either side, and about 2000 tons of coal have been extracted. The mine is not yet in a condition to turn out 500 tons a day continuously, but the necessary development and equipment can be got ready long before the shipping facilities are provided. Additional working faces, trucks, and probably coal mining machines for undercutting are necessary. In addition the single track in the main heading and to the loading station will have to be duplicated, and the arrangements for tipping the trucks on to the screens improved. This again is not an alteration of much magnitude. Timber both for mining and construction is abundant and available.

There are no miners on the property at present, but we understand that it will be possible to get the nucleus of a force from the Mount Nicholas Range mines, as the conditions at Dalmayne are better, and gradually add to this nucleus.

The coal tipple and screen, though small, are not designed for storage, but only to feed the ropeway taking the coal to a large storage bin at the coast. An aerial tram (by Ropeways Limited) of a nominal capacity of 40 tons per hour, and which has been worked to 60 tons per hour, is erected, and has a length of  $3\frac{1}{2}$  miles. With the fall of 1049 feet to sea level, this ropeway is self-acting and will carry the tonnage required.

The critical point in the supply of coal is that of placing the coal on shipboard. The coast is exposed and is only an open roadstead facing east. Normally being in a region of westerly winds, the coast is reasonably accessible, but occasional easterly, north-easterly, and south-easterly gales occur, the latter being severe. A weather record has been kept by the Manager of the Mine (Mr. Butt) over a period from January 1st, 1919, to August 21st, 1920, a period of 599

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days, in which he has noted the calm and the rough seas. This record shows that out of the 599 days, there were 340 days (56.7 per cent) calm days, and 259 (43.3 per cent) rough days. Taking the twelve months, 1st January to 31st December, 1919, the percentage of calm days was 55.3, and the percentage of rough days was 44.7.

The Company built a 1000 ton hopper on the shore at Picanini Point with a jetty 550 feet long with truck loading. The jetty was built on Picanini Point, a granite reef, and for some reason the site was shifted so that the depth was not more than  $14\frac{1}{2}$  feet at low water. Shortly after completion, the outer 200 feet of the jetty was washed away in a storm. It is now evident that this jetty is useless, and the Dalmayne Colliery proposes to build an island hopper of 3600 tons a little to the north in the position shown on the accompanying photograph, and 300 yards out from the beach. The position is stated to give 25 feet at low water (rise of tide four to six feet) and the bottom is 20 feet or more of sand. Shipping masters report that there would be no danger to a ship berthing and loading at such a hopper in reasonable weather and that they could get to sea on the approach of bad weather.

The bin is designed to load 600 tons per hour so that the loading from the bin would present no difficulty or delay. While, however, a ship would be able to escape a storm, the bin would require to be sufficiently strong to withstand any gale and sea. Opinions of engineers familiar with the site differ as to the permanency of such a structure. The teredo is destructive on the coast and turpentine piles would have to be got from New South Wales. We inspected two designs in Melbourne for such a bin. Both designs show a superstructure 25 feet above low water which should escape the impact of the seas, but as the superstructure ranges from 50 to 80 feet above the sand bottom, there would be heavy wind pressure. One design, to load on one side only, was estimated to cost £35,000, the other, loading on both sides £25,000, utilising local timber

and the old bin material in the superstructure. The Company offers to submit these designs to the South Australian Government's engineers, for their opinion as to the stability of the hopper. The weather conditions are probably similar to those on the South Coast Coal Field of New South Wales where jetties are used successfully. If the Dalmayne coal becomes a very important factor, South Australia would be faced with the risk that if this hopper bin was destroyed, the State would be thrown without warning back upon the New South Wales coal fields, and it might not be possible to so organise the new supply as to avert a coal crisis. Seymour, a small shipping point a few miles south, has similar disabilities.

As Dalmayne is not the only colliery on the east coast, but only part of a coal field extending many miles to the southward, it appears that the ultimate development of this east coast coal-field will depend upon the utilization of Coles Bay, a well-sheltered, deep harbor on the west side of Freycinet Peninsula. This would involve the construction of 35 miles of railway at a probable cost of £4,000 to £6,000 per mile and wharfage to serve the field from Dalmayne downwards. With the current coal freight on Tasmanian Railways of a half-penny per ton mile, this would add approximately  $1\frac{s}{d}$ /<sub>6</sub> per ton to the cost of the coal, possibly partly offset by the fact that ships could load at all times without delay. Such a railway would be beyond the powers of the Company, even if private lines were encouraged in Tasmania, and we were informed that there is no immediate intention of the Government building such a line. We understand that there is a Company undertaking to supply 3000 to 4000 tons of coal a month to the National Cement Company being formed to work on Maria Island and under present conditions this Company will have shipping facilities little, if any, better than Dalmayne. Whether these two Companies could show substantial reason to the Government for building the line, either by a guaranteed coal traffic or by building part of the railway in lieu of costly and hazardous shipping points, is not for the writers to predict. If they can, it will be a very

considerably longer time than the hopper scheme would require before the coal became available, but once such a line was built there would be nothing to interfere with deliveries but strikes and the difficulty of obtaining ship tonnage.

Ships. The Company states that they can get control of a 3000 ton steamer for the trade and point out that the relative distances from Adelaide are :-

To Picanini Point 859 miles.

To Newcastle 1030 "

A saving of distance equivalent to about three days on the round trip. There is, however, no possibility of loading from Adelaide to Picanini Point, and probably boats would go to Hobart, a further 170 miles. By so doing there would be zinc ore freight from Port Pirie and possibly other mineral freight from Gulf ports. At present the Electrolytic Zinc Co. is making 15 tons of zinc a day at Risdon (Hobart) and in about two years expects to make 100 tons a day, so that over 200 tons of ore a day of back freight should be possible. At present the boats taking concentrates to Risdon return with timber, but no doubt would take coal if available.

Should such a two-way traffic develop, there would be no objection to the extra distance to Coles Bay which would be but slightly off the line of route.

While a hopper can undoubtedly be built, there will be the constant risk of destruction and interruption of supply. Coles Bay would be safe and certain but the cost would be increased by about  $\frac{s}{d}$  per ton for rail haulage, less the depreciation to be allotted in the hopper scheme.

VALUE OF THE COAL. By the courtesy of the Government of Tasmania, we were enabled to see a test of the Dalmayne coal on the St. Marys - Conara Railway. Mr. G.H. Tretheway, Locomotive Inspector, arranged and was in charge of the test. This is the only line on which the Tasmanian coal is used exclusively; on all other sections the normal proportion is 2 native to 1 of Newcastle with

variations of 1 to 1 to 3 to 1. The two to one mixture is found satisfactory by the men using it. Various statements were made as to the relative value of the Native coal in locomotives, varying from 66 to 80 per cent of Newcastle, that is in the ratio of 100 tons of Newcastle equal to from 125 to 150 tons of Dalmayne coal, but as no definite comparative tests based on the evaporating value have ever been made, these statements are more or less matters of opinion. Probably the ratio 100:125 is based on a half and half mixture of Newcastle and Native coals, while the ratio 100:150 refers to the use of Native coal by itself. The Loco. Department states that time is liable to be lost if Native coal is used in as great proportion as four to one. They also state that if they could get a sufficiency of Pelaw Main (N.S.W.) coal, they would use it exclusively. It may be noted that with the exception of naval work, railway conditions are the most severe that a coal can be subjected to, and that the better the coal the greater the efficiency of the boiler, and hence the call for high grade fuel by all concerned with the working of locomotives.

The Dalmayne coal on analysis is very like the native coal now in use on the Tasmanian Railways.

RAILWAYS TEST. The engine used (C+4 by Dubs, 1890, see blue print) had a heating surface, 755.3 sq. ft.

Grate area	13.24 sq.ft.
Cylinders	15" x 20".
Class.	4. 6. 0.
Diameter of driving wheels.	39".
Weight of engine in working order	27 tons 15 cwt. 2 qtrs.
Weight of tender in working order.	21 " 7 " 0 "

Run. St. Marys to Conara 46 $\frac{1}{2}$  miles  
Load. Max. 214 t. 11 cwt. mean 195 tons 3 cwt.

made up as follows :-

	Tons	Cwt.	Miles	Ton Miles.
St. Marys to Cullensworth	34	5	2.5	85.625
Cullensworth to Mt. Nicholas	118	17	2	237.700
Mt. Nicholas to Tullochgorum	193	6	12.5	2420.000
Tullochgorun to Conara	214	11	29.75	6382.8625.
			<u>46.75</u>	<u>9124.1875</u> 6

Steam was made and then the fires almost drawn and the ashpit cleaned before the fires were made up with the weighed coal. At the completion of the run, the firebox was emptied till about the same quantity of fire remained, the coal having been burned during shunting. The grate was a fixed one, bars spaced 1" to 1½" to suit the coal. The fire was kept 6 to 8 inches thick.

The running time on the trip was	2 hrs. 24 mins.
Standing and shunting time on the trip was	58 "
Shunting at Conara, during which practically no coal was added and the fire allowed to burn to ash.	1 " 40 "

Shunting time is regarded as equal to 5 miles per hour on full load, or another 13 miles of running; say 2517 ton miles. Steam was maintained at 140 lbs. (blow off point) and occasionally fell to 130 lbs. Firing was light and well done. Steam was available when required, and the gauge was noted to rise even when on a ruling grade with the throttle full open so that there is no question of the ability of the coal to maintain steam. The flame is fairly short and very little smoke is produced. Sparks were not abundant and the railway men say that it does not spark quite as much as Newcastle. We had no good opportunity of judging as no night run was made. The coal used had been fork loaded and so fines were absent. It was fired from the size of nuts to four inches in diameter. The coke does not cake, but yet there is little ash (0.85 per cent) carried into the smoke box. The ash was grey, bulky and porous and formed no clinker. A slice was passed through the fire three times during the trip, cleaning it very easily. During the trip 187½ lbs. of ash containing about 25 per cent

of unconsumed coal was removed from the ash pan. At Conara the fire almost burnt out while shunting, and the fire-box was then thoroughly cleaned and the ashes weighed.

The coal used was 3632 lbs.

The total ash was 680 lbs. of which 31 lbs. were taken from the smoke-box.

No appliances were available for obtaining the quantity of water used.

When the full time from time of starting to the cleaning of the fire-box is considered, the coal was burned at the rate of 54 lbs. per square foot of grate area, but if the mileage (13) assigned to shunting time is computed on the average rate of the journey, it makes the running time (at full speed) 3 hours 4 minutes. On this basis, the rate of burning would be 89 lbs. per square foot of grate per hour. This rate is very high, and was almost certainly exceeded during portion of the journey, and with a more moderate rate of combustion, the efficiency of the coal would be improved.

#### RESULTS:

- (1) Steam was available as required.
- (2) 18.73 per cent of ash free of clinker and containing some small coal was obtained.
- (3). On the actual journey .397 lb. of coal was used per ton mile.
- (4) Including shunting mileage .312 lb. of coal was used per ton mile.

One of the writers (R.L.J.) in 1905 conducted some tests on steep grade sections in Western Australia, and the following results were obtained with a good class of Newcastle coal.

On steep grade section, round trip, .31 lb. per ton mile.

The engines are not comparable, that in Western Australia being more modern while the grades were less, so that the comparison is against the Dalmayne coal. The test was comparable to the figure .397 given above (for actual journey). This gives 100 parts of Newcastle coal as equivalent to 128 parts of Dalmayne, but at the conditions were different, too much weight

can not be given to this comparison.

MODIFICATIONS INSTALLED FOR THE BURNING  
OF HIGH ASH TASMANIAN COAL.

We inspected a number  
of engines at the  
Hobart roundhouse to

see the types of grate used. The standard rocking bar fitting is shown on the accompanying blue print supplied by the Chief Mechanical Engineer, Mr. W. R. Deeble, of Launceston. The grate is made of three types of castings. The front one is designed to work separately for the discharge of large masses of clinker, or of arch brick. The remainder of the grate is made up of castings about two feet by one foot which can all be canted together for the discharge of the whole of the fire-box contents. In each of these units a fingered rocker bar can be worked, also by a lever in the cab, for normal cleaning of the fire while running. Provision is made for spraying the ash pan and the bottom of the pan can be dropped by the release of a lever beside the ash pan. We saw the apparatus in action and no time is lost by it. The Garrett engine (Beyer Peacock) of 90 tons, load 275 tons on 1 in 40 grade, is fitted with a Bell-paise furnace  $7\frac{1}{2}$  feet by  $5\frac{1}{2}$  feet outside measurement at grate level and is cleaned without difficulty by this apparatus. This engine has two trucks or tenders of 2.6.2 type each driven by compounded cylinders using superheated steam furnished by a boiler slung between the two trucks. A working model of the grate in the possession of the Chief Mechanical Engineer, could be borrowed for inspection if so desired by the Government.

The cost of conversion of six engines, 3' 6" gauge, in 1909, was £44 each, and the ordinary bars can be replaced if required "between trips".

THE QUALITY OF THE COAL  
CHEMICAL AND PHYSICAL

The following samples were taken by the writers as representative of the seam after cleaning down the face.

No.1. Face of main heading about 12 chains in.

Roof: coal and shale.

Coal inferior

Clay seam.  $\frac{1}{2}$  inch.

Coal clean 6 inches x

Shale and inferior coal. 1 ft. 4 inches.

Coal without partings. 4 ft. 0 inches. x

Coal underfoot. 6 inches.

Floor.

The sample was taken from the portions marked with an "x" which can be broken cleanly.

No.2. Upper coal in rise 40 feet back from No.1, and separated from lower coal by 2' 6" of clay and coal. Cleavage planes were slightly stained with infiltrated iron oxide. Thickness of upper coal samples = 8 feet, less 2 inches band in centre.

No.3. In stall about 8 chains in and to the north-west of heading. It was from this face that the coal used in the locomotive trial was obtained.

Roof. Clay band parting.

Lower coal. 4 ft. 6 inches.

Floor. Clay shale.

Two small partings of  $\frac{1}{4}$ " each were noted in the coal, but being too small to separate in mining are included in the sample.

No.4. In stall off south-east side of main heading opposite No.3.

Roof Clay band parting.

Coal without partings. 4 ft. 9 inches.

Floor. Clay.

#### ANALYSES OF DALMAYNE COAL.

Samples of coal were taken from three faces in the mine workings as already described, and these were numbered, 1, 3 and 4 respectively. Samples weighing about 30 lbs. were cut across the seam after cleaning the face, and these were broken down and quartered until samples suitable for analysis were

obtained. Portions of the samples were placed in tins and sealed up to prevent loss of moisture. The results of the analyses of these samples are shown in the table under the heading "Dalmayne coal as mined", Nos. IA, 3A, and 4A. Samples were also independently taken and placed in bags. These samples were subsequently air dried in the laboratory of the Department of Chemistry and analysed in that condition. These analyses are shown in the table under the heading "Dalmayne coal air-dry", Nos. 1, 3, and 4.

Further than this a bulk sample was made at the mine composed of two parts from No. 1 face mixed with one part from No. 3 face, and one part from No. 4 face. This bulk sample was subsequently used for the Distillation tests, and the results of the low temperature carbonization of this sample are given below.

A sample (marked 2.) was also taken from the roof opening near No. 1 face. This was air dried and the results of the analyses are shown in the table as "Dalmayne coal air-dry, No. 2". The analyses show that this sample is like that from No. 4 face. The results of the analyses are shown in the table. In this table are also given figures for a "Dalmayne Composite" which are calculated from the air-dry samples 1, 3, and 4 by taking two parts of 1 and one part each of 3 and 4. These figures may be taken as representing the general average value of the coal which would be sent away from the mine.

In the table are also given figures for an air-dry "Newcastle Composite" representing the average of 51 analyses of samples of coal collected systematically by the Government Inspectors of Mines in New South Wales from the working faces of the mines in the Lower Coal Measures of the Northern Coal-field. The analyses were made in the Geological Survey Laboratory by Messrs. J. C. H. Mingaye, H. P. White, and W. A. Greig, and the average composition here set out is taken from "The Coal Resources of New South Wales" by Edward F. Pittman, Government Geologist for New South Wales. The mines comprised in this

average are Aberdare, Aberdare Extended, Abermain, Central Greta, East Greta, Ebb Main, Hobburn, Muswellbrook, Noath, Pelaw Main, South Greta, Stanford-Merthyr, West Greta, and Whitburn.

This table also gives the calculated figures for oven-dry Dalmayne Coals, Nos. 1, 2, and 4, Dalmayne Composite oven-dry, Newcastle coal oven-dry, Dalmayne Composite dry and ashless, and Newcastle Composite dry and ashless.

It should be noted that in this report unless otherwise indicated, the term "Newcastle coal" has reference to coal of the character represented by the Newcastle Composite in the table. Newcastle coal, therefore, so far as this report is concerned really means coal from the Maitland district and is the kind of coal which generally comes to South Australia and is generally known as Newcastle coal.

#### DISTILLATION RESULTS.

##### Low Temperature Carbonisation of Dalmayne Coal.

A composite sample of Dalmayne coal, composed of fifty per cent of No.1, twenty five per cent of No. 3, and twenty five per cent of No.4, was submitted to distillation in the low temperature carbonization apparatus in the Department of Chemistry. Tests were made with, in each case, 1000 grammes of the composite sample reduced to  $\frac{1}{2}$  inch mesh, and raised to a temperature of  $550^{\circ}$  C. for  $3\frac{1}{2}$  hours.

Products of Distillation. The following products were obtained:

Carbon residue in retort		76.7 per cent of coal taken
Aqueous distillate:		
Moisture	4.3)	
Water of combination	3.7)	8.0 " " " " "
Tar and oils		4.0 " " " " "
Gas =		3,200 cubic feet per ton of coal.

Carbon residue: The Carbon residue on analysis yielded the following:

Fixed Carbon	62.9 per cent.
Volatiles.	9.6 " "
Ash.	27.5 " "
	<u>100.0</u>

Sulphur = 0.25 per cent.

Aqueous Distillate: The aqueous distillate was alkaline to litmus and contained ammoniacal compounds equal to 2.16 lbs. of ammonia per ton of coal which is equivalent to 8.38 lbs. of ammonium sulphate per ton of coal.

Tar and Oils: The tar and oils fraction from the primary distillation was fractionately distilled as follows:-

Up to 110° C.	=	3.29	lbs.	per	ton	of	coal
110°C. to 200°C.	=	3.29	"	"	"	"	"
200°C. to 240°C.	=	9.55	"	"	"	"	"
240°C. to 270°C.	=	2.85	"	"	"	"	"
270°C. to 310°C.	=	9.02	"	"	"	"	"
Residue on flask and loss	=	61.80	"	"	"	"	"

89.80lbs. per ton of coal = 4  
per cent of the coal.

Gas: The gas was analysed with the following results :-

Carbon dioxide	7.3	per	cent.
Oxygen	1.5	"	"
Unsaturated hydrocarbons.	2.0	"	"
Carbon monoxide	7.4	"	"
Hydrogen.	53.6	"	"
Marsh gas, etc.	28.2	"	"
Nitrogen (by difference)	nil		
	<u>100.0</u>	"	"

Calculated calorific value of the gas = 521.9 B.T.U.  
per cubic foot.

#### QUALITY OF DALMAYNE COAL.

This is a dull black, semi-bituminous non-caking and non-clinkering coal.

It is high in ash but low in sulphur. As a set off against the high ash is the fact that the ash does not form clinker. While the fixed carbon is about equal in quantity and character to that of Newcastle coal, the volatile matter is about two-thirds in quantity, and consequently as a gas producer it is not so useful as Newcastle coal. This is shown both by the analyses and the distillation results in the comparatively low yield of gas. Consequently Dalmayne coal burns with comparatively little flame and very little smoke in comparison with Newcastle coal. Owing to the high ash and the low proportion of volatile matter, the Dalmayne coal is somewhat slow in burning and requires a good draught of air. Care must be taken not to let the fire set down when using it and a fair body of fire must always be maintained. As the ash does not clinker, the firebars are

easy to clean and the fire is easy to rake. Comparing the figures for Newcastle and Dalmayne coals calculated to the moisture-free and ash-free condition, it is found that the Dalmayne coal substance is somewhat superior to the Newcastle coal in calorific value and in fixed carbon. There are many lots of Newcastle coal coming to South Australia from time to time having ash content almost as high as the Dalmayne coal, some of the analyses showing from 17 to 21 per cent of ash, and having calorific value not much greater than that indicated by the Dalmayne samples.

The carbon residue obtained in the low temperature carbonization of the Dalmayne coal, although in the main that of a non-caking coal, showed a small amount of cohesion between the particles indicating that this coal is near the borderland of the caking coals. The aqueous distillate is made up partly of the moisture adhering to the coal (4.3 per cent) and partly of the water produced by the combination of hydrogen and oxygen in the coal during carbonization (3.7 per cent).

The yield of tar and oils is low. The results are interesting in that they show a production of only about half a gallon of "petrol" by direct distillation, although no doubt more could be obtained by "cracking". The total yield (4 per cent) is only about 42 per cent of that which can be obtained from good quality Newcastle coal of the Greta class. In general, the tar and oils produced are of the usual type produced by low temperature distillation consisting of crude naphthas and light and heavy oils.

The gases produced by low temperature carbonization are less in quantity than are produced by the ordinary processes of high temperature carbonization as practised in gas works. In this respect Newcastle coal which yields upwards of 10,000 cubic feet of gas in high temperature carbonization yields only 4,560 cubic feet when distilled at a temperature not exceeding 550°U. as adopted in this investigation. The Dalmayne coal yielded only 3,200 cubic feet of gas which is a low result by comparison. The calorific value of the gas is, however, fairly

good, and well over the standard of 500 B.T.U. per cubic foot although Newcastle coal by the same process yields a gas of calorific value of 760 B.T.U. These results confirm the results of the proximate analyses and show that this coal is not well adapted for gas production, and that its uses are as a steam coal. The conclusion is borne out by the actual trial in the locomotive from St. Marys to Conara in Tasmania, referred to elsewhere in this report which showed that there was no difficulty in keeping up steam with the Dalmayne coal.

CALORIFIC VALUE. The calorific values of the samples were determined in a Berthelot-Mahler bomb.

calorimeter. The results set out in the table are gross values, and give the maximum amount of heat in British Thermal Units given out by the complete combustion of one pound weight of each sample. The equivalent in pounds weight of water evaporated from and at 212° F. by one pound of the sample is also shown.

By comparing the gross calorific values of the Newcastle and Dalmayne coals, it is seen that they have the ratio 12,678 B.T.U. to 10,502 B.T.U. or 13.07 lbs. to 10.82 lbs. evaporative value. In other words the ratio is approximately 121 to 100. That is, these two coals stand to one another in gross fuel value such that 100 tons of Newcastle coal are equivalent to 121 tons of Dalmayne coal.

It is to be noted that this is a comparison of gross calorific values, and is not the same as a ratio of the actual heating values when used in a locomotive. For various causes, such as loss of heat in raising the temperature of the air required for combustion to the temperature of the chimney gases, loss of heat by radiation from the boiler and fittings and ash pit, heat lost by being rendered latent and lost up the chimney in converting water in the coal into steam, and hydrogen in the coal to steam and other products to the gaseous condition and raising them to the temperature of the flue gases, heat lost due to unburnt carbon in the ashes, heat loss through not burning the coal to the best advantage, the useful heating value of a coal is much less than its total heating value and for a locomotive is generally from

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45 to 70 per cent of the gross value, according to the type of locomotive and the quality of the fuel used.

VALUE OF THE COAL      As the determination of the net calorific value of Dalmaine coal is rather indefinite and dependent on so many varying factors, it is difficult to make a direct calculation of the value of the coal. Hence it is better in the first instance to compare the coals on the basis of their gross calorific values, which are established by the analyses and calorimeter determinations, and subsequently make such allowance and deductions as seem reasonable and in accord with the practical use of the coals in locomotives.

The ratio 100:121 will be taken, and it will be assumed that 121 tons of Dalmaine coal have to be used to replace 100 tons of Newcastle coal. This assumption is rather favorable to the Dalmaine coal because while the calculation will indicate for instance that 121 tons of Dalmaine coal have to be carried in place of 100 tons of Newcastle coal, in reality a larger quantity would have to be hauled according to the falling off in efficiency in using the lower grade fuel and consequently the advantage of using the cheaper fuel would be less than will appear in the calculation.

Every pound of coal used on a locomotive has to be carried some distance from the port before it is burned. Even in the case of a suburban train, the coal may be carried on the average 20 to 40 miles before it is burned and on country lines it may be hundreds of miles. It is probably safe to say that all the coal used on the South Australian Railways is carried on the average a distance of at least 100 miles.

Tasmanian coal can not be satisfactorily used on locomotives by itself. It is not so used in Tasmania (except on one line from Conara to St. Marys) although patriotic motives should ensure the greatest efforts to use the native coal, and as the coal is comparatively cheap (12s/6d per ton) questions of economy would suggest its use in place of Newcastle coal. It is used in admixture with Newcastle coal. The use of a mixture necessitates having two kinds of stacks of coal at each

depot, and this causes considerable difficulty in adjusting stocks as well as involving some expense.

In South Australia the use of two kinds of coal would be cumbersome, and would introduce such difficulties of handling that it is not to be lightly undertaken. It would be adopted only when the saving in cost of the inferior coal was well pronounced or when quite other reasons such as shortage of Newcastle coal made it necessary or advisable. The mixing of coals for locomotive use would have to be in simple ratios such as 2:1 or 1:1 or 1:2, etc. Experience in Tasmania teaches not only that the Dalmayne coal can not be satisfactorily used by itself but that any mixture greater than 2 of Dalmayne coal to 1 of Newcastle is unsatisfactory. For the principal trains the mixture used is 1:1.

A 2:1 ratio in South Australia would only be suitable on a few lines where the working to a strict time-table is not of importance. It has to be remembered that owing to the conditions of this proposition, the working of the Dalmayne Collieries is dependent on the provision of an expensive hopper in the sea, and that unless the Dalmayne coal is used in large quantities, it will not pay to erect the hopper. Hence a beginning with the use of this coal can not be made gradually. On the other hand, the use of a ratio of more than 1:1 would be a radical alteration in practice in South Australia.

It appears to us, therefore, to be reasonable to assume that the ratio that would be used would be 1:1.

Assuming the coal requirements of the railways at present are 200,000 tons of Newcastle coal, which are to be replaced by a mixture containing equal quantities of Newcastle and Dalmayne coals, and the gross values of the coals are as 100:121, calculation shows that 109,502 tons of each would be required.

Then 109502 tons Newcastle coal at 34/6	=	£188,890
109502 " Dalmayne " " 23/-	=	125,927
		<u>£314,817.</u>
200000 tons Newcastle coal at 34/6	=	£345,000
219004 " of mixture at 32/11	=	314,817
		<u>£ 30,183</u>

The gross apparent saving in using Dalmayne would be, with

these assumptions, £30,183.

There are, however, a number of deductions to be made before the probable net saving can be ascertained. First, every pound of coal used on the railways is, on the average, carried a distance of at least 100 miles before it is burnt. Hence instead of carrying 200,000 tons for 100 miles, 219,000 tons would be carried that distance. That is, an excess quantity of 19,000 tons would be carried 100 miles at the cost of (say) one halfpenny per mile. This deduction would thus amount to £3,959. Second, there would be the annual expense of handling two kinds of coal, the annual cost (interest and redemption) of providing dual stacking sites, mixing the fuels, altering the locomotives, etc., and the extra cost of dealing with the extra ash produced. It is not possible for us to estimate the cost of this, but probably a sum of (say) £6,000 per annum would be needed to meet this. Third, we have to allow for the probable falling off in the efficiency of the locomotives in using the mixed fuel, meaning by the term efficiency, the ratio of the quantity of water actually turned to steam in the boiler to the quantity of steam which would be produced if all the available heating value of the coal could be utilised.

The Outdoor Running Superintendent of the S.A. Railways (Mr. Hayman) reported on 2/9/19 respecting trials made with Dalmyne coal on locomotives, that the evaporative value of Dalmyne coal is 5.12 lbs. of water per 1 lb. burnt, against 7.46 lbs. of water evaporated for 1 lb. A.A. coal burnt. The pressures at which those results were obtained were not recorded but assuming an average pressure of 145 lbs. per sq. inch in the boiler, the figures given by Mr. Hayman correspond to 5919 B.T.U. and 8624 B.T.U. respectively. The gross calorific values of the coals are correspondingly 10,502 B.T.U. and 12,678 B.T.U. Allowing for the water in the coals and water produced by combustion which is turned to steam and lost up the chimney, the lower calorific values are approximately 10,348 B.T.U. and 12,483 B.T.U. Hence the efficiency (19).

when using Newcastle coal may be taken as 69 per cent and when using Dalmayne coal as 57 per cent. When using a mixture, the efficiency would be somewhere between, but just where could only be found by actual trials. If we assume that it might be (say) 65 per cent, then more coal would be required to do the work than if the efficiency were 69 per cent. The extra coal thus required would be 13,477 tons of mixture. The cost of the mixture  $\frac{34/6 + 23}{2} + 4/2d$  haulage = 32/11d. per ton.

13,477 tons at 32/11d. = £22,180.

Therefore we would, with these assumptions, have:-

Apparent gross saving in using Dalmayne coal	=	£30,183	
Deductions for haulage	=	£3,959	
Deductions for general costs	=	6,000	
Deductions for reduced efficiency	=	22,180	
			<u>32,139</u>
Loss	=	£	<u>1,956</u>

Under these conditions there would be a loss instead of a gain in using Dalmayne coal, and there would be a saving only when a greater efficiency than 65 per cent could be obtained in working the mixture.

#### CONCLUSIONS.

Taking all the factors into consideration, including the difficulties attendant on shipping the coal from an exposed roadstead at Picanini Point, the possibility that the Company could not supply at so low a figure as 22/- per ton, the dislocation to railway traffic that would be caused by failure of supplies to come promptly and regularly to hand, the fact that Dalmayne coal can not satisfactorily be used on locomotives by itself and that large quantities of Newcastle coal would still be required, and that after all there would be little or no profit in the transaction, the proposition of the Dalmayne Collieries Company becomes a very doubtful one from a business point of view and we are therefore unable to recommend that it should be entertained so far as its use on locomotives is concerned.

There may, however, be other reasons which make it desirable

to build up reserves of coal in South Australia, and it may be a question of policy to secure 150,000 tons of this coal for a few years to build up reserves. The suspension of shipping, due to destruction of the hopper at Picanini Point or accident to ships, would not then be such a serious matter as if the railways were dependent on this coal. Respecting the building up of reserves, it should be noted that coal exposed to the weather in the seaside bin at Picanini Point for two years, and at the mine, showed no tendency to disintegrate. The coal is hard and stands handling, so that there would be little or no deterioration in handling or in storing. The low sulphur content, and the history of the Tasmanian Jurassic coals, show that there is no danger of spontaneous combustion during storage.

Having a good supply of this coal available, it might be profitably used in stationary boiler plants and so liberate an equivalent amount of Newcastle coal for use on the railways. In the case of stationary boilers, the use of Dalmayne coal would be a very different proposition from its use on locomotives. In modern well-designed power plants with mechanical stokers, economisers, feed water heaters, and scientific control with analyses of flue gases and ashes, etc., low grade fuels can be burnt with practically as good an efficiency as high grade fuels. If the price is right, it might become economical to use low grade fuels.

Much of the Newcastle coal used in large plants in South Australia is low grade. Slack coal carries on an average 4 per cent of moisture and 11 per cent of ash. Indeed much coal coming from the well known collieries of the Maitland District may contain up to 21 per cent of ash, and have a calorific value on the oven-dry coal of very little over 11,000 B.T.U. which is the value of oven dry Dalmayne coal.

Where such coal can be economically used it is more than probable that Dalmayne coal at 23/- would be a good proposition, and it is respectfully suggested that the larger users of coal at Port Adelaide and other ports might be invited to discuss the question.

If reserves of this coal were built up, the stocks could from time to time be replaced by Newcastle coal, the Dalmayne coal being issued as required. It could thus take the place of such coal as is required for domestic purposes, since the Dalmayne coal is a perfectly satisfactory household coal.

SUMMARY.

1. The Dalmayne Colliery on the East Coast of Tasmania near St. Marys is quite capable with a little development and equipment of yielding abundant supplies of coal to satisfy a contract for the delivery at Port Adelaide of 150,000 tons per annum for two years.
2. The coal is offered at 23/- per ton, free on trucks, Port Adelaide, but the ability of the Company to supply at this price is dependent on shipping facilities and the difficulties of loading at an open roadstead.
3. The mine was not examined with a view to its valuation for purchase. To do this would require more extended investigation at the mine.
4. There are at present no means of shipping the coal except at exorbitant charges for cartage, railage, etc.
5. There is no available safe harbor at present on the east coast of Tasmania, but if there were a railway 35 miles to Coles Bay, a safe and sheltered port could be obtained. There is no intention at present of building this railway either on the part of the Government or of the Company.
6. It is proposed by the Company to build a hopper for 3,600 tons out in the sea 1,000 feet from the beach, at a cost of from £25,000 to £35,000. This is contingent upon the Company getting a large order such as now proposed.
7. Shipping masters say the roadstead can be safely used in good weather and ships can go out to sea in bad weather.
8. Engineers' opinions differ as to the stability of the

- proposed island hopper during storms. The teredo is bad in the locality.
9. Dalmayne coal as compared with coal from the Maitland District in New South Wales is low grade. It is, however, as good as some Newcastle coals. It is remarkable in containing a high ash content (22 per cent on the average), a moderate amount of fixed carbon (47 per cent), and low volatiles (27 per cent). The moisture is 4 per cent in the air-dry condition.
  10. The gross calorific value of Dalmayne coal is 10,502 B.T.U. as compared with 12,678 for Newcastle (Maitland) coal. That is, in gross calorific value, the coals are in the relation that 100 tons of Newcastle coal are equivalent to 121 tons of Dalmayne.
  11. The locomotive boiler efficiency in using Newcastle coal is about 69 per cent while that for using Dalmayne coal by itself is about 57 per cent under the same conditions.
  12. Dalmayne coal can not be satisfactorily used in locomotives by itself, but it can be used mixed with Newcastle coal in the proportions 1 to 1, 2 to 1, and 3 to 1. In Tasmania for the principal traffic similar coal is used mixed in ratio 1:1 with Newcastle coal.
  13. The gross apparent saving in using Dalmayne coal at 23/- per ton at Pt. Adelaide to replace half the Newcastle coal now used by the Railways in South Australia is £30,183 per annum, but owing to reduced efficiency due to lower grade and other costs of using the coal, this apparent saving will be so greatly reduced that there would be little or no profit in using the coal on locomotives, and as a business proposition it is not attractive, and is not recommended.
  14. As a domestic fuel Dalmayne coal is quite satisfactory, and its use in well designed stationary boilers is a very different proposition from using the coal on locomotives. Its

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use on large plants would probably be economical.

15. If it is considered desirable to lay in reserves of coal in this State Dalmayne coal may be profitably used for the purpose. Its keeping qualities are excellent, it does not disintegrate, and it is not liable to spontaneous combustion.

Respectfully submitted.

(Sgd.) W. A. HARGREAVES

(Sgd.) R. LOCKHART JACK

ADELAIDE,

21st September, 1920.

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## TABLE OF ANALYSES.

Coal.	No.	Moisture	Volatile.	Fixed Carbon	Ash	Sulphur Per cent	Gross calorific value. B.T.U. per lb.	Lbs. of water converted to steam by 1 lb. of coal.
Dalmayne Coal as mined.	1A	5.83	27.20	47.84	19.13	.340	10,812	11.14
" " " "	3A	5.55	26.99	46.96	20.50	.348	10,470	10.79
" " " "	4A	5.19	23.97	44.43	26.41	.271	9,531	9.83
Dalmayne Coal air-dry.	1	4.50	28.14	47.57	19.79	.348	10,934	11.27
" " " "	3	3.90	26.87	46.22	23.01	.340	10,462	10.79
" " " "	4	4.27	24.19	45.31	28.23	.266	9,677	9.98
" " " "	2	4.97	24.53	45.03	25.47	.322	9,642	9.94
Dalmayne Composite air-dry.		4.29	26.84	46.67	22.20	.325	10,502	10.82
Newcastle Composite air-dry (Average of 51 samples from Maitland District analysed in the Geological Survey Laboratories, N.S.W.)		1.84	41.61	49.52	7.03	1.291	12,678	13.07
Dalmayne Coal oven-dry	1		28.88	50.80	20.31	.361	11,481	11.84
" " " "	3		28.57	49.71	21.70	.368	11,085	11.43
" " " "	4		25.28	49.53	27.85	.286	10,053	10.36
Dalmayne Composite oven dry			28.04	48.76	23.19	.339	10,972	11.31
Newcastle Composite oven dry			42.39	50.44	7.16	1.315	12,916	13.31
Dalmayne Composite Dry and ashless.			36.51	63.49			14,286	14.72
Newcastle Composite " " "			45.67	54.34			13,912	14.34