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R E P O R T

by

DR. WADE

on

"The Properties of the Railton-Latrobe Shale Oil Co. N.L."

1915

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R E P O R T

On the properties of the Railton-Latrobe Shale Oil Co. N.L.

by

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1. BUSINESS. The Company is at present mining Oil Shale of the variety known as Tasmanite, and is distilling the same for petroleum products in plant erected for this purpose on its properties.

2. SITUATION. The properties of the Company consist of two blocks of Mineral Leases held under the Mining Acts of Tasmania, in the vicinity of the town of Latrobe and the township of Railton on the Mersey River and extending from seven to ten miles due south from the port of Devonport on the north coast of Tasmania. The Western Railway (Government line Launceston-Burnie) runs parallel with the properties and about 1 mile to the west of them.

3. EXTENT. The first block of leases is on the east bank of the Mersey about 2½ miles S.E. from Latrobe. The numbers and areas of the leases are as follows:-

4164 M - 256 acres
3996 M - 200 "
3995 M - 320 "

The second block is situated about three miles to the south of the first and about 1 mile to the north west of the railway junction at Railton. It consists of:-

4619 M - 107 acres
2546 M - 299 "
2542 M - 100 "
2540 M - 100 "
2543 M - 100 "

The total acreage is 1,482 acres of land carrying oil shales held under a consolidated lease which simplifies the working so far as the labour conditions are concerned.

4. THE SHALE

a. QUANTITY.

The acreage given does not coincide exactly with the extent of ground underlain by the oil-shale on the properties mentioned. The materials lie in basins between outcrops of schist and basalt which occupy some part of the areas. Mr. W.H. Twelvetrees, the Government Geologist for Tasmania, spent a considerable time in an able investigation of these shale areas and has reported to the Government on their geology and economic potentialities. In his report Mr. W. H. Twelvetrees estimates the actual areas underlain by workable shale on the various properties. He states that these estimates are not for the purpose of company flotation but for the information of the Government & in preparing them he makes liberal deductions for the thinning edges of the shale basins and other interruptions to working which would cause loss. Taking the results so obtained as a basis I estimate the total area actually occupied of workable shale on the properties owned by this company on the eastern bank of the Mersey to be about 430 acres out of the 776 acres. On the western side of the Mersey it will amount to about 500 acres out of a total of 700, or in all 930, acres out of the 1420 acres held in lease. The shale is present in a single seam which varies from a few inches to about 7 feet in thickness. In making the above estimates shale less than about 20 inches in thickness is neglected as unworkable. The seam in its thicker parts is interrupted as a rule by a clay band 1 to 2 feet in thickness occupying a more or less centrally placed parting which divides it into upper and lower portions. Although this has to be deducted from the total thickness of the seam in estimating quantities, the occurrence of this band has

"The Tasmanite Shale Fields of the Mersey District," Tasmanian Geol. Surv. Bull. No.11 1912.

its advantages in the winning of the shale underground. It is readily distinguished from the shale and is easily sorted. From observations made in the Company's mines, workings and bores on the eastern blocks and from the evidence supplied by quarries and bores on the western side of the Mersey the average thickness of the workable shale underlying the total 930 acres before mentioned can be taken as 4 feet, an estimate which is in my opinion certain to be somewhat exceeded as the work progresses.

Mr. Twelvetrees takes the specific gravity of the shale as 1.6 and adopts the 4 ft average in his calculations. He deducts between one-quarter and one-third of the total amount of shale for loss in working and for faults, pinches etc. which is quite as much as can reasonably be deducted for such causes. He then arrives at 1,500 tons per acre as the probable tonnage per foot of seam. Taking this standard the probable amount of shale available for development on the Company's leases amounts to 5,580,000 tons or over 5½ million tons.

In making these calculations it is assured that the shale is a horozintal sheet. On the eastern side of the Mersey however there is an observable dip to the north-east of about 10° while on the western side the borings have proved that the shale is folded into a distinct synclinal curve. This dipping and folding will appreciably increase the estimated quantities, but 5½ million tons can be counted on as a working basis.

b. QUALITY. Physically the shale is a finely laminated material, brown in colour, sectile, tough and resistant to weathering agencies. It contains a large proportion of carbonaceous matter which ignites readily and is capable of being converted into petroleum products by destructive distillation. It is not necessary for the purpose of this report to enter into the question of its origin. That is fully dealt with in a report by Mr. Twelvetrees. It sometimes contains fossils of marine organisms usually preserved in pyrites, which accounts

Loc. cit p. No. 1

for some of the sulphur present in its products and for the variability of the sulphur contents. Four analyses made by Mr. W.F. Ward, Government Analyst, quoted by Mr. Twelvetrees, show the composition of the shale :-

	Section 2540 M Shaft No. 2	Section 46197 Richard's Quarry	Keep's Freehold	Ray's Freehold.
Mineral Matter	58.00	74.20	65.60.	58.60
Volatile Matter	37.30	22.07	31.30	37.70
Fixed Carbon	3.40	2.83	2.50	3.00
Moisture lost at 212° F.	1.30	0.90	0.60	0.70
Sulphur	2.60			
Yield of Oil per ton	50 Gals.	29.4 Gals.	41.70	50.30

Mr. Twelvetrees notes that the sample from Richard's Quarry includes some of the unproductive clay band, hence the low quantity of oil produced. The sulphur content is determined in only one sample and is certainly above average, some samples tested in the Company's laboratory giving less than 1% of sulphur. The average sulphur content determined by many experiments may be taken as 1.25%., which is well below the standard now adopted in the specifications for the British Admirality which is 3%. In the actual process of distillation on a commercial scale samples submitted by the Punpherston Works in Scotland yielded about 41½ gallons per ton. Distillation in the Company's own retorts gives similar results, the shale proving to be remarkably uniform in quality when distilled in quantity.

During my inspection of these properties a test was made by us in the experimental retort belonging to the Company. 6½ (six and a half) cwts. of shale were distilled and yielded 120.25 lbs. of crude oil, corresponding with a production of 39.10 gallons per ton of shale. The distillation was carried out continuously day and night. The smearing losses by night were more considerable than by day.

Loc. cit p. 67
do. p.93
do. p. 94

This was shown by the fact that 2cwts. distilled by day yielded 39.25 lbs. of crude oil, which corresponds to 41.5 gallons of oil per ton. Even here there were losses of both oil and gas so that the adoption of more refined methods of treatment should result in greater gains. It seems quite certain that the average yield of crude oil per ton of shale will exceed 40 gallons but taking that figure as the average the Company should be able to produce 220,000,000 gallons of crude oil.

The crude oil is dark olive green in colour and has a peculiar and characteristic odour. The specific gravity of different samples distilled by us averaged about .942. It contains little or no paraffin but has an asphaltic base. It flows readily and does not solidify nor deposit solid constitutents at ordinary temperature. It is therefore admirably adapted for transfer by pipe lines. The shales distil more readily than do the Scotch Oil Shales so that the cost of distillation will be low.

5. PHYSIOGRAPHY OF THE SHALE FIELD.

Before going into more technical matters it may be advantageous to describe briefly the country under which the shale occurs. The River Mersey is the central feature, winding northwards through a hilly region occupied by forests of fine timber with flat alluvial plains and lower rises bordering the river given over to general agricultural purposes and apple orchards. The ridges which are invariably well timbered, run generally in north and south directions and rarely exceed 300 or 400 feet in height. The country is well watered by the Mersey and its tributaries. The river never fails and is navigable up to Latrobe by small ocean going steamers. Larger steamers stop in the estuary at Devonport.

6. GEOLOGY.

The geology of the area has been admirably dealt with by Mr. Twelvetrees in the report already quoted, which is accompanied by effective geological maps.

Generally speaking the north and south ridges are composed of Pre-Cambrian and Cambrian schists quartzites and conglomerates,

sills and intrusions of Mesozoic diabase and basaltic dykes and sheets of Tertiary age. Patches of highly folded Silurian limestone occur in places. The shale bed occurs in strata of Permo-Carboniferous age which were evidently laid down in hollows on an old and much denuded Palaeozic surface over which the sea has encroached. The beds consist of yellow sandstones, mudstones, and conglomerates, the shale itself sometimes containing pebbles derived from the older rocks. In the basins occupied by the shale the upper beds tend to overlap the lower ones, so that the full extent of the shale seam is somewhat less than that occupied by the upper shale measures and boring is necessary to discover its limits. This has been done to some extent. The shale series usually dips gently to the N.E. at about 10^{o} and is in some places somewhat folded and faulted probably due to differential earth movements along the axes of the ridges. The folding and faulting is not severe enough to affect the mining adversely, rather it is beneficial in most cases since the faulting keeps the shale series sufficiently near the surface to do away with the necessity for expensive shaft sinking and the folding enables the material to be economically mined by gravitation methods. In addition to the above mentioned strata some soft Tertiary sands and lignitic clays are present in the area and alluvial deposits occupy the flats bordering the river.

7. MINING.

The thickness of the shale seam makes mining an easy matter. The clays are hard enough and sufficiently well bedded to form a good roof. The dip of the beds enables the material to be run out of the mine by gravitation at a moderate speed, the full trucks running out by their own weight, the empty ones only, having to run on an up grade. It also allows the mine to be efficiently and economically drained. Timber suitable for mine purposes abounds on the properties and is cheaply got. The overburden is not great, rarely exceeding 100 feet, sufficient to keep a good cover but too great to permit of actual quarrying in most cases. The pillar and stall method is at present employed and is best for these conditions.

The clay band and waste provides sufficient mullock for packing. Actual mining is at present in progress on 4164 M. The Company's retorting plant is on the same block about a quarter of a mile to the west. Between the two is a ridge of schist over which the shale is carried by the means of a cable tramway. The total cost of mining including maintenance of mine and delivery to retorts does not exceed 7/6 per ton at the present time. As the work progresses and opens out this figure should be reduced, probably to less than 6/- per ton.

8. DISTILLATION.

The Company has been working with four vertical and four horozintal retorts. The former are used for the coarse broken shale and the latter for the finer material. At the present moment four vertical retorts of an improved pattern are in course of construction. This type of retort is the most suitable for the purpose and should give good results. At present the shale is broken by means of a cone crusher. This is not suited to this class of material. The crushed product is too irregular in size and is accompanied by too much dust. The best results would be obtained by adopting a crusher consisting of revolving horizontal cylinders set with teeth which would break the shale into fairly even fragments about 4 inches square and produce a minimum of the smaller stuff.

When the present plant is completed there will be eight vertical and four horozintal retorts capable of dealing with more than 15 tons of shale per day. The shale distils rapidly and easily, leaving a residue of ash and fixed carbon. The resulting gases travel freely to the condensers especially in the presence of steam leaving no solid deposits in the tubes. Most of the gas condenses into dark olive green oil, density about .942, the yield in actual practice being over 40 gallons to the ton of shale. In addition five gallons of crude spirit is obtained from the gases by condensation, while some considerable quantity of uncondensable gases remains. The yield of crude spirit should be increased to nearly 10 gallons per ton when efficient scrubbing is employed, while the uncondensable gas could be used in firing the retorts

and should be sufficient for the purpose. At present half a ton of wood-fuel is required per ton of shale. The wood is obtained on the properties but costs 5/- per ton to get. The use of gas would therefor ensure a considerable saving in the present cost of retorting. Taking the low average yield of 40 gallons of oil per ton of shale, this is subjected to further distillation and treatment at the Company's works. It produces :-

6 gallons	Crude spirit		
2 "	Heavy Motor spirit	S.G.	.780
2 "	Turpentine substitute	S.G.	.800
2 "	Heavy engine combustion or cleaning oil	S.G.	.820

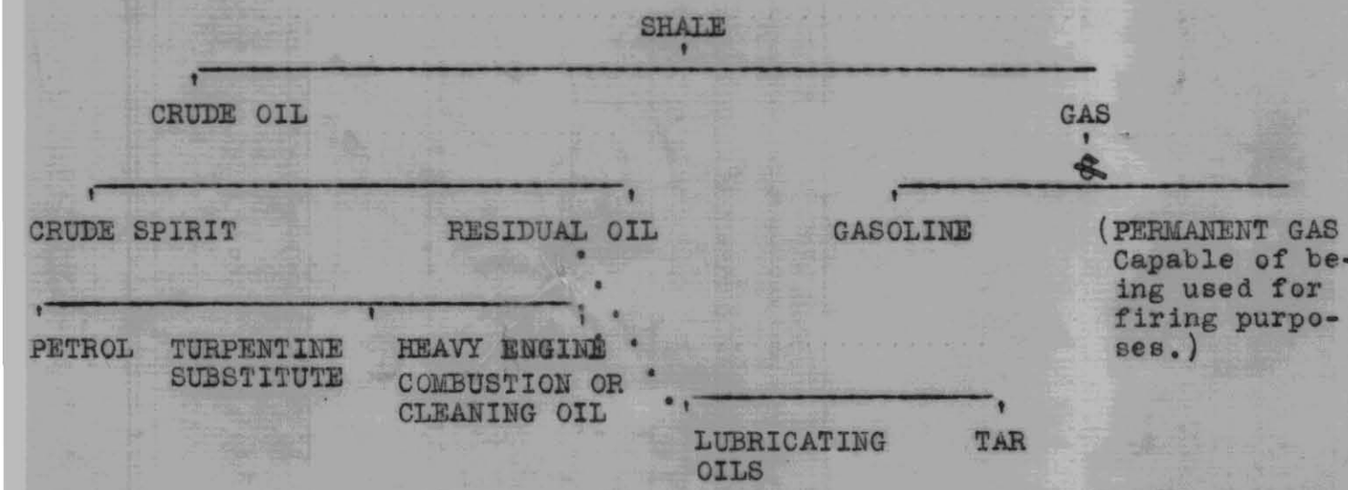
Deducting from the remaining oil 2 gallons for loss during distillation, there remains :-

32 gallons residue oil suitable for oil fuel S.G. .950.

In addition 5 gallons of crude spirit must be added to the first product, making 11 gallons in all, a quantity which should be increased to about 15 or 16 gallons as the work progresses and improved plant installed.

The crude oil is capable of producing a good percentage of fine lubricating oils which are at present neglected, but which could easily be obtained by suitable plant and treatment.

The following table will give a good idea of the products of distillation:-



The nitrogen and paraffin contents in the shale are low so that no production of ammonium sulphate or paraffin wax is to be expected. The Cpmpany produces however a liquid which is highly thought of by orchardists as a spray for wolly aphis and such like pests and which sells profitably. Many other bye-products may be developed

in connection with the distillation, especially disinfectants. There is much room for chemical research in the Company's Laboratories which in good hands would result in additional profits. The bye-products alone provide a separate field which may yield larger returns than the oils themselves.

9. FINANCIAL ASPECTS AND DEVELOPMENTS.

Without going into details, the total mining and distillation charges now amount to 14/8 per ton of shale, a figure which will certainly be reduced by the adoption of methods now under consideration and by extended working to about 10/- per ton. At present prices the Company's products will bring a return of about 30/- per ton, giving a present gross profit of about 15/- per ton, and capable in the near future of increasing to 20/- per ton. Even this gives no idea of the return which may reasonably be expected if the plant be increased in size and efficiency and the range of products increased.

The nominal capital of the Company is at present £40,000. When the present plant is completed and on the present limited scale of working, the gross annual products should be -barring accidents- £4,500 per annum, reckoning 300 working days to the year. From this must be deducted however capital charges for management, Rents, and Depreciation and some allowance made for Reserves. £2,000 would provide a return of 5% interest on the capital but it is very unlikely that the charges mentioned would amount to as much as half the gross profits, so that a return of considerably more than 5% is probable. Further, an increase of capital expenditure properly made, would not mean an increase in profits but an increase greater in proportion than the increase in capital. Everything that will increase the efficiency of the plant will lead to increase in profits. A further bench of retorts will be required on the properties west of the Mersey when those properties are opened up. With a greater supply of crude oil it will be necessary to construct a central Refinery for the higher branches of refining. This might be done on a central site near the railway passing the properties, or the crude oil might be piped directly to Devonport (about seven miles distant) by means of -----

3 or 4 inch pipes and the Refinery constructed there right at the sea-port from which the bulk of the oil must go for distribution. In my opinion the latter scheme would be best. It would save railway charges on all the materials required in refining, most of which would have to be imported, as well as on the refined products being sent to the port for export. Against this would be the cartage of wood fuel to the Refinery which would not be necessary in the other case. It would however probably be far cheaper to import coal direct from Newcastle for this purpose, the greater efficiency of the coal counterbalancing its higher price. A further alternative may be found in the use of oil fuel where boilers are necessary. Some modern boilers such as the Bone-Court boiler are especially suited to such conditions and attain a higher efficiency than the ordinary coal-fired boilers even with much smaller sizes.

The country is admirably adapted to a pipe line service. The oil is free running and is not likely to leave solid deposits which would clog. The line should be buried 2 or 3 feet underground and be fitted with expansion loops at inter vals. Motor Trenches for making excavations for the laying of the pipes are used in America, enabling a pipe line to be laid very rapidly. The ground near Latrobe would provide no obstacles to the use of such methods. The oil would probably have to be pumped to storage tanks on one of the hills near the Company's works from which it would run by gravitation down to the works at Devonport.

10. CONCLUSIONS.

The great advantage of a shale oil proposition over oil obtained from wells by borings is its certainty. The oil well is a speculation at allttimes. The boring may be a failure even in the midst of a proved oil field and the life of the well can rarely be predicted. It is subject to all sorts of troubde and difficulties which are absent in the case of oil shales.

c The disadvantage under which the oil shale labours is the greater expense of getting and distilling. A successful oil well does half the work itself and begins right away with the production of oil. It may produce oil for a few weeks or for many years. If the former be the case heavy financial loss ensues, if the latter, the gains are great in proportion. But with oil shales the production is known, the extent of the deposit can be determined and the life of the field at a given rate of production forecasted with some degree of accuracy.

If Australia produced oil in quantities by means of wells and borings it would be difficult to make a shale proposition pay, but depending almost entirely as she does on imported petroleum products a local development of the industry would be a great advantage to the whole continent. Turning from generalities to the present properties.. We have here a supply of shale about which there is no speculative element and which will take more than 50 years to work out at an average rate of production. The estimate of 5½ million tons is based on actual observations and measurements. The Shale preserves a remarkably constant average of quality. It distils easily and yields more than 40 gallons of crude oil to the ton which is a better average than the famous Scottish Oil Shale Companies can show. The whole of the products will find ready markets and little of the material when mined will go to waste, even the spent shale finds a market as a land dressing manure. The oils are of good quality. Bye-products yielding very considerable profits are likely to be developed in the future. The properties of the Company are exceedingly well placed, the river and railway being close at hand. Timber for all purposes abounds on the properties and is sawn by the Company's own mill. A good deep water port is only 7 miles away and the country is very favourable for cheap transport by pipe lines.

The tendency of all prices in connection with petroleum products is a rising one. The demand is even now potentially if not actually in excess of the supply. A constant supply would greatly increase the demand, for it has been proved in many parts of the world that oil fuel whether for battle ships or ships of commerce, for railways or for factories and for all purposes where coal can be used is both cheaper, more convenient and more efficient in the production of power than coal. With a larger and better plant, suitable refineries, general equipment, all of which will require additional capital, the Company should with careful and efficient management acquire a very sound position which will be greatly to the advantage of the State.

(Signed) ARTHUR WADE,

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