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Capricorn Mining Ltd.,
151 - 155 Dorcas Street,
South Melbourne,
Victoria. 3205

REPORT ZAN 704/8

80-1463

TASMANIAN COAL PROSPECTS

QUARTERLY INTERIM REPORT

for

CAPRICORN MINING LTD.

by

GENERAL GEOLOGICAL SERVICES

Work Order ZAN 704

JUNE, 1980

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TASMANIAN COAL PROSPECTS

QUARTERLY INTERIM REPORT

CONTENTS

TASMANIAN COAL PROSPECTS

QUARTERLY INTERIM REPORT

1. INTRODUCTION

Capricorn Mining Ltd. is a subsidiary of Zanex Ltd. and as such is responsible for coal and allied mineral investigations for Zanex Ltd.

This report presents the operations carried out by General Geological Services for Capricorn Mining Ltd. in connection with coal search throughout four exploration licence areas in central-south Tasmania for the period of 2nd May to 24th July, 1980. It also outlines plans for operations during the next quarter.

Capricorn Mining Ltd. applied to the Tasmanian Department of Mines in July 1979 for approval to undertake exploration for "coal (including peat and shale)" as set out in Section 15B of The Mining Act, 1929, in four prospective areas covering approximately 3,616 square kilometres as shown in Figure 1. These areas include not only already known coal localities but also geological formations possessing a potential for coal occurrence.

A summary of the licence areas is given below. Specific data on the location and extent of each of these areas appears in Figures 2 to 6, and in their respective Schedules (Appendix 1).

Capricorn Mining Survey Areas		Tasmanian Mines Department Exploration Licence Areas			
No.	Name	No.	Land District	Vicinity	Area (Km^{-2})
1.	Sandfly	26/79	Buckingham	Sandfly	825
2.	Hamilton	27/79	Cumberland, Monmouth & Buckingham	Hamilton	870
3.	Colebrook	28/79	Monmouth & Somerset	Colebrook	1,561
4.	Cygnet	29/79	Buckingham	Cygnet	360

The framework of the exploration programme as initially proposed (General Geological Services, October 1979 and December 1979) is as follows:

Stage	Work Programme	Timing
		Year One
1.	Region geological appraisal	12 months
	A. Preliminary reconnaissance	2 months
	B. Detailed geological mapping and sampling	4 months
	C. Geophysical and scout-drilling programmes	6 months
2.	Engineering and reverse economic studies	6 months (With Stage 1C)
		Year Two
3.	Detailed evaluation of coal	8 months
4.	Feasibility studies	4 months

The geological appraisal to date embraces Stages 1A and 1B; it has included a literature search and a field survey which covers both the region as a whole and the specific exploration licence areas. The work programme for Stages 1A and 1B in the next quarter will involve a literature review, analysis of survey data, and preparation of a report.

Monthly reports have been prepared for each of the four exploration licence areas for the month ending 31st May, 1980. This interim report should be read in conjunction with the monthly reports.

2. PROJECT BACKGROUND

2.1 Exploration and Production History

The earliest discoveries of coal in Tasmania were made in the south-eastern part of the State. In 1824, J. Hobbs found coal seams in the cliff overlooking the sea at South Cape. Some years later these deposits were explored by the Imperial Government with convict labour, as were also the Recherche Bay seams found in 1834. Strzelecki visited Colebrook in 1834 and mentioned the discovery of coal by convicts at the site of the existing mine. He also referred to the occurrences of coal at several places around Hobart.

The first important development in the coal-mining industry in Tasmania was the re-opening of the Colebrook mine in 1879. During the next twenty years a large quantity of steaming coal was sold to the Railways Department.

The large Cornwall and Fingal deposits were not discovered until 1886 but soon became the dominant coalfields of Tasmania, causing industrial interest to move from the south-eastern fields to the central north of the State.

Information dealing with the development of the early mines is meagre and it was not until 1922 that the Tasmanian Department of Mines prepared a comprehensive report on the coal resources of the State. This report gives detailed accounts of the operation and production of the mines in the south-eastern region up until that time, including those now included in the Capricorn Exploration Licençe Areas. Selected passages from this report are appended (Appendix 4).

During the 1940's and up until 1972, small mines spasmodically operated in the south-eastern region and produced supplies of relatively high quality steaming coal for use in local industries in Hobart. These mines gradually closed down as a result of a change to cheaper hydro-electric power and to the relatively depressed price of coal. The areas have remained virtually unexplored until now.

No! it was change to oil burning

2.2 Licence Area Selection

Four areas have been selected for investigation and development by Capricorn Mining Ltd. in the composite Permo-Triassic coal basin of south-eastern Tasmania as being worthy of detailed exploration and evaluation. The areas were chosen so as to cover extensive known outcrops of carbonaceous units within the Permo-Triassic Parameener Super-Group of the Tasmanian Basin, to embrace the sites of many collieries mined in the past and to include those geological formations that proved favourable during this year's field studies.

Collieries in these four areas (referred by by Capricorn Mining as Sandfly, Hamilton, Colebrook, and Cygnet) have the following reserves:

Area	Mine	Reserves (Million Tonnes)
1. Sandfly	Sandfly	16.2
	Mt. Lloyd	1.0
2. Hamilton	Macquarie Plains	0.4
	Lawrenny	14.1
	Plenty	0.4
3. Colebrook	Colebrook	3.6
	Mike Howe's Marsh	2.7
	York Plains	0.2
	Kempton	0.2
4. Cygnet	Cygnet	0.7
	Gordon	0.2
		39.7

(Abstracted from Tasmanian Department of Mines, Report No. 7, 1922)

The specific licence application areas (Appendices 1 and 2) total 3,616 Km^2, with Sandfly 825 Km^2, Hamilton 870 Km^2, Colebrook 1,561 Km^2, and Cygnet 360 Km^2. In addition to pursuing a vigorous exploration programme for new coal resources in these areas, Capricorn Mining Ltd. intends to prove up, and hopefully increase substantially, the inferred reserves of the major collieries which contain a total of

40 million tonnes that are conservatively estimated to represent 20% of all Tasmanian inferred coal reserves (A.I.M.M., 1975: based on 1961 data). Less than one million tonnes of coal have been produced from all the mines in the south-eastern part of the State (A.I.M.M., 1975: based on 1972 data).

The significant coal deposits of the Tasmanian Basin occur in two separate sequences within the Parmeener Super-Group:

(a) The lower sequence comprises the Cygnet Coal Measures of late Permian age and includes two seams of a sub-anthracitic nature. Although these seams are generally thinner than those of the upper sequence, their quality is usually better. Only one seam has been exploited at Mt. Cygnet.

(b) The upper sequence encompasses coal measures of Triassic age, and these are widely developed in the drainage basins of the Huon, Derwent, and Coal Rivers. Although mostly sub-bituminous steaming coals have been mined to date in these areas, the fact that semi-coking coal of the same age is known to occur elsewhere in Tasmania broadens the prospects of future exploration.

Not it - medium rank bituminous

The Triassic coal seams in the areas of interest are similar in many respects to those currently mined at Cornwall and Fingal in the north-eastern part of the State. More than 90% of the total production of coal in Tasmania has come from these seams.

2.3 Policy and Objectives

A leading coal marketing authority predicts that a reviving demand for coking coal will be joined by tremendous growth in steaming coal sales and a significant price increase in the early 1980's (The Miner Newspaper, May 1979). Capricorn Mining Ltd. considers that this predicted upsurge in potential markets, coupled with recent technological advances in the extraction of coal in underground mines, makes the re-assessment of south-eastern Tasmania an attractive prospect. It should be noted that no comprehensive review of the coal resources of the region has been made since 1922 (Tasmanian Department of Mines, 1922).

It is believed that by carefully establishing exploratory drilling grids, fault blocks and sill rock can be located or avoided. Furthermore, it is confidently anticipated that the proposed geological re-appraisal of the region supported by scout drilling will lead to new discoveries of good coal.

Capricorn Mining Ltd. has consequently developed an intensive programme of exploration that will be carried out in four stages. A brief outline follows:

<u>STAGE 1</u> — <u>Regional geological appraisal</u>

Based on stratigraphic and structural mapping at 1:10,000 scale, palaeo-environmental and facies interpretation, coal sampling and analysis, geophysical survey, and scout drilling.

<u>STAGE 2</u> — <u>Engineering and reverse economic studies</u>

Includes a preliminary assessment of the economic potential and mining viability of the coal deposits as regards capital operating and infrastructure costs, extraction technology and environmental impact.

<u>STAGE 3</u> — <u>Detailed evaluation of coal seams</u>

<u>STAGE 4</u> — <u>Feasibility studies</u>

This programme has been designed so as to evaluate the extent, quality, quantity, and marketability of the coal resources in south-eastern Tasmania. It is estimated that Stages 1 and 2 will cost $120,000.

The south-eastern Tasmanian region appears at this time to possess a significant coal potential which could be developed by several modest sized mines, together with a number of smaller operations. Prompting us to pursue the above programme with vigour is the fact that almost every day there is reported the signing of new contracts for coal with large overseas users. To sum up, we see ourselves being profitably involved in coal industry because -

(a) our Tasmanian prospects are good, and

(b) the industry has a long term bright future (Cortis & Carr, 1979)

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REFERENCES

CORTIS & CARR, 1979 "Australian Coal - Energy for the 1980's 95p

HUGHES 1959 REPORT NO. 3 TASMANIAN DEPARTMENT OF MINES p 89-111

JENNINGS & WILLIAMS 1967 GEOLOGICAL SURVEY BULL NO. 50
TASMANIA DEPARTMENT OF MINES p 84-6

"THE COAL RESOURCES OF TASMANIA" GEOL SURVEY MINERAL RESOURCES NO. 7 1922

3. OPERATIONS PERFORMED

3.1 Establishment

Capricorn Mining Ltd. is meeting its exploration responsibilities in Tasmania through the activity and advice of General Geological Services who are retained as both administrative and technical managers and consultants for the current coal programme.

The address of Capricorn Mining Ltd. is:

151-155 Dorcas Street,
South Melbourne,
Victoria. 3205
Telephone - (03) 690 5317, (03) 690 5900

3.1.1 Administrative Management

All administrative matters concerning the programme are under the control of Mr. Colin Glazebrook who is Managing Director of General Geological Services (155 Dorcas Street, South Melbourne, Victoria, 3205); he also acts as Exploration Manager for Capricorn Mining Ltd.

3.1.2 Technical Management

General Geological Services has engaged senior consultants for the duration of the programme. Project Manager is Mr. R.C. Glenie who is responsible for supervising the field work and the detailed reporting of the Stage 1A and 1B programmes. He is supported by Dr. A.G. Link and several geological assistants. These consultants will be supplemented by additional personnel and service company representatives depending on the development of the exploration programme.

A field office was established at Claremont - 45 km NW of Hobart. This location permitted relatively efficient access for field parties to Capricorn Mining Areas 1 (Sandfly), 2 (Hamilton), 3 (Colebrook) and 4 (Cygnet).

3.2 Data Collection

3.2.1 Literature Search

An initial collection and review of the most important literature was made prior to application for exploration licences. This information was augmented during and following the field programme from a systematic search for relevant literature made at

(i) technical libraries in Melbourne, and particularly at

(ii) the Tasmanian Department of Mines in Hobart where early records, documents, and open-file material were available.

The main categories of data compiled from these sources can be listed as follows:

* Regional geological and geophysical data in the form of published papers and maps dealing with basin-wide Permo-Triassic rock units, major structural elements, hydrogeology, bio-stratigraphy, and palaeo-environmental interpretations.
* Specific information on the geology and mining of the coal deposits as recorded in the form of technical papers, unpublished reports and plans, and related documents.
* Topographic maps.
* Land ownership plans.
* Environmental and conservation data.

3.2.2 Photographic and Imagery Cover

In order to supplement existing geological maps and to extend coal units into unmapped areas during the field survey, the following aerial photographs were obtained from the Tasmanian Department of Lands:

* Complete stereo-aerial photographic coverage of all exploration licence areas selected from the best quality available, regardless of scale.

As a regional overview of the geological framework of the whole of south-eastern Tasmania, appropriate satellite imagery was ordered from the Australian Department of National Development:

* Erts band 7 imagery in one sheet across south-eastern Tasmania.

3.3 Geological Reconnaissance

A preliminary drive-through reconnaissance of all four licence areas was made by the Exploration Manager of Capricorn Mining Ltd. during the setting out of lease datum notices.

Following establishment of the field office, the survey personnel first examined type and reference sections of the major Permian and Triassic litho-stratigraphic units in southern Tasmania, in particular along the coastal sections between Gordon and Cygnet.

Orientation surveys were carried out by the field team split into two parties led by the Project Manager and by the Senior Consultant respectively through Capricorn Areas 1 (E.L. 26/79), 4 (E.L. 29/79) and Areas 2 (E.L. 27/79) and 3 (E.L. 28/79). Following initial assessment of area potential, prospective localities were examined in detail either by combined or by interchanged survey parties in order to test opinions and to obtain accurate and correlateable field evaluations.

A generalised model for the depositional environment of the black coal in the Late Permian and Late Triassic basins was constructed at the commencement of the field programme. This model greatly assisted in the interpretation of stratigraphic units, particularly those units in areas where the earlier available mapping by others is accompanied by little geological description and coarse stratigraphic sub-division.

A critically limiting factor in the field exploration programme was the overall paucity of outcrop of the prospective stratigraphic units.

The field parties were continuously active in southern Tasmania for six weeks during February and March.

Samples were taken from coals found in outcrop in Capricorn Mining Area 1 (E.L. 26/79), Area 2 (E.L. 27/79), Area 3 (E.L. 28/79) and Area 4 (E.L. 29/79)

Previous Mining and Environmental Factor Evaluation

Information on past coal mining has been assembled; the sites of these mines were visited during the field programme. A number of the adits and shafts are still partly open and the remains of associated haulage equipment and processing plants are often identifiable.

Other old workings indicating past small mining operations occur in the Capricorn Mining licence areas. The most important mines were at Sandfly (Area 1: E.L. 26/79) and at Lawrenny (Area 2: E.L. 27/79).

The areas of past mining operations have been examined from the viewpoint of their short and long period impact on aspects of the local environment (including soil and vegetation disturbance, deforestation, spring and seepage interference, run-off and drainage change, stream sedimentation and pollution, landslide and subsidence). The more direct effects on land ownership and utilization, grazing and agricultural capacity, water rights, forest management, etc. caused by tailing dumps and settling ponds, adits and shafts, drillholes, processing plants, roads and railways, etc. have also been assessed.

Consideration has also been given to possible sensitive environmental issues which might be raised by rural communities, conservation groups, and forest-product industries.

4. EXPENDITURE

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GENERAL GEOLOGICAL SERVICES

EXPENDITURE REPORT

QUARTER ENDING 30TH JUNE, 1980

COMPANY: CAPRICORN MINING LTD.

WORK ORDER: ZAN 704

PROSPECT NAME: Capricorn Area 1 - Sandfly, Area 2 - Hamilton, Area 3 - Colebrook, Area 4 - Cygnet

LOCATION AND PERMIT NO.: SANDFLY E.L. 26/79, HAMILTON E.L. 27/79, COLEBROOK E.L. 28/79, CYGNET E.L. 29/79

EXPENDITURE DETAILS

	E.L. 26/79 $	E.L. 27/79 $	E.L. 28/79 $	E.L. 29/79 $	Total $
ADMINISTRATION COSTS	602	415	402	422	1,841
OFFICE STUDIES	1,217	1,184	1,002	725	4,128
FIELD STUDIES					
Geological	6,070	3,748	9,531	4,753	24,102
Geophysical					
Drilling					
RENTAL EQUIPMENT ETC.	1,593	374	1,967	898	4,832
TOTAL	$9,482	$5,721	$12,902	$6,798	$34,903

ACCOUNTING OFFICE MAKING REPORT: CAPRICORN MINING LTD.

DATE: 1ST JULY, 1980.

5. OPERATIONS PLANNED

5.1 Objective

The ultimate objective of the regional appraisal (i.e. Stages 1A, 1B and 1C) is to provide assessments of the following:

(i) Likely maximum and minimum in-situ tonnages (inferred reserves).

(ii) Likely coal quality and its variation (rank, ash, sulphur, specific energy, etc.).

(iii) Broad variations expected in seam thickness.

(iv) Structure in terms of maximum, minimum, and average dips, and degree of faulting.

(v) Range of depths at which coal may occur (overburden) and some broad idea as to the proportions of coal tonnage which is mineable by open-cut and underground methods.

Although part of these objectives can be reached at the present stage, some cannot be achieved until completion of the geophysical and scout-drilling programmes (Stage 1C). Thus data concerning inferred coal reserves, grade, seam thickness and overburden, structural situation, mining method viability, environmental constraints, etc., will be provisional estimates.

5.2 Interpretation

The next quarter will be devoted to an integrated geological interpretation of all data obtained from the review of relevant literature on Tasmanian coal deposits, and from the results of the field survey in the Capricorn Mining exploration licence areas.

This interpretation will provide a basis for the preliminary assessment of the coal potential which will complete Stages 1A and 1B of the exploration programme.

5.3 Maps

A series of maps will be prepared showing the results of the field geological survey and economic assessment on base maps at scales of 1:50,000 and 1:100,000. Base sheets already prepared at 1:10,000 scale are too detailed for presenting data compiled at this stage, but will probably be incorporated into later stages of the programme.

The maps will contain the following information:

- Location of exploration licence area boundaries.
- Past mining areas including adits and shafts.
- Geological data including significant rock units and structural elements.
- Coal potential assessment including preliminary estimates of inferred reserves, and overburden nature.
- Drillhole sites and geophysical traverse lines for next stage.
- Land ownership and utilization.
- Economic factors including power and water supply, road and rail transport, etc.
- Areas recommended for relinquishment and/or progress to Stage 1C.

5.4 Assays

Selected samples of coal and associated rocks will be submitted for chemical analysis and prepared for petrographic examination.

The coal analyses will generally include a proximate analysis (moisture, ash, volatile matter, fixed carbon), sulphur, and specific gravity.

5.5 Report

A final report for Stages 1A and 1B of the regional appraisal will be submitted at the end of the next quarter. It will contain conclusions and recommendations on the programme carried out to date.

APPENDIX 1

EXPLORATION LICENCE AREA SCHEDULES

E.L. 26/79 - CAPRICORN MINING AREA 1 (SANDFLY)

Commencing at the Posted Notice situate at a north east angle of the area whose grid co-ordinates are 499,000 metres E., 5,261,000 metres N., thence grid south to 5,250,000 metres N., grid east to 520,000 metres E., again grid south to 5,230,000 metres N., grid west to 490,000 metres E., grid north to 5,240,000 metres N., again grid west to 484,000 metres E., again grid north to 5,261,000 metres N. aforesaid thence again grid east to the point of commencement.

E.L. 27/79 - CAPRICORN MINING AREA 2 (HAMILTON)

Commencing at the Posted Notice situate at a south west angle of the area whose grid co-ordinates are 489,000 metres E., 5,274,000 metres N., thence grid west to 480,000 metres E., grid north to 5,285,000 metres N., again grid west to 475,000 metres E., again grid north to 5,295,000 metres N., again grid west to 470,000 metres E., again grid north to 5,315,000 metres N., grid east to 484,000 metres E., grid south to 5,305,000 metres N., again grid east to 490,000 metres E., again grid south to 5,290,000 metres N., again grid east to 500,000 metres E., again grid south to 5,264,000 N., again grid west to 489,000 metres E. aforesaid thence again grid north to the point of commencement.

E.L. 28/79 - CAPRICORN MINING AREA 3 (COLEBROOK)

Commencing at the Posted Notice situate at a southwest corner of the area whose grid co-ordinates are 509,000 metres E., 5,280,000 metres N., thence grid north to 5,327,000 metres N., grid east to 530,000 metres E., grid south to 5,324,000 metres N., again grid east to 546,000 metres E., again grid south to 5,310,000 metres N., grid west to 540,000 metres E., again grid south to 5,275,000 metres N., again grid west to 530,000 metres E. aforesaid again grid north to 5,280,000 metres N. aforesaid thence again grid west to the point of commencement.

E.L. 29/79 - CAPRICORN MINING AREA 4 (CYGNET)

Commencing at the Posted Notice situate at the north east angle of the area whose grid co-ordinates are 520,000 metres E., 5,230,000 metres N., thence grid south to 5,218,350 metres N. and being a point at low-water-mark on D'Entrecasteaux Channel by that low-water-mark, the low-water-mark on the Huon River, the low-water-mark on Port Cygnet and again the low-water-mark on the Huon River in a general southerly and north westerly direction to 500,000 metres E., grid north to 5,230,000 metres N. aforesaid thence grid east to the point of commencement.

APPENDIX 2

LOCATION PLANS

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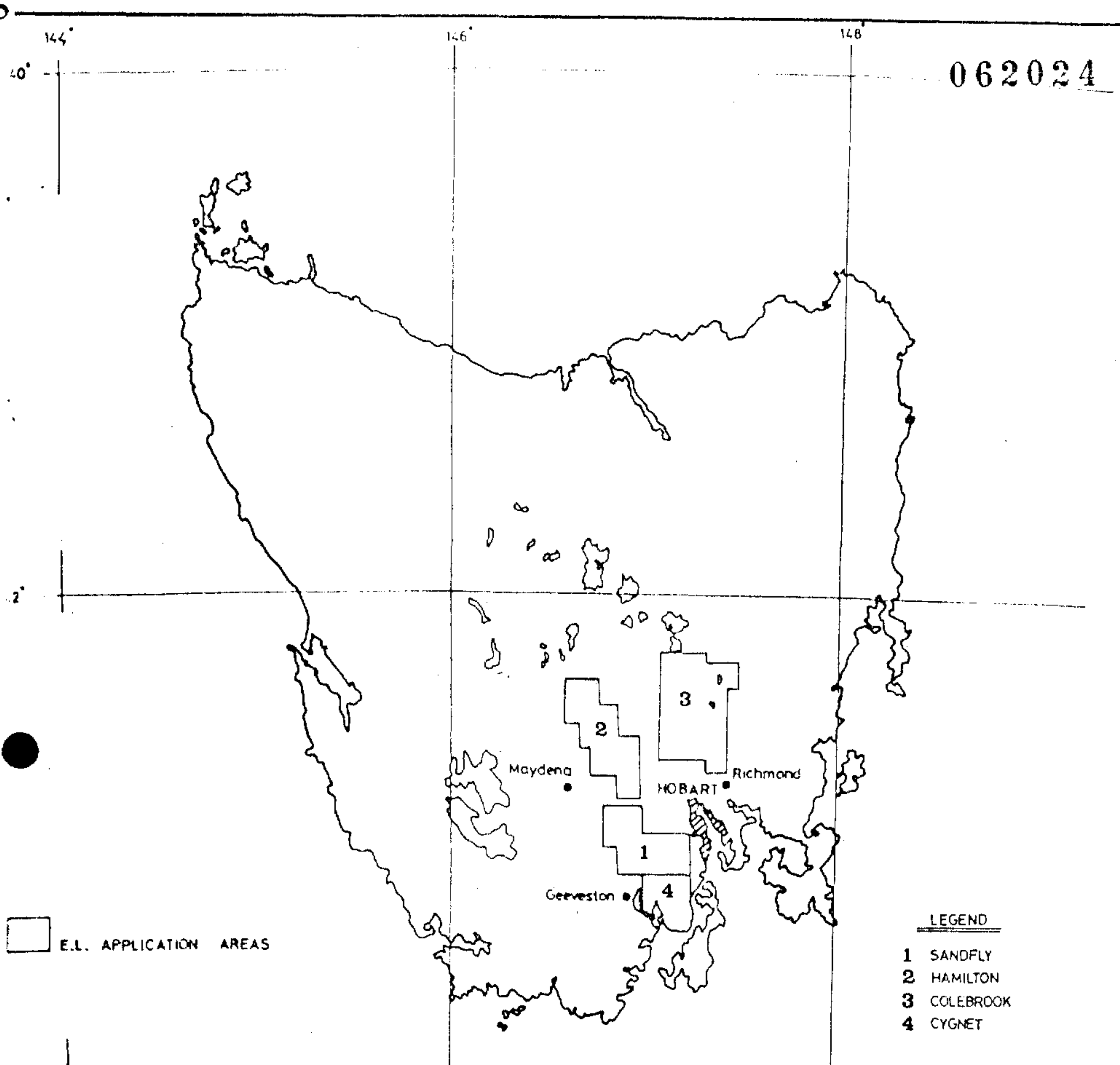

TRIASSIC COAL LOCALITIES S.E. TASMANIA

C.009/2

5 cm

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CAPRICORN MINING LTD.
C.001

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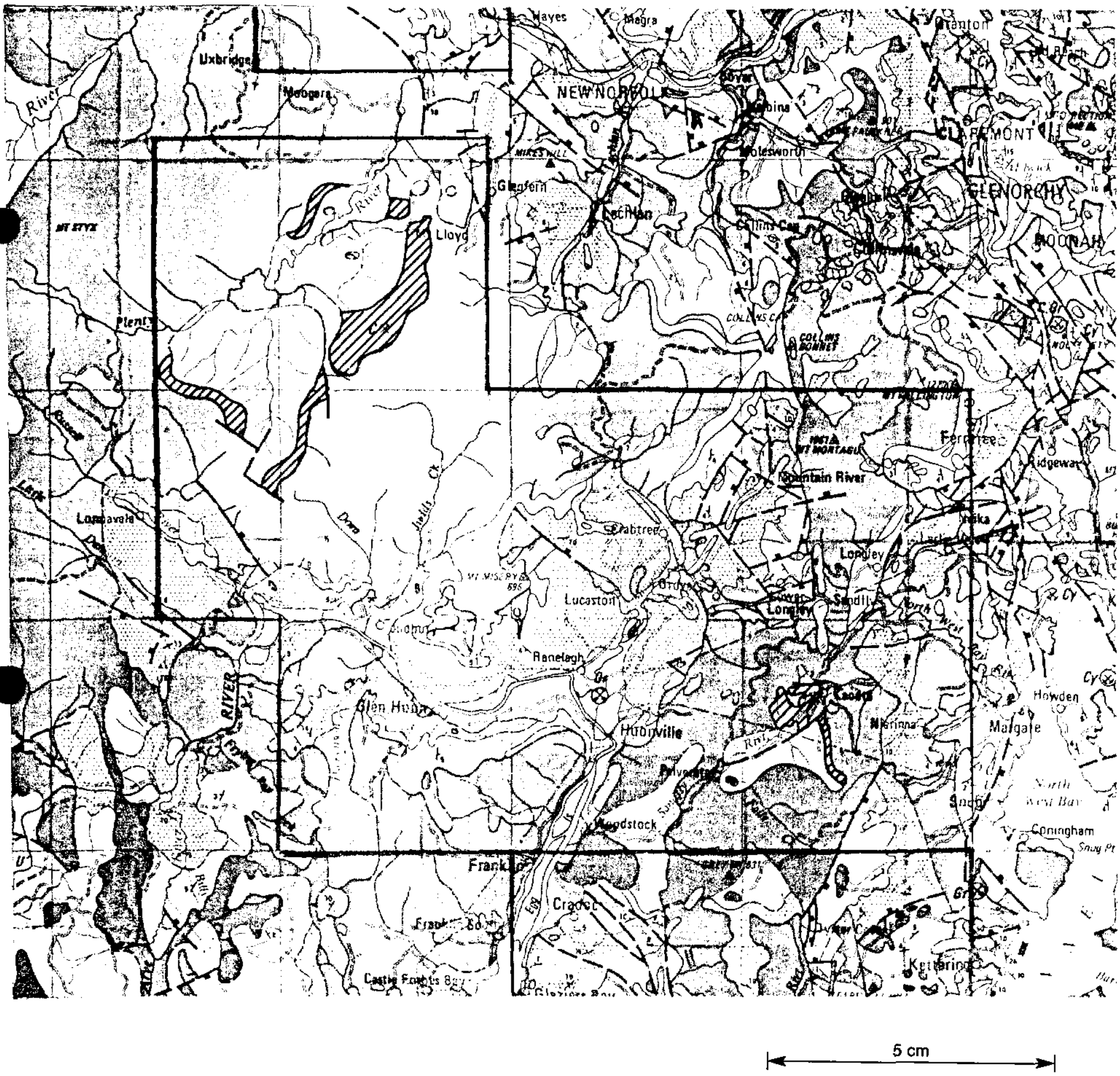
LEGEND

E.L. AREA

TRIASSIC COAL FORMATION



LOCATION PLAN. E.L. AREA 1
SANDFLY TASMANIA

SCALE 1:250,000

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CAPRICORN MINING LTD.

C.002

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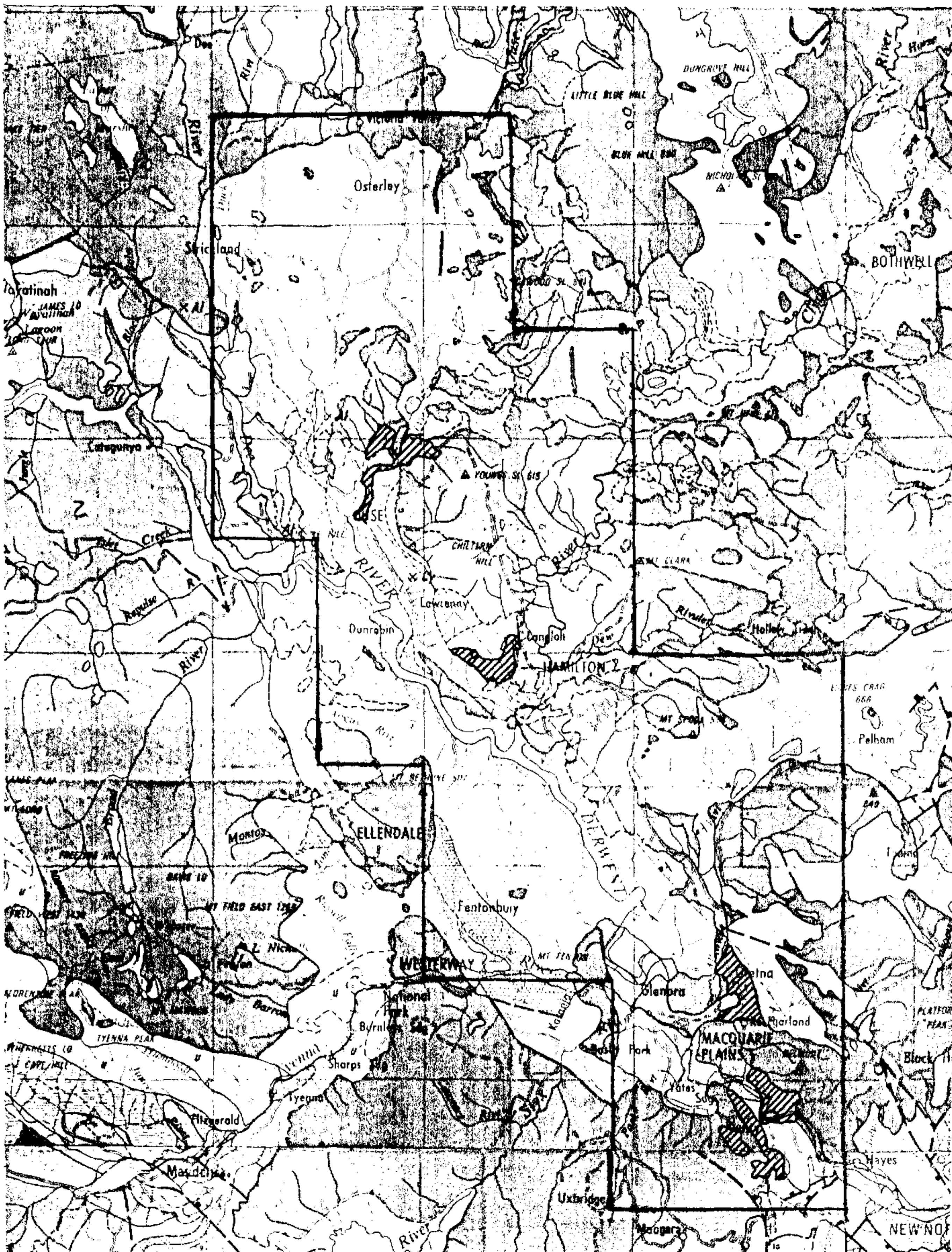
LEGEND

E.L. AREA

TRIASSIC COAL FORMATION



LOCATION PLAN. E.L. AREA 2
HAMILTON TASMANIA

5 cm

SCALE 1:250,000

026

CAPRICORN MINING LTD.
C.003

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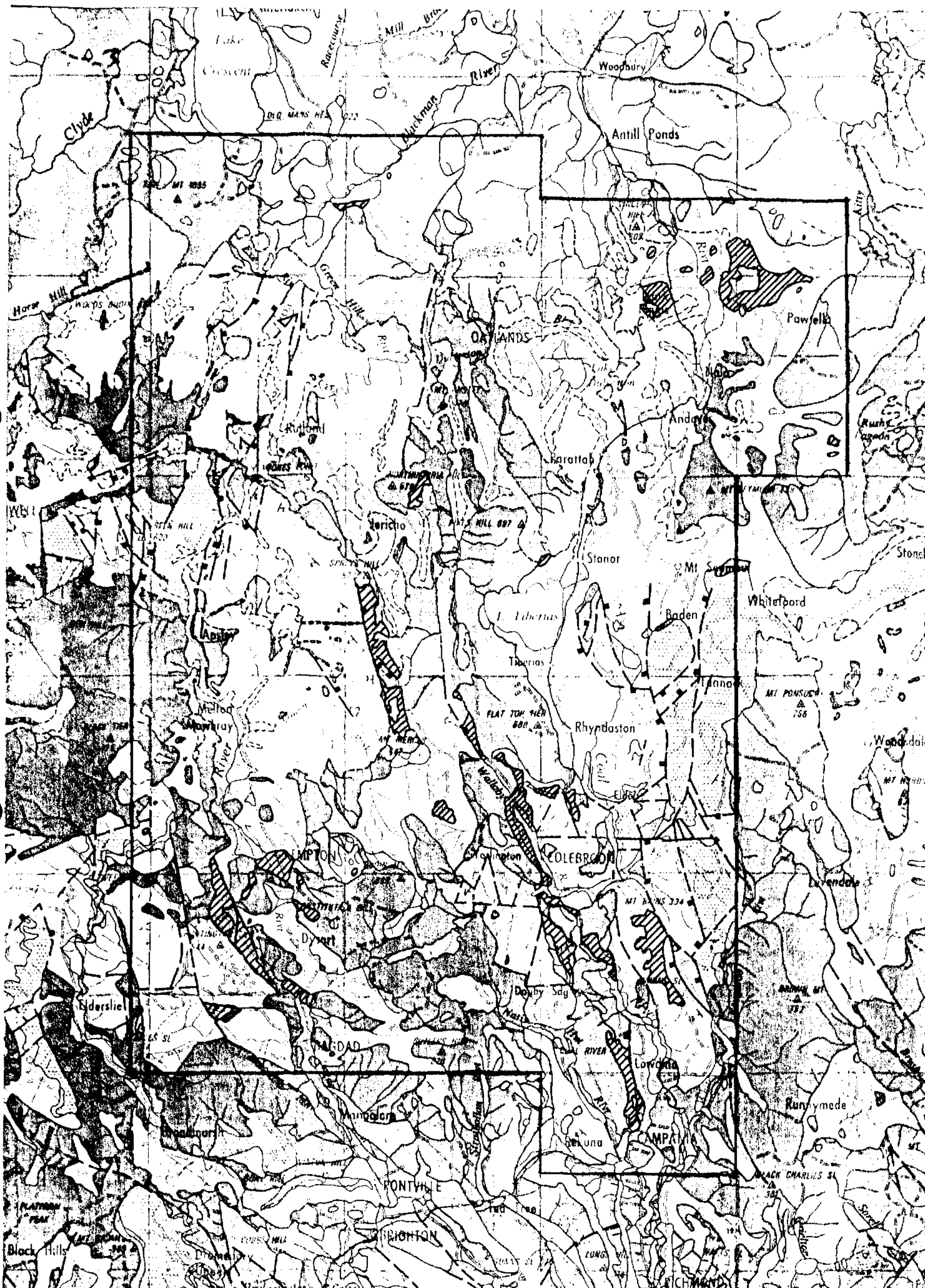
LEGEND

E.L. AREA

TRIASSIC COAL FORMATION



LOCATION PLAN. E.L. AREA 3
COLEBROOK TASMANIA

5 cm

SCALE 1:250,000

027

CAPRICORN MINING LTD. 062028

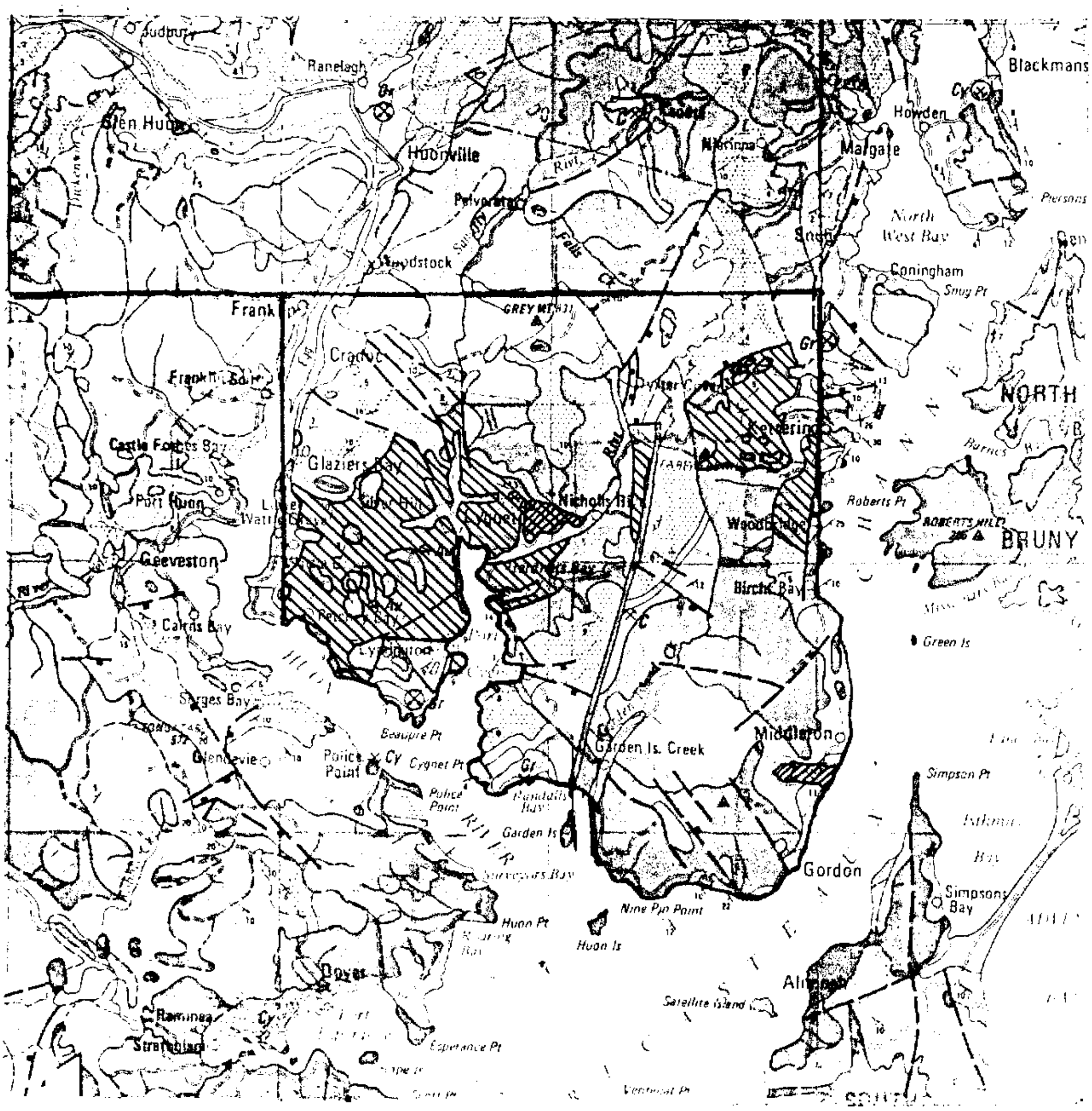
C.004

LEGEND

E.L. AREA

TRIASSIC COAL FORMATION

OIL SHALE FORMATION



5 cm

LOCATION PLAN. E.L. AREA 4
CYGNET TASMANIA

SCALE 1:250,000

APPENDIX 3

CONSULTING SERVICES AND PERSONNEL

GENERAL GEOLOGICAL SERVICES

General Geological Services is a professional and technical consulting group of qualified Geologists and allied earth scientists with a range of skilled field and research experience in the exploration and development of petroleum and mineral resources in the Australasian, South Pacific, and South-East Asian regions.

The consultants collectively have a background in hard and soft rock geology throughout inland and coastal Australia and in the adjacent archipelagos and oceanic islands. They have conducted large and small exploration programmes for oil, coal, and minerals from initial inspection through to final evaluation. The consultants have, in particular, established an expertise in the study of stratigraphic entrapments for oil and gas in Australia by the use of depositional environment studies, seismic stratigraphy, and structure analysis.

The Principal Consultant is Mr. Colin Glazebrook whose qualifications and experience are listed below.

C. GLAZEBROOK, B.Sc. (Melb), A.A.I.M.M., Member of Geological Society of Australia - Exploration Manager, Petroleum Geologist and Geophysicist

Mr. Glazebrook acts as Exploration Manager and Chief Petroleum Geologist for the Zanex-Oil & Minerals Quest Group of associated companies. He obtained his B.Sc. (Geology and Geophysics) at Melbourne University in 1963, and since that time has worked continuously as a geologist in both the petroleum and mining industries. Between 1963 and 1970 he was employed by Core Laboratories Incorporated, initially as a Geological Engineer and subsequently as a Consulting Petroleum Geologist. His initial employment was within Australia and New Zealand and included work in Queensland (Surat, Adavale, and Gallilee Basins), Victoria (Gippsland Basin), Northern Territory (Amadeus Basin), and Western

Australia (Carnarvon and Canning Basins), where he specialised in well-site geology, basin studies, petroleum engineering, and core analysis. In 1966 he was transferred by Core to their North Sea operations and carried out assignments in West Africa and the Persian Gulf.

On returning to Australia, he was engaged as Senior Geologist in Australia for Austin-Anderson (Aust) Pty. Ltd. In 1973 he established his own consulting business, General Geological Services, specialising in stratigraphic, structural and sedimentary studies for minerals, coal, and petroleum and has carried out investigations for clients throughout Australia and the South Pacific. Since 1978 he has been acting as Chief Petroleum Geologist and Exploration Manager for the Zarex-OMQ Energy Resource Group.

Other consultants engaged by General Geological Services and available to the Consortium include the following:

DR. A.G. LINK, M.Sc. (Melb), Ph.D (A.N.U.), M.A.A.P.G., M.A.I.M.M. - Petroleum Geologist, Seismic Stratigrapher, and Depositional Analyst

Dr. Link graduated with M.Sc. in 1965, and specialising in sedimentology, took out a Ph.D. in 1970. Since that time he has specialised in Depositional Systems Analysis.

As seismic interpretation provides such a useful insight into sedimentary disposition in sedimentary basins, Dr. Link has concentrated on interpretation techniques and methods with particular emphasis on the Gippsland, Bass and Otway Basins of Victoria.

Dr. Link has consented to work for General Geological Services in a consulting capacity in stratigraphic evaluation and structural analysis.

DR. P.G. LADD, B.Sc.(Hons), Ph.D (Botany) - Paynologist

Dr. Ladd obtained his B.Sc.(Hons) in Geology at Melbourne University in 1971 and followed this with a degree of Doctor of Philosophy (Botany) also at Melbourne University in 1977.

Dr. Ladd has carried out considerable research into both Tertiary Micro-fossils and Pollen Morphology, which has made him familiar with the pollen sequences for the Otway, Bass and Gippsland Basins of Southern Australia in particular. This research and present lecture studies are in fact oriented towards the interpretation of fossil pollen sequences in terms of paleo-environments which have proved invaluable in the stratigraphic correlation of sedimentary units in the search for petroleum in the Southern Basins. Dr. Ladd has written and published several papers on pollen studies as allied to stratigraphic interpretation and paleoenvironments and his assistance and advice will greatly aid in the evaluation of seismic sequence studies and stratigraphic analyses planned for hydrocarbon investigation.

Dr. Ladd has agreed to act as a Consultant to the Consortium on an "as needed" basis.

B.R. MOORE, M.Sc., Ph.D. - Senior Geological Consultant

Professor Moore has been involved in geological studies and exploration investigation continuously since graduating from Melbourne University in 1952. At present he is the Associate Professor of Geological and Exploration Studies at the University of Kentucky, USA, where he has specialised in sedimentary ore body evaluation and written over fifty major publications. For the past 13 years he has acted as a Consultant to the mining and petroleum industries for such companies as Waranda, Union Carbide and the Mineral Resources Group.

At present he is engaged in the evaluation of oil shale deposits both in the USA and South America. Professor Moore has consented to act as a Consultant to the Consortium on an "as needed" basis.

W.T. WELLS, Jnr., B.Sc. (Pet. Eng.) Texas, S.E.P. Stanford - Petroleum Engineer

Mr. Wells has had extensive experience within the United States of America, Middle East, South-east Asia and Australia in Petroleum Engineering. For

20 years he worked for Tenneco Oil Company, firstly as Area Engineer responsible for performance of general petroleum engineering, then as Chief Engineer responsible for reservoir engineering, data compilation, field evaluation and testing. Mr. Wells became Vice President of Tenneco in 1968 and held that position until 1972 when he came to Australia as Managing Director for the International Oil Company Group. During the period 1972/1976, Mr. Wells directed the activities of the group and, in particular, the production operations of the Moonie and Alton fields.

R. GLENIE, A.R.M.T.C. Geology (Melb), F.R.M.I.T. Geology by Research (Melb), Member of Geological Society of Australia, Member of P.E.S.A. - Stratigrapher, Sedimentologist, and Energy Resource Analyst

Mr. Glenie has acquired a wide experience in sedimentary basin studies over many years since initial graduation in 1956. He commenced with the Victorian Department of Minerals and Energy, with which he worked from 1957 to 1970 carrying out geological surveys, supervising drilling projects, and contributing technical reports and maps.

During 1968 Mr. Glenie was engaged by the United Nations Organization as Hydrogeological Adviser to the Indonesian Government. From 1970 - 971, as a Senior Geologist for Austin-Anderson (Aust) Pty. Ltd., Mr. Glenie carried out mineral exploration throughout Australia and the Southwest Pacific. From 1971 - 1973, as a Senior Consultant with Australian Groundwater Consultants Pty. Ltd., he was involved with groundwater investigations and sedimentary basin studies both in Australia and Indonesia. Since 1973 Mr. Glenie has conducted his own consulting geological practice specialising in stratigraphic analyses and sedimentary studies for groundwater, coal and hydrocarbons. During this time he has carried out investigations for clients throughout Australia and also in Southern Africa and the Middle East.

Following closely developments within any prospect, additional consultants, junior geological, geophysical and other technical staff will be appointed to the Company's support team or to General Geological Services.

APPENDIX 4

LITERATURE EXTRACTS

Part V.

The Total Coal Reserves and their Exploitation.

Chapter I.

THE TOTAL AMOUNT OF COAL AVAILABLE.

Although coal-mining commenced during the early years of colonisation in Tasmania the systematic geological survey of the fields was long neglected, and it was owing to the future bright industrial outlook that a detailed survey was instituted. Even yet the investigation of the coalfields has not been thorough, and the data relating to the more remote fields is too scanty to enable an estimate of the actual amount of the coal reserves to be made. However, reconnaissance surveys afford data for a fairly accurate conception of the geology of these outlying coalfields, and serve as a basis from which to calculate the probable amount of coal in them. The detailed examination of the main fields has afforded sufficient data for accurate calculations of the coal reserve.

(1) THE TONNAGE AVAILABLE FOR PAYABLE EXTRACTION ACCORDING TO THE INDUSTRIAL AND ECONOMIC CONDITIONS IN THE RESPECTIVE FIELDS.

The present commercial value of the coals of this State varies according to age. Thus, the oldest (Permo-Carboniferous) is of much greater value for general use than the youngest (Tertiary). Accordingly, under like conditions a thin seam of Permo-Carboniferous coal can be profitably mined, where a much thicker seam of Tertiary coal would prove unprofitable.

Under present economic conditions it is held that the critical thickness of coal below which it cannot be extracted at a profit for the several classes of coal are—

	Inches.
Permo-Carboniferous—	
Humic-kerogenites	12
Pelionite and torbanite	8
Trias-Jura—	
Sub-anthracite and non-caking humic	30
Tertiary—	
Lignite and brown coal	48

Many other factors, such as facilities for transport, remoteness from markets, &c., enter into the calculation, but in general the conditions do not vary much. A particular advantage possessed by one coalfield is offset largely by the advantages on other fields.

Unfortunately there are insufficient data available relating to the Tertiary coals to enable even an approximate estimate to be made. Tertiary coal basins are found in all quarters of the island, and some are extensive, and contain seams of workable thickness, but at present there is no local market for this coal as a fuel.

The details of the quantity of coal available under existing conditions for industrial purposes is given in the subjoined table:

TABLE II.—COAL RESERVES BASED ON EXISTING ECONOMIC CONDITIONS.

Coalfield.	Coal Seams.		Extent, Quantity, and Quality of Coal available for Profitable Extraction under present Economic Conditions.		
	No. of Seams.	Aggregate Thickness.	Area in Acres.	Class.	Metric Tons.
		ft.			
Mt. Nicholas	2	9	4300	Non-caking humic	55,728,000
Fingal	3	11	1706	" "	27,050,000
Dalmayne	3	15	700	" "	15,120,000
Douglas River	1	4	460	" "	2,208,000
Mt. Paul	1	6	640	" "	4,700,000
Denison River	1	2	450	" "	1,080,000
York Plains	1	3	40	" "	144,000
Colebrook	2	4·75	250	" "	1,425,000
Avoca	4	18	160	" "	2,498,000
Catamaran	2	7	230	" "	1,110,000
Sandfly	6	17	800	Sub-anthracite and non-caking humic	6,300,000
Cygnet	2	3·9	280	" "	716,000
Lawrenny	4	10	250	Non-caking humic	2,740,000
Mersey	1	1·8	450	Humic-kerogenite	136,000
Longford	2	7	45	Non-caking humic	150,000
Buckland	3	9	40	" "	288,000
Preolenna	4	6·5	760	Kerogenite and humic-kerogenite	5,000,000
Barn Bluff	2	2·75	5000	Humic-kerogenite & non-caking humic	9,000,000
		Total			134,398,000

(2)—THE COAL RESERVE, CALCULATED AND CLASSIFIED ON THE BASIS LAID DOWN BY THE INTERNATIONAL GEOLOGICAL CONGRESS.

In the scheme of coal classification adopted by the International Geological Congress, held in Canada in 1913 for the purposes of compiling statistics as to the coal resources of the world, coal seams were divided into two groups:—

Group 1 included seams of 1 foot or over to a depth of 4000 feet.

Group 2 included seams 2 feet and over, between depths of 4000 and 6000 feet.

All of the Tasmanian occurrences come within Group 1. In order, therefore, to make the information in this publication complete, the estimation of the coal reserves has been made in accordance with the International Geological Congress scheme. Comparison is thus possible on common ground with the coal resources of other parts of the world. Full particulars of the scheme of classification can be obtained in the "Coal Resources of the World" publication, Volume I.

The reserve is divided up into three divisions:—

Actual Reserve—Calculation based on actual thickness and extent.

Probable Reserve—Approximate estimate.

Possible Reserve—Which includes general indications of further deposits of coal on geological evidence, with no data available for calculation of actual tonnage.

The class of coal indicated in the statement of coal reserves on this basis in the following table is that of the International Geological Congress scheme, full particulars of which will be found in the abovementioned publication.

TABLE III.—COAL RESERVES BASED ON SCHEME ADOPTED BY INTERNATIONAL GEOLOGICAL CONGRESS FOR CALCULATING THE COAL RESOURCES OF THE WORLD.

District.	Coal Seams.		Actual Reserve. (Calculation based on actual thickness and extent.)			Probable Reserve. (Approximate Estimate.)			Possible Reserve.
	No. of Seam.	Aggregate Thickness.	Area in Acres.	Class.	Metric Tons.	Area Acres.	Class.	Metric Tons.	
		ft.							
Mt. Nicholas	2 3 3	9 7 ...	1300	B2	55,728,000	4300	B2	43,344,000	Fairly large
Fingal	3 5	11 ...	1700	B2	27,050,000	...	...	...	Large
Dalmayne ...	3 1 4	15 5 ...	700	B2	15,120,000	500	B2	3,600,000	Fairly large
Seymour	1	2·5	...	...	...	1500	B2	4,000,000	...
Douglas R.	2 5	6 ...	460	B2	3,200,000	...	...	...	Small
Denison R.	3 4	5·5 ...	450	B2	2,500,000	...	...	...	Fair
St. Albans ...	7	...	...	...	...	...	...	...	Fairly large
Steep Creek	2 6	3·5 ...	500	B2	2,000,000	...	...	...	Fairly large
Fosbrooks ...	1 4	1·7 ...	60	B2	120,000	...	...	...	Medium
Mt. Paul......	1 3	6 ...	640	B2	4,700,000	...	...	...	Fairly large
Schouten I.	...	...	...	...	...	...	...	...	Small
Triabunna ...	...	...	...	...	...	...	...	...	Small
York Plains	2	7	40	B2	144,000	40	B2	192,000	...
Mike Howe's Marsh......	1	3·5	...	...	...	640	B2	2,688,000	...
Colebrook....	2	4·75	250	B2	1,425,000	640	B2	3,648,000	...
Richmond....	1	4	...	...	...	...	...	...	Not large
Brewer's Valley	1	1·25	...	...	...	...	...	...	Not large
Native Corners.........	1	0·75	...	...	...	...	...	...	Not large
Kempton-Bagdad	1	1·80	...	...	...	...	...	...	Not large
Lawrenny	4	10	250	B2	2,740,000	250	B2	14,123,000	Not large
Plenty.........	1	1·5	200	...	...	200	B2	360,000	Small
Macquarie Plains......	1	1·2	...	...	...	...	...	...	Not large
New Town ...	4	6	300	...	200,000	...	...	700,000	Small
Sandfly	6	17	800	A2 & B2	5,900,000	1000	A2 & B2	16,200,000	Not large
Cygnet	2	3·9	280	A2	715,000	190	A2	400,000	Not large
Strathblane ..	1	3	110	B2	306,000	700	B2	1,062,000	...
Hastings......	2	5	60	B2	360,000	80	B2	480,000	...
Catamaran ...	1	3·6	60	B2	360,000	1200	B2	4,000,000	Fairly large
Ida Bay	2	6	...	...	...	60	B2	432,000	Small
Lune River...	3	9	...	...	...	100	B2	1,080,000	Small
Merrywood..	1	6	40	B2	288,000	200	B2	1,410,000	Large
Lewis Hill ..	3	10	...	...	...	200	B2	2,100,000	Not large
Buena Vista..	4	18	100	B2	2,160,000	300	B2	7,480,000	Large
Mt. Christie..	4	18	20	B2	50,000	60	B2	720,000	...
Longford......	2	7	...	...	...	250	B2	900,000	Large
Mersey	1	1·8	450	C	136,000	950	C	300,000	Not large
Buckland ...	3	9	40	B3	288,000	120	B3	804,000	...
Preolenna ...	4	6·5	...	...	...	760	C	6,000,000	Fairly large
Barn Bluff-Pelion	1	2	...	...	...	3200	B2	7,600,000	Large
Totals	...	...	...	...	124,980,000	...	...	123,013,000	

Part VI.

The Commercial Value of the Coal and its Industrial Applications.

Chapter I.

THE ASH CONTENT—ITS AMOUNT, CHARACTER, FUSING-POINT, AND THE EXTENT TO WHICH IT CAN BE ELIMINATED.

(1) Amount and Character of Ash.

In general, Tasmanian coals as delivered to market, contain a large proportion of ash, compared with the higher-grade coals of New South Wales. The ash content ranges from 10 to 25 per cent. The amount of ash in commercial coal depends largely on the character of the roof and floor, and the number and thickness of the partings and binders in the seam.

In some mines the coal seams are contained in shale, a considerable amount of which breaks with the coal in mining, and reduces its market value. Where the overlying shale is thin and fissile, and has to be removed to reach the sandstone roof, it is very difficult to keep it separate. With very few exceptions Tasmanian coal seams contain partings and binders of shale, clay, and sandstone, a certain amount of which inevitably finds its way into the coal product. This is especially the case with seams containing thin, soft partings of clay or shale, and hard adherent binders of black carbonaceous sandstone. In addition to these sedimentary impurities, thin veinlets and films of calcite, pyrite, silica, and kaolin, have been deposited from solution on the walls of joints and cracks. This increases the quantity of intrinsic ash considerably.

(2) Extent to which Ash Can be Eliminated.

Exhaustive washing tests were carried out last year on samples of Tasmanian coal, to determine to what extent the ash could be eliminated by washing.

Parcels of five tons each of Mt. Nicholas, Cornwall, Dalmayne, Fingal, and Preolenna coals were sent to the Purified Coal and Coke Company's coal-washing plant at Jesmond, near Newcastle, New South Wales.

The tests were carried out under the supervision of H. G. W. Keid, Assistant Government Geologist.

The plant, which has a capacity of 180 tons of coal per day of eight hours, is arranged in four sections, as follows:—jaw-breakers, rollers, bashers or washers, and pulverisers.

The coal was crushed to, approximately, 3-inch size by jaw-breakers, and carried by a belt-conveyor to a bin at the rollers. It was then lifted by an elevator to the rollers, and crushed to about 1½-inch size. The coal, lifted by another elevator above the level of the washer, was fed into a series of four washers. The races were so designed that the coal entered the back of the washer and passed over the front. The surface measurements of the washer were 6 feet by 3 feet. The upper portion was in the form of a box about 5 feet deep. Under it a tapered hopper was affixed to collect powdered coal, which might pass through the sieve. The latter had six holes to the linear inch, and was placed 15 inches from the top of the washer. The coal was fed on to this sieve. A plate 6 inches high was fastened on each of three sides at the top to prevent the coal overflowing in all directions. The coal after being washed passed over the front, and rotating arms pushed it into the race, which extended along the front of the washer to the drying appliances.

Directly above the sieve on the front of the washer a 3-inch slot was provided for the escape of the waste material, which passed from the sieve into a closed chamber. A screw operating in this chamber collected the waste and delivered it to a bin from which it was removed when necessary.

The coal, which entered the washer at the back, and gradually worked its way to the front as the result of the flow of water, and the pulsations produced by a piston 18 inches diameter, with a 12-inch stroke operating in a cylinder, is separated according to the specific gravity of the pieces.

From the bottom of the cylinder a pipe 16 inches in diameter connected with the washer through the back and directly below the sieve. The flow of water was maintained by having the supply tank 20 feet above the general level of the plant The water, after passing through the process, was returned to the tank by means of an 8-inch centrifugal pump. The fact that the pipe from the cylinder entered the washer below the sieve ensured the agitation of the whole of the coal in the washer. In this plant the pulsations were regulated to, approximately, 150 per minute.

From the front of the washer the coal was carried in a stream of water to the drying appliances, which were simple in character, and were made in four sections, each approximating 12 feet in length. Each section was in the form of an open race, about 15 inches deep. At 9 inches from the top perforated copper plating was placed to form a false bottom, and the coal was washed on to it. In a short distance most of the water had passed through the plating, and then the coal was pushed along from one section of the drying plant to the next by a series of paddles attached to endless chains. After passing over the four sections of the drier the samples were found to be completely dry. From the end of the drier the coal dropped into a storage bin.

The coal used in these washing tests was sampled at the company's works under H. G. W. Keid's supervision, both before and after treatment.

It was estimated by the manager that thirteen pence would cover the cost of washing each ton of coal delivered to the plant. The cost of the latter was several thousands of pounds.

The average reduction in the ash content, as shown in the accompanying table of analyses (page 253), indicates that the gain in quality when these coals are crushed to, approximately, 1½-inch size is not sufficient to warrant the erection of a washing plant of this type.

W. E. Lawrie, of the Blackheath Colliery, Queensland, has recently designed a coal washer capable of treating 20 tons of coal per hour. It is estimated that the plant will cost £640.

The amount of ash in the ordinary run-of-mine coal could be reduced to some extent by rigid supervision underground, and by passing the coal from the mine over a screen (to free it from slack) on to a picking belt, driven at the rate of about 60 feet per minute, so that lumps of shale and shaly coal could be picked out by hand.

(3)—Fusing Point of Ash.

With the exception of the coal from the Preolenna, Hlamatha, and Spreyton Mines, and one lot from Mt. Cygnet, the samples when burned were grey or cream in colour, thus indicating a low percentage of ferric oxide and a high percentage of silica and alumina. The light-coloured ash suggested a high fusion point, and, with the exception of the Catamaran sample, which contained nearly 30 per cent. of lime, this was borne out by the fusibility tests.

The analysis of the ash serves as a guide as to whether it will clinker or not within certain limits. With few exceptions, as indicated in the accompanying table, the coal ash examined in the typical samples showed an exceptionally high fusion point; hence these ashes will not readily form clinker.

It is interesting to note the difference in the melting points of samples 478 and 482, both from Mt. Cygnet. The latter sample contains a high percentage of ferric oxide, and is more fusible.

TABLE V.—ANALYSES OF COAL BEFORE AND AFTER WASHING TESTS.

Mine.	Reg. No.	Moisture at 105° C.	Volatile Combustible Matter.	Fixed Carbon.	Ash.	Sulphur.
Mt. Nicholas, before washing	725	4·42	25·12	48·12	22·34	0·44
Mt. Nicholas, after washing ...	726	4·40	26·90	50·70	18·00	0·40
Fingal, before washing	727	2·82	22·30	54·84	20·04	0·37
Fingal, after washing	728	3·60	23·86	56·87	15·67	0·37
Preolenna, before washing......	757	1·52	32·46	52·30	13·72	5·87
Preolenna, after washing	758	1·56	33·82	54·94	9·68	3·38
Dalmayne, before washing......	759	3·14	20·42	54·34	22·10	0·44
Dalmayne, after washing	760	2·68	23·32	55·24	18·76	0·44
Cornwall, before washing	761	3·50	23·30	55·62	17·58	0·41
Cornwall, after washing.........	762	3·18	24·34	58·20	14·28	0·38

TABLE VI.—TESTS OF FUSIBILITY OF COAL ASH.

Mine.	Reg. No.	Degrees Centigrade.	Remarks.
Cardiff	322	1980	No softening
Jubilee	325	2000	Fused
Bruny Island	114	1950	No softening
Fingal	494	1700	Fused
York Plains...........................	520	1880	Fused
Dalmayne	412	1980	No softening
Dalmayne	415	2000	No softening
Douglas River............	417	2000	No softening
Douglas River........................	418	2100	No softening
Denison River........................	419	1950	No softening
Hastings	428	2000	No softening
Strathblane	429	2100	Fused
Sandfly	434	2000	No softening
Sandfly	438	1700	Fused
Catamaran	464	1660	Fused
Mt. Cygnet	478	2000	Fused
Tasman Peninsula	481	2000	No softening
Buckland	494	1980	No softening
Seymour	624	1950	No softening
Mt. Nicholas	628	1980	Fused
Cornwall	629	1960	No softening
Mt. Christie..........................	688	2000	No softening
Merrywood	693	1940	No softening
Mt. Paul	746	1960	No softening
Illamatha	152	1630	Fused
Spreyton	153	1960	Fused
Preolenna.............................	757	1940	Fused
Mt Cygnet	482	1880	Fused

TABLE VII.—COAL ASH ANALYSES.

Reg. No.	Colour of Ash	Silica, SiO_2	Ferric Oxide, Fe_2O_3	Alumina, Al_2O_3	Manganese Oxide, MnO	Lime, CaO	Magnesia, MgO	Sulphur Trioxide, SO_3	Potash, K_2O	Soda, Na_2O	Vanadium, V	Name of Mine or Locality.
319	Cream	58·70	3·83	35.97	...	1·06	0·72	...	...	...	...	Cardiff
320	Cream	56·56	4·18	37·52	...	1·19	0·72	...	...	...	...	Cardiff
321	Cream	66·16	3·32	29·18	...	0·69	0·94	...	...	...	...	Cardiff
322	Cream	60·80	3·11	34·44	...	0·94	0·80	...	...	...	...	Cardiff
323	Cream	56·16	3·65	39·35	...	0·65	0·72	...	...	...	...	Jubilee
324	Cream	65·20	3·72	29·38	...	0·65	1·21	...	...	...	...	Jubilee
325	Cream	60·30	3·79	35·11	...	0·65	0·50	...	...	...	...	Jubilee
386	Cream	63·60	6·13	25·87	...	1·55	2·18	0·85	...	...	...	Silkstone
492	Cream	57·20	6·61	31·10	0·37	2·58	2·10	0·40	...	...	...	Fingal
493	Cream	50·60	3·52	30·44	0·37	10·55	1·45	3·05	...	...	...	Fingal
494	Dark-cream	50·32	3·43	23·49	1·30	17·00	1·55	3·05	...	...	...	Fingal
495	Cream	63·08	3·10	30·90	0·37	1·55	1·45	Trace	...	...	...	Fingal
513	Buff-red	59·88	15·41	21·07	...	1·18	2·68	0·17	...	...	...	Fingal
519	Dark-cream	44·60	5·07	28·33	0·56	16·38	2·10	3·05	...	...	...	York Plains
520	Dark-cream	43·04	4·79	28·48	0·93	17·25	1·80	3·98	...	...	...	York Plains
114	Light-buff	57·28	5·86	34·44	...	0·55	1·45	0·27	...	...	...	Bruny Island
411	Cream	55·56	4·06	38·91	...	1·27	0·43	...	...	...	...	Dalmayne
412	White	57·80	2·80	38·80	...	0·78	0·14	...	...	...	...	Dalmayne
413	White	56·40	2·80	39·80	...	1·12	0·14	...	...	...	...	Dalmayne
414	Dark-cream	60·40	2·86	35·14	...	0·95	0·72	0·20	...	...	...	Dalmayne
415	Dark-cream	59·80	4·50	33·80	...	1·20	0·72	0·20	...	...	...	Dalmayne
416	Cream	60·16	5·00	33·40	...	1·00	0·41	0·27	...	...	...	Steep Creek
417	Cream	61·60	3·93	33·27	...	0·60	0·58	0·20	...	...	...	Douglas River
418	Dark-cream	73·96	2·36	22·64	...	0·53	0·72	0·13	...	...	...	Douglas River
419	Dark-cream	68·60	4·29	25·31	0·48	0·80	0·26	0·20	...	...	...	Douglas River
427	White	72·40	3·13	22·17	...	0·80	1·09	0·17	...	...	...	Hastings
428	Cream	64·64	2·29	31·87	...	0·72	0·69	...	...	...	...	Hastings
429	Dark-cream	66·84	4·43	25·77	...	1·30	1·69	...	...	...	...	Strathblane
430	White	57·72	1·57	39·43	...	1·00	0·50	...	...	...	...	Catamaran
433	Light-buff	44·64	8·15	34·85	0·67	8·60	2·98	...	...	...	...	Sandfly
434	Light-buff	55·28	5·13	32·47	...	4·35	1·08	1·89	...	...	...	Sandfly
435	Cream	52·80	4·80	29·08	0·56	8·28	1·45	2·74	...	...	...	Sandfly
436	Cream	46·08	3·72	30·16	0·45	13·85	1·16	4·39	...	...	...	Sandfly
437	Cream	45·76	2·57	29·43	0·74	16·60	1·59	3·67	...	...	...	Sandfly
438	Light-buff	52·88	6·72	32·86	0·55	4·55	2·10	0·62	...	...	...	Sandfly
439	Grey	58·44	2·57	34·43	0·22	3·38	1·00	0·20	...	...	...	Sandfly
440	Dark-cream	60·00	5·45	27·37	0·74	2·85	2·39	1·47	...	...	...	Sandfly
441	Cream	52·20	2·86	36·94	Trace	4·60	1·45	1·92	...	...	...	Sandfly
442	Yellow	55·84	5·00	34·00	0·29	3·55	1·59	0·10	...	...	...	Sandfly
443	Buff-red	56·52	8·86	24·14	...	7·10	2·17	1·61	...	...	...	Sandfly
444	Cream	57·28	5·21	32·79	...	2·85	1·95	0·31	...	...	...	Sandfly
445	Cream	47·18	3·00	28·20	0·55	14·25	2·03	3·36	1·18	0·10	...	Sandfly
465	Light-brown	59·08	5·68	21·17	1·30	28·02	0·79	3·53	...	...	...	Catamaran
478	Dark-cream	72·30	7·29	11·51	0·54	5·40	0·38	2·68	...	...	...	Mt. Cygnet
479	Buff-red	59·60	13·00	24·52	...	1·05	1·73	0·34	...	...	...	Mt. Cygnet
480	Dark-cream	66·10	10·15	21·09	...	0·95	1·65	0·34	...	...	...	Mt. Cygnet
481	Cream	57·08	4·29	34·07	0·54	2·48	1·08	0·58	...	...	...	Tasman Peninsula
482	Dark-red	40·84	34·43	21·77	...	0·86	2·53	Trace	...	...	...	Cygnet
494 B	Dark-cream	50·92	5·93	35·63	...	4·25	2·89	0·75	...	...	...	Buckland
495	Cream	58·16	2·46	28·76	...	8·49	1·23	1·30	...	...	...	Buckland
496	Cream	59·76	7·43	25·33	0·37	1·45	1·45	0·55	2·41	1·40	...	Mountain River
497	Buff-red	40·40	26·31	29·93	0·55	0·80	0·72	0·27	0·04	0·97	...	Buckland
498	Light-buff	49·40	6·29	38·87	...	3·05	1·08	1·33	...	...	...	Buckland
499	Grey	51·60	4·57	39·63	0·44	2·55	0·29	1·03	...	...	...	Buckland
512	Cream	56·88	2·71	37·29	0·55	1·30	1·00	0·48	...	...	...	Buckland
517	Cream	48·60	3·94	28·86	0·56	13·28	0·80	1·23	1·20	1·38	...	Bagdad
624	White	60·72	2·57	35·43	...	0·60	0·94	0·06	...	...	...	Seymour
625	Cream	61·08	2·15	35·65	...	0·59	1·00	0·06	...	...	...	Seymour
626	White	58·00	2·53	37·47	...	0·70	0·94	0·24	...	...	...	Seymour
627	Light-buff	59·76	5·00	31·80	...	2·00	1·24	0·27	...	...	...	Mt. Nicholas
628	Light-buff	53·92	5·29	32·71	...	5·64	1·08	1·57	...	...	...	Mt. Nicholas
629	Cream	54·76	4·43	39·77	0·37	0·65	0·22	...	...	...	...	Cornwall
630	Cream	53·26	3·72	38·28	...	3·52	0·51	0·96	...	...	...	Cornwall
516	Dark-cream	53·48	5·86	21·74	0·74	13·30	3·11	1·96	...	...	...	Colebrook
684	Dark-cream	62·80	5·00	29·60	...	1·20	1·45	0·10	...	...	...	Mt. Christie
685	Cream	63·76	4·86	28·22	0·56	1·20	1·45	0·21	...	...	...	Mt. Christie
686	Light-buff	52·56	5·00	22·60	...	12·35	3·84	4·10	...	...	...	Mt. Christie
687	Cream	50·60	5·43	30·17	...	7·55	3·60	2·68	...	...	...	Mt. Christie
688	Cream	58·32	2·79	37·41	Trace	0·65	1·09	0·08	...	...	...	Mt. Christie
689	Cream	56·56	2·70	39·30	...	0·80	0·58	0·31	...	...	...	Mt. Christie
690	Cream	54·80	2·43	41·37	...	0·75	0·72	0·21	...	...	...	Mt. Christie
691	Cream	56·20	3·72	36·28	...	2·20	1·45	0·51	...	...	...	Brambletye
692	Cream	56·80	2·58	37·02	...	2·25	0·50	1·27	...	...	...	Ben Lomond
693	Cream	65·48	3·79	29·21	Trace	0·75	1·00	0·15	...	...	...	Merrywood
745	Cream	61·10	2·86	31·14	...	0·45	0·87	0·35	2·16	0·71	...	Mt. Paul
746	White	56·04	2·86	36·14	0·55	2·50	1·01	1·13	...	...	...	Mt. Paul
152	Dark-red	26·24	49·00	17·96	0·54	3·78	0·58	1·99	...	...	...	Illamatha
153	Dark-red	31·20	46·17	16·79	0·54	3·43	0·54	1·58	...	...	...	Spreyton
725	Dark-cream	61·88	5·00	30·24	...	1·90	1·12	...	...	...	...	Nicholas, before washing
726	Dark-cream	59·76	6·44	31·76	...	1·30	0·90	...	...	...	...	Nicholas, after washing
727	Cream	49·60	3·28	28·72	0·56	13·90	1·05	2·91	...	...	...	Fingal, before washing
728	Cream	48·80	4·15	30·85	0·56	11·00	1·05	3·77	...	...	...	Fingal, after washing
757	Dark-red	34·10	44·62	19·18	...	1·30	0·58	0·17	...	...	...	Preolenna, before washing
758	Dark-red	36·72	30·30	27·42	...	4·80	0·58	0·50	...	...	...	Preolenna, after washing
759	Cream	57·20	3·58	37·22	...	1·45	0·43	0·17	...	...	...	Dalmayne, before washing
760	Cream	58·08	4·29	35·31	...	1·70	0·58	0·36	...	...	...	Dalmayne, after washing
761	Dark-cream	54·80	4·43	39·57	...	0·65	0·50	0·13	...	...	...	Cornwall, before washing
762	Dark-cream	54·24	5·00	39·20	...	0·80	0·72	0·15	...	...	...	Cornwall, after washing

Chapter II.

THE SULPHUR CONTENT, AND ITS EFFECT ON THE INDUSTRIAL VALUE OF THE VARIOUS COALS.

The amount of sulphur in Tasmanian coals varies within limits according to the age. Thus, Tertiary lignites and brown coals contain very little sulphur, the Trias-Jura black coals from 0·5 to 2·5, and the Permo-Carboniferous from 1·5 to 6 per cent. The sulphur content of Trias-Jura coals seldom exceeds 0·75 per cent., and the Permo-Carboniferous is usually in excess of 3 per cent.

The sulphur is either disseminated through the body of the coal, or occurs in the form of nodules, bunches, veinlets, lenses, and thin films between the layers. It is usually found in combination with iron as pyrite and marcasite, and rarely as arsenopyrite. Free sulphur is very uncommon.

A considerable reduction in the sulphur content of Permo-Carboniferous coals can be effected by picking, screening, and washing. Lump pyrite can be removed by hand, and as the larger portion occurs in the form of veinlets of loosely aggregated crystals only slightly adherent to the coal surfaces a very considerable amount goes into the slack, and is separated by screening. Further treatment of the slack coal in washing machines results in another marketable product.

In addition to its effect as a diluent of the highly combustible materials of the coal, it has an injurious effect in the application of the coal to industrial uses. In furnaces the sulphur liberated from the iron by oxidation, attacks the firebars, flues, and tubes. Minute films of pyrite between laminæ give rise to violent decrepitation on heating, and render the coal unsuitable for domestic use, because of this "spitting," as it is termed.

Chapter III.

THE HEATING VALUE OF TASMANIAN COALS AS COMPARED WITH STANDARD COALS.

The heating or calorific value of Tasmanian coals has been dealt with in Part III., Chapter III., and Table I., presented in that part of the publication, gives full detailed information.

It is desirable, however, to determine how the calorific value of Tasmanian coals compares with other well-known coals, and particularly with the coals produced in the Pacific. To enable such a comparison to be made, Table VIII. has been prepared, and is presented herewith.

This table shows that in comparison with the coals of India and South Africa, the average of the Tasmanian coals compares quite favourably. The calorific value of New South Wales coals is somewhat higher, running up to 12,000 b.t.u., as compared with the 10,000 of our Tasmanian coals. It must be remembered that the calorific value of 10,000, which is the average of our Tasmanian coals, is quite a good one, and undoubtedly makes it valuable for steam-raising in the manner discussed in Chapter IV., Part VI.

It must be recognised, however, that our Tasmanian coal cannot compare, on the average with that of Japanese coals, the Pennsylvanian anthracites of the United States, the British Columbia coals, or the Paparoa coals of New Zealand. These coals are amongst the best steam coals in the world, exceeding, as some of them do, the best steam coals of Great Britain, which are also shown in Table VIII.

Although our Tasmanian coals are on a somewhat lower plane than these, yet it must be recognised that they have a distinct value for steam-raising, averaging, as they do, a calorific value of over 10,000 b.t.u. Table VIII. is designed to show this relative utility quite plainly.

TABLE VIII.—THE HEATING VALUE OF TASMANIAN COALS AS COMPARED WITH STANDARD COALS.

Country.	Moisture.	Volatile Hydro-Carbons.	Fixed Carbon.	Ash.	Sulphur.	Evaporative Power.	Calorific Value.	
							Calories.	B.T.U.
India	2·56	28·17	55·81	13·49	0·68	11·94	6547	11,734
Pennsylvania (Anthracite)	3·04	4·74	83·20	8·98	0·91	13·50	7431	13,375
Illinois	9·78	31·67	48·39	10·19	2·66	11·80	6463	11,634
Japan (Chikubo Field)	4·21	42·92	45·71	7·33	0·68	13·40	7205	12,965
British Columbia (Crow's Nest)	0·90	24·60	64·20	11·20	...	13·85	7444	13,400
Vancouver Island ...	1·53	39·46	47·53	10·60	0·86	13·26	7123	12,820
New Zealand (Paparoa Range)	0·67	33·53	62·90	2·90	0·33	15·71	8443	15,197
New South Wales (Newcastle)	2·11	36·43	53·86	7·77	0·45	12·80	6873	12,377
New South Wales (South Coast)......	0·16	23·25	63·57	12·46	0·48	11·80	6336	11,410
South Africa (Transvaal)	2·22	25·83	57·19	14·76	0·53	12·07	6481	11,297
Britain (Newcastle)	1·50	33·31	59·40	4·23	1·56	14·35	7700	13,860
Britain (South Wales, Anthracite)	0·70	11·76	85·57	2·00	0·52	13·93	7480	13,464
Tasmania	4·36	21·27	51·84	22·64	0·60	10·49	5636	10,145

Chapter IV.

APPLICABILITY TO STEAM-RAISING.

Coals from the several fields have been tested under varying conditions for steam-raising. Tests have been made of the coal from nearly all the Mesozoic fields with fairly satisfactory results on steamers, railway, and stationary engines. The conditions under which the experiments were carried out were not suitable, and much better results would have been obtained had certain modifications in the boilers been made. The chief objection to the use of this coal is the large quantity of ash it contains compared with Newcastle. By the adoption of the rocking grate, designed by W. R. Deeble, of the Railway Department, in place of the fixed bar grate in general use, the difficulty in stoking can be obviated to a considerable extent. Another serious objection to its more general use is the "dead" weight it represents in carriage over long distances. This last disability has little significance in Tasmania, where the longest haul does not exceed 140 miles.

Tests of the Dalmayne coal were made on the St. Marys-Conara railway, in the presence of the writer, by Mr. R. L. Jack, and Dr. W. A. Hargreaves, on behalf of the South Australian Government.

On this line Tasmanian coal is used exclusively; on other lines various mixtures with Newcastle coal are used, ranging from 1 to 1 to 1 to 3.

The engine used (C + 4, 1890) had a heating surface of 755·3 square feet, and was of the following dimensions:—

> Grate area, 13·24 square feet.
> Cylinders, 15 inches by 20 inches.
> Class 4.6.0.
> Diameter of driving wheels, 39 inches.
> Weight of engine in working order, 27 tons 15 cwt. 2 qr
> Weight of tender in working order, 21 tons 7 cwt.

The run between St. Marys and Conara is 46¾ miles, on grades not exceeding 1 in 40. The test was made on the outward journey only, and, in consequence, the results are unsuitable for comparison with tests on other lines, and with other types of engines.

The maximum load drawn on this journey was 214 tons 11 cwt., and the mean 195 tons 3 cwt., equal to 9124·19 ton miles.

The running time on the trip was 2 hours 24 minutes, and the standing and shunting time 58 minutes. Shunting at Conara occupied 1 hour 40 minutes. On these lines shunting time is considered equal to 5 miles per hour on full load, therefore the additional energy developed in this test amounts to an additional 2517 ton miles.

The coal used weighed 3632 lb., and 680 lb of ash was obtained from the fire-box and smoke-box after burning, the proportion of ash to coal being 18·73 per cent.

Considered from the time of starting to the time of cleaning the engine, coal was consumed at the rate of 54 lb. per square foot of grate area.

Although there were not sufficient data upon which a comparison could be made, the results were in general highly satisfactory.

Steam was maintained at 140 lb. per square inch without difficulty, even on the steep grades, with an occasional drop to 130 lb. pressure. It was noticed that the engine gained steam with the throttle open full on the steep grades, and was generally blowing-off at the safety-valve.

The test proved the great value of this coal for steaming purposes. Although the ash content is high, it does not clinker, and being soft and friable easily passes through the fire-bars. For the use of this class of coal many of the engines are fitted with rocking-bar grates, which, operated by lever, disposes of the accumulated ash without the necessity for the use of the slice. Another advantage in the use of this coal is the comparative freedom from sparks and smoke.

The coal used in this test is typical of that mined throughout the Mt. Nicholas and East Coast fields. There are slight local variations in the physical and chemical properties, but essentially the quality is remarkably similar in all coals of this age (Trias-Jura) in Tasmania.

Steaming tests of the Cornwall, Mt. Nicholas, Lawrenny, and coals from other localities, gave similar results. Catamaran coal is unsurpassed in steaming qualities, but it is tender, and inclined to slack. The much lower percentage of ash in this coal adds to its value, and for this purpose it is equal to the higher grades of Newcastle. For naval use it has proved excellent.

The ash content of Permo-Carboniferous coals is about half that of the Trias-Jura, but whereas the latter contain under 1 per cent. of sulphur, the former contain over 3 and up to 6 per cent. In other respects, the Permo-Carboniferous coals possess all the desired qualities for steam raising.

In 1916 the writer supervised the extraction and testing of Preolenna coal on the Government railway between Preolenna siding and Flowerdale. Unscreened wet coal was used, but the results were highly satisfactory, except in one particular. The high content of sulphur was the only objectionable quality in an otherwise good steaming coal. By mixing this in suitable proportions with Trias-Jura coals an excellent product would be obtained.

Chapter V.

APPLICABILITY TO GAS-MAKING AND COKE-MANUFACTURE.

The physical quality and chemical composition are the chief determining factors in the selection of a coal for the manufacture of gas.

The coal should show the proper percentage of volatile combustible matter and contain a low percentage of sulphur and ash and possess good coking qualities. The Preolenna, Illamatha, Brambletye, and Mountain River coals are suitable for the manufacture of gas, and are the only Tasmanian coals which form good coke.

A sample of Preolenna coal was tested by the Launceston Gas Company in 1902, and the following extract has been taken from the secretary's report(76):—

"The second sample was tested fully for gas and coke, and the average of three very careful tests gave the following very satisfactory results:—Volatile matter, 47·19 per cent.; coke, 52·81 per cent. The coal yielded 12,030 cubic feet of gas per ton and 10 cwt. 2 qr. of excellent coke. I am very pleased to be able to report not only was the quantity of gas per ton greater than that from any other test of coal, either Tasmanian or Newcastle (N.S.W.), made at these works, but the quality was also superior. Tested by the jet photometer (Kirkham and Sugg's patent), the illuminating power of the gas was 20 candles per gas referee's burner, and I have no hesitation in saying that if coal can be supplied in quantity equal to the samples submitted for tests, I should prefer it as a gas coal to any we have yet received from New South Wales."

The lower-grade Tasmanian coals could be utilised in the manufacture of producer gas, a low-grade fuel which can be cheaply produced, and is largely used for the generation of power by means of internal combustion engines.

The coke produced from Tasmanian coals would be as gas coke made by a process to produce the largest yield of gas and considering the coke as of secondary importance only.

In the Preolenna and Illamatha coals there is a high sulphur content in the form of pyrite, but as the latter occurs mostly in aggregations and not disseminated throughout the seams, it would not be difficult to remove the greater part of this impurity by crushing the coal to approximately one-quarter-inch size, and then subjecting it to treatment in a suitable coal-washer.

Washing tests recently carried out in New South Wales on a bulk sample of Preolenna coal crushed to about 1½-inch size reduced the sulphur content from 5·87 to 3·38 per cent. Laboratory washing tests have shown a much better result by crushing the coal to ¼-inch size.

In the manufacture of coke, either in retorts or ovens, only about one-third of the sulphur is expelled with the gases. The remainder is retained by the coke. The Mountain River and Brambletye coals, which produced excellent coke, contain low percentages of sulphur.

The following coals are semi-coking:—Seymour, Mt. Christie, Mt. Paul, and Catamaran.

Laboratory tests have shown that these semi-coking coals, when mixed with varying proportions of Preolenna coal, do not form marketable coke. A semi-coking coal will give a much better coke when carbonised in a retort than in a coke oven, but the result is unsatisfactory in either case.

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(76) The Kerosene Shale at Preolenna, by W. H. Twelvetrees, pages 11-12.

Chapter VI.

VALUE AS A DOMESTIC FUEL.

Both the Trias-Jura and Permo-Carboniferous coals are valuable for domestic use. There is now very little demand for the higher-grade imported coals for this purpose, owing to the prevailing high prices, and soon the comparatively cheap Tasmanian coals will be used exclusively in the local markets.

As might be expected, there is a marked variation in the qualities of the Trias-Jura and Permo-Carboniferous coals. Not only so, but there is a decided change in the several seams of each of these formations, and actually the quality varies from point to point in the same seam. From the above statement it will be seen that there is a wide range of coal available from which a choice can be made to suit the particular requirements of consumers. Of course, there are poor sections of these seams in which the coals are unsuitable for domestic or any other purpose, but such are comparatively small and are common to all coalfields.

The Trias-Jura seams are much thicker than the Permo-Carboniferous; they are more numerous and much more extensive, and consequently they are the more important. At present the greater part of the coal required for local consumption is drawn from the Cornwall, Mt. Nicholas, and Jubilee collieries. In addition to the mines named, good household coals occur at Dalmayne, the Douglas and Denison River country, at Buckland, and elsewhere in the East Coast districts. These are the so-called sub-bituminous coals of commerce. They ignite slowly, burn quietly with little decrepitation, are non-coking and do not intumesce, and they are rather high in ash. The heating value is high, and fires made with this coal in stoves are very hot when there is sufficient natural draft, and it retains heat for a considerable time when the supply of air is cut off. The ash is soft, friable, and free from clinker, and a large portion falls between the fire-bars as it is set free. Most of this coal is carried to Launceston and Hobart, where it is in great demand as a domestic coal.

Coke of fair grade has been made from the Avoca coal, which is also valuable for household purposes, and in some quarters is particularly desired.

Perhaps the best coal of this age is that mined at Catamaran. Besides possessing all the good qualities of the coals from the Eastern and Midland fields, it contains a comparatively low percentage of ash, and should command the highest prices in local markets. It should, however, be handled with care, on account of its tendency to crumble on long exposure to the sun and air.

The Strathblane and Hastings coals differ from the Catamaran in containing a higher percentage of ash and volatile hydrocarbons, with correspondingly lower fixed carbon content. They may be employed with advantage in open grates and stoves, as they ignite easily, burn freely with a long yellow flame, and do not spark.

Two of the eight seams at Sandfly contain coal suitable in every way for household use; the others do not possess the requisite qualities for this purpose. The popularity of the coal from this mine has been impaired somewhat by the inclusion of calcareous binders which, on heating, decrepitate violently and scatter particles over the floor. By careful sorting the explosive bands may be removed, and an otherwise valueless coal may be turned to good account. Owing to the comparatively low percentage of combustible volatile matter in these coals very little soot is formed, the flame is short, and the heat is confined largely to the grate.

In some areas these coals contain thin films of pyrite between the laminæ. During the combustion of the coal the sulphur component of the pyrite is oxidised, and the heated gas thus formed in releasing itself causes much spluttering and expulsion of coal particles.

Permo-Carboniferous coals have been mined for domestic use at Mersey for many years, and considerable quantities have been produced for this purpose from the Cygnet mines. The coal from the latter locality is a high carbon variety, and not well adapted for use in open fireplaces and stoves, in which it has had little application. In addition to the Mersey, the Preolenna and Barn Bluff fields contain coals of high potential value. Owing to lack of transportation facilities these latter coals have not come into general use, but the time is not distant when they will become better known in local markets. They are high in volatile matter, ignite easily, burn freely with evolution of great heat, and on account of their tendency to coke hold the fire longer than free-burning coals. They, however, contain an excessive amount of pyrite, which in unwashed coal renders it disagreeable. In certain varieties, owing to the high percentage of combustible volatile matter in the coal, a large amount of soot is formed, unless proper precautions are taken to assure complete combustion, and, even under natural draft, the temperature in the uptake is high. This is due largely to the oil-producing properties of this coal. In other respects these coals are ideally suitable for domestic use.

Chapter VII.

UTILISATION IN THE POWDERED FORM.

Pulverised coal has been successfully used in cement kilns, reverberatory, and metallurgical furnaces, in firing boilers, and locomotives.

During the past year over 12,000,000 tons were pulverised for industrial consumption in the United States of America. Of this amount, approximately 6,000,000 tons were used in the manufacture of cement, and the remainder principally in the iron and steel industry, copper refining, and power plants.

Cement-kilns. Tasmanian coal, pulverised to the standard degree of fineness—that is, 95 per cent. through 100-mesh sieve, and 85 per cent. through 200-mesh—has been used in modern rotary kilns with very satisfactory results.

With the development of the Portland cement industry in the State a demand will be created for slack coal for pulverising.

The pulverised fuel is injected into the kiln by a jet of air obtained from a fan or compressor. The additional air needed for combustion enters the discharge opening for clinker and through openings in the hood. To obtain an even temperature in the combustion chamber it is essential that the stream of powdered coal be supplied to the kiln in a uniform and not intermittent manner.

Stationary Boilers.—Recent investigations in the use of powdered coal for stationary boilers have shown that sufficient progress has been made in its adaptation to warrant its use in boiler furnaces. Former difficulties have been overcome, and the conditions necessary for its successful application are now thoroughly understood. The design and construction of the combustion chamber will depend upon the grade of coal to be used. The greater part of the coal produced in Tasmania has a high ash and low sulphur content, but it can be burned in the powdered form to much advantage in steam generating plants regardless of the high percentage of ash. Laboratory tests have shown that the latter fuses in the majority of instances at exceptionally high temperatures, hence under ordinary working conditions no clinker will be formed.

The scientific method of burning coal in suspension allows the whole combustible in the coal to be burnt, and the feed control to be efficiently regulated. It must ultimately replace all methods of burning solid fuel.

The successful application of powdered coal as a fuel in boilers has been demonstrated by the fact that boilers have been in continuous operation for periods extending from one to three years.

Locomotives.—Experiments have been carried out in some of the mainland States using pulverised coal as a fuel in locomotives, but partly owing to the possible dangers of spontaneous combustion the tests have been discontinued temporarily. The question of pulverising coal on locomotives has also been considered.

So far as Tasmanian coals are concerned, investigations carried out in the Geological Survey Laboratory have shown that there is no danger of spontaneous combustion. These coals can be stored dry in the powdered form with perfect safety.

The use of pulverised coal in locomotives has passed the experimental stage. Its economic advantages over coarse fuel should ensure its adoption for firing modern locomotives. In the existing types alterations could be made to allow of fuel in this form to be used.

With the introduction of pulverised coal the necessity of importing New South Wales coal to mix with native coal for use on the Tasmanian railways would no longer exist.

Quoting largely from papers presented by J. E. Muhlfeld to the New York Railroad Club and the A.S.M.E. meeting in 1916, C. F. Herington (77) states—

"The large quantity of steam used by the modern locomotive necessitates high rates of evaporation, and these can be economically obtained only by some means for burning solid fuel other than on grates, in order to reduce the waste due to the loss of combustible dust and that from imperfect combustion.

"Steam locomotives must be equipped to approximate more nearly the electric locomotive, with regard to the elimination of smoke, soot, cinders, and sparks; the reduction of noise, time for despatching at terminals, and stand-by losses; and the increasing of the daily mileage by longer runs, and more nearly continuous service between general repair periods.

"Workmen of a higher average quality should be induced to enter the service as firemen, eligible for promotion as engineers, by reducing the arduous work now required to shovel ahead and supply coarse coal to grates, and to rake and clean fires and ash-pans.

"The future steam locomotive will be required to produce maximum hauling capacity per unit of total weight, at the minimum cost per pound of draw-bar pull, and with the least liability to delay because of mechanical failures.

"In meeting the conditions outlined above, powdered coal has succeeded because of the following advantages:—

(1) It offers opportunity for even greater accomplishments in the steam railway field than have heretofore been obtained through its use in cement kilns and in metallurgical furnaces.

(2) It produces a saving of from 15 to 25 per cent. in coal of equivalent heat value, as compared with hand firing of coarse coal on grates. Powdered coal may run as high as 10 per cent. in sulphur and 35 per cent. in ash, and still produce maximum steam-heating capacity; so that otherwise unsuitable and unsaleable or refuse grades of coal may be utilised, and hence the saving in cost per unit of heat evolved will be a considerable item.

(3) It enables us to maintain fire-box temperatures and sustained boiler capacities equivalent to and exceeding those obtainable from crude or fuel oil.

(4) It maintains the steam locomotive on its present relatively low first cost and expense-for-fixed-charge basis, and further reduces the cost for maintenance and operation of large units.

(5) It eliminates the waste products of combustion and fire hazards, and permits the enlargement of exhaust steam passages, and thus produces increased efficiency at the cylinders.

"In the application of powdered coal-burning equipment to existing types of steam locomotives, the following constitute all the changes that are necessary:—

"Smoke Box.—Remove the existing diaphragm table and deflector plates, nettings, hand holes, and cinder hoppers, enlarge the exhaust nozzle opening.

"Fire Box.—Remove the existing grates, ash pans, fire doors, and operating gear; utilise the usual arch tubes and sectional type of brick arch; and install fire-brick-lined fire pan, primary arch, fuel and air mixers, and nozzle.

"Cab.—Install regulating levers for furnace door, fuel, and air supply.

"Tender.—Install enclosed fuel container equipment with fuel and pressure air conveying, feeding, commingling, and discharge apparatus, and steam turbine or motor mechanism.

(77) Powdered Coal as a Fuel, by C. F. Herington, pages 161, 162, 167-169.

"Engine and Tender Connections.—These are made by the use of one or more sections of hose, which connect the fuel and pressure air outlets on the tender, with the fuel and pressure air nozzles on the engine. Metallic flexible conduits are employed for conveying the fan blast and fuel feeding motive power."

In order to make comparative tests, and to determine the best type of equipment for burning pulverised Tasmanian coal, it would be desirable to make the necessary alterations to one of the existing locomotives, so that accurate trials could be carried out.

Chapter VI.

THE SANDFLY - CYGNET COALFIELD.

(1)—The Sandfly Coal Area.

A.—*Location and Extent.*

The Sandfly coal area, somewhat over 1000 acres in extent, lies midway between Huonville and Margate. The chief centre of population is Hobart, about 28 miles to the north-east. Sandfly settlement is 6 miles distant, on the road to Hobart, and Margate, the nearest seaport, is 12 miles away, at the head of North-West Bay.

B.—*Access.*

This coal area is now fairly easy of access. Road communication with the main highways is good, although the grades are steep. In addition to these facilities a 2-ft. gauge tramway connects the mines with the seaport of Margate. If the proposed Huon railway is constructed the area will be brought into railway communication with Hobart. One route being investigated passes through the centre of the coal area, the other is only 4 miles distant. The construction of this railway, although of advantage to this field, is not essential to its development, in view of the availability of cheap water-carriage and the existence of tramway and pier, more or less ready to be put into operation.

C.—*Previous Reports.*

The first official report on this area was prepared by G. Thureau ([20]) in 1881. In consequence of the undeveloped condition of the mine, and the difficulty experienced in traversing this heavily-wooded, mountainous country, Mr. Thureau, in the short space of time available, was unable to examine the area in detail. This work was left for A. Montgomery ([21]) to complete, and in his report a detailed account was given of the results of his investigations. In the intervening period a considerable amount of development work had been accomplished, enabling a more accurate survey to be made.

In 1903 W. H. Twelvetrees ([22]) was detailed to visit the field and report on the further progress of developments. Since Mr. Twelvetrees' visit attention has been given almost exclusively to the most important seam, and a large tonnage of coal has been shipped to market.

D.—*Topography.*

(1)—General Description.

The extremely rugged topography of this field is due largely to the erosion of the coal-bearing and associated rocks from the subterranean ridges of diabase. Almost invariably, it is found that the highest hills and mountains either consist of or are capped with diabase, and as a rule the valleys are occupied by remnants only of the great beds of sedimentary rocks that once extended over the whole region. In few places only have representatives of the upper coal measures been found, and these would have long since disappeared had it not been for the supporting buttresses of diabase surrounding them. The diabase ridges, although very irregular in outline and discontinuous at the higher altitudes for any considerable distance, have a general meridional trend. The breaks between successive ridges

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([20]) Thureau, G.: Report on the Southern Coal Measures at Sandfly, 1881. House of Assembly Paper, No. 109.

([21]) Montgomery, A.: Report on the Sandfly Coal Mine. Secretary for Mines Report, 1893.

([22]) Twelvetrees, W. H.: Report on the Sandfly Coal Mines. Secretary for Mines Report, 1903.

define the courses pursued by the major streams, all of which ultimately empty into the D'Entrecasteaux Channel. The Huon River, for instance, flows in a general easterly direction to Huonville, where, meeting the massive diabase wall at the foot of Grey Mountain, it turns abruptly to the south, continuing in this direction for 11 miles, until it finds an opening between the diabase ranges, and then follows an east-south east course to the sea. All other streams are mountain torrents, which have carved deeply-incised channels through the comparatively soft sedimentaries.

D'Entrecasteaux Channel lies between long ridges of diabase on the mainland and Bruny Island. Long before the subsidence of the land in Tertiary time this waterway received the drainage of the whole region, and so its existence was partly due to erosion.

(2)—Relation to Mining.

As already pointed out the present irregular topography is directly due to erosion, and indirectly to the great uplifting movements accompanying the intrusion of the diabase. The resultant effects of the elevation of the land surface and the dislocation of the strata were the beginning of a long cycle of erosion, and the defining of the lines of drainage. The dissection of the coal-bearing strata, which occur at high altitudes, has been minute. Under the heavy precipitation in this region the torrential streams have cut deeply into the coal measures, exposing steep sections to view. In some places erosion acting on the soft felspathic sandstones and shales has produced cliffs in the overlying siliceous sandstones, a deep talus from which covers up the outcrops in the coal-bearing strata underneath. The seams dip north-west into the hill, therefore the coal cannot be wholly extracted by means of horizontal tunnelling, except under very heavy expense. However, the contour of the hill is such that a large portion of the area could be operated from "strike" tunnels. The conditions are advantageous in this respect.

Owing to the high altitude of the mine and the rugged nature of the country, tramway connection with the seaboard has been very difficult. About a mile from the mine workings the tramway surmounts a saddle (1400 feet above sea-level), from which it cannot be constructed low enough to reach the workings on the lower seams. For these reasons working from dip-tunnels, except in unusual cases, is preferable to operation by any other method.

E.—*Geology*.

(1)—Geological Map.

The geological map (Plate XVIII.) is based on the mineral charts of the districts embraced in this coalfield. Owing to the limitations of the map, the Bruny Island coalfield is not included, but is shown on the adjoining plan to the south.

The accompanying map shows the location of the mining properties and unleased coal-bearing areas, the positions of the fault lines, the variation in the direction and degree of the strike and dip of the strata and the general physical features of the region. It shows also the relationship between th Trias-Jura and Permo-Carboniferous strata and the intrusive diabase, and the later igneous rocks.

In this coalfield the area of the Trias-Jura formation is very small, but the Permo-Carboniferous occupy about one-third of the surface. The latter, therefore, afford greater possibilities for the existence of extensive coalfields. However, the occurrence of great masses of diabase limits the extent of workable coal ground, and the disruption of the strata renders the exploitation of the seams rather difficult.

The sedimentaries in the southern and eastern parts of the field, consisting of Lower Marine limestones, mudstones, sandstones, and shales, have been pierced and traversed by alkali-rich rocks of variable lithological character and composition. This suite consists of alkali syenites, elaeolite syenites, elaeolite syenite porphyries (including solvsbergite and tinguaite), and essexite. The belt of this porphyry country around Cyguet is 3 miles wide, and extends from Desolation Bay, on the southern side of Huon River, to Little Oyster Cove. The general trend of these intrusives is a little east of north, but subsidiary narrow dykes cutting through Permo-Carboniferous sediments and diabase alike take a northerly course along the sea coast. In the neighbourhood of Kettering sills of these rocks jut out between sandstones and mudstones, and on the Woodbridge road and elsewhere in the neighbourhood numerous narrow dykes completely intersect the diabase. As the diabase intrusion took place at or near the end of the Mesozoic period, the alkali rocks may be assigned to the Lower Tertiary.

Remnants of extensive lava flows of Upper Tertiary basalt are jotted here and there over the coalfield. Some occur at high altitudes, such as that at Sandfly, while others, such as those in the neighbourhood of Margate, occur at sea-level. The variation in altitude of this lava shows that the topography has not changed very much since the late Tertiary.

(2)—The Permo-Carboniferous—Trias-Jura Section.

The several members of the Trias-Jura formation are represented here by small isolated remnants only of the great coal-bearing measures that once extended over the greater part of Tasmania. The most representative section of this formation is found at Sandfly mines, where part of the uppermost member occurs and forms a protective covering to the relatively soft felspathic sandstones and shales containing the coal beds. These felspathic sandstones and intercalated shales are over 600 feet thick. Details of these strata are given in the accompanying log of the boring operations conducted here many years ago.

Outside the confines of the Sandfly coal mines the productive measures of this age have not been found in this area. The shales between the coal beds are replete with impressions of the following:—

Cladophlebis australis	Morris
Thinnfeldia obtusifolia	Johnston
Sphenopteris lobifolia	Morris
Phœnicopsis	Heer

Underlying the felspathic sandstones are over 400 feet of the siliceous or Ross sandstones, which, under normal conditions, rest conformably on the Permo-Carboniferous.

A complete series of the Trias-Jura and Permo-Carboniferous is not found in this area. The intruding diabase appears to have separated dissimilar members of both formations, and at the Sandfly mines is found immediately under the coal-bearing felspathic sandstones of the Trias-Jura. The result of the intrusion of this igneous rock is the dislocation of both formations and their division into small areas raised to various altitudes.

Indications of coal were observed in several places in a gully leading from Bailey's land towards Sandfly Rivulet. These probably belong to the lowest group of beds, but their exact stratigraphic position could not be determined without further prospecting.

Further west, at a higher altitude, other beds crop out, but the outcrops cannot be traced continuously owing to the deep soil cover. It is probable that the beds in this direction are thinning out, and they appear to be too dirty for mining.

On the north side of the Heron Back the productive measures occur again, and three coal beds have been found in them. Several old prospect shafts and tunnels were discovered, but none of them was accessible, and in only one place was it possible to obtain a sample. The stratigraphic horizon of these beds could not be established, because their relative positions were not determined, and only one outcrop was observed.

(3)—The Mode of Occurrence of the Diabase.

By reference to the geological map (Plate XVIII.) it will be seen that diabase occupies a very large portion of the surface of this field. These protrusions, although irregular in outline and elevation, have a general meridional direction and parallel arrangement. The form this intrusive takes is doubtless that of an enormous laccolith, out of which have sprung minor injections in the forms of sills and dykes. Apparently the sills were injected generally at the horizon of the coal measures, but large masses of the igneous rock are also found at lower horizons in both Trias-Jura and Permo-Carboniferous formations.

Almost without exception the bore holes drilled through the coal measures strata have bottomed on diabase. The most striking features about the intrusion are the extreme irregularity of its contour, and the homogeneous nature of the diabase. In the midst of high hilly projections are found flat stretches of diabase under a thin cover of fossiliferous mudstone. Evidently in its ascent the igneous rock broke through the fractured sedimentaries in some places, and spread out between them in others. The amount of resorption that has taken place could not be determined, but it was inconsiderable. In the large masses the diabase is of medium to coarse grain texture, but in the small dykes and near the point of contact with the intruded sediments the rock is invariably fine-grained.

(4)—Structure.

(*a*) *Faults.*—Numerous small faults and slips are met with in the workings here and there, and several faults of considerable displacement occur that limit the workable area of coal from any particular opening. Parallel to the diabase dyke a transverse fault, having a displacement of 105 feet to the south, extends for over a mile from the main workings in a westerly direction. The proximity of the workings to this fault is indicated in the north face by numerous small displacements. Coursing almost at right angles to this an axial fault was encountered at the bottom of the dip tunnel. The amount of displacement has not been accurately determined, but it has been calculated to be about 120 feet. Parallel to this again 35 chains further to the west is another axial fault of unknown extent. The effect of this system of faults on mining development is everywhere apparent.

At the western end of the new workings there is a downthrow fault of unknown extent. On the surface it is indicated by a gully extending down hill to Woodstock road from the eastern side of the diabase outcrop high up on the hillside. The accompanying section (Plate XIX.) clearly shows the faulted positions of the coal beds relative to one another.

(*b*) *Dip of Coal Seams.*—At the Sandfly mines the dip of the coal beds is north-west, and the strike is north-east, but neither the dip nor the strike is constant for more than a few hundred yards in any part of the area. The coal bed in the upper part of the main workings of the Sandfly Mine dips 40 degrees west of north at an inclination of 5 degrees, while in the lower part the dip increases to [illegible] degrees. Three hundred feet to the south-west the angle of dip amounts to [illegible] degrees, and a half-mile away to the west the angle increases to 14 degrees. The tilting of the coal measures to the north-west is contrary to the dip of the strata in other parts of this area, and in the adjacent area to the south the direction of dip is reversed.

(5)—The Coal Seams Represented in the Field.

In this field there are eight coal beds, four of which are of workable thickness throughout, and the others can be worked in parts. The variation in the quality of the coals, the seaming of the beds and the changes in the nature and character of the intervening rocks are so great that the correlation of the several beds has been attended with considerable difficulty. The intricate faulting that has taken place in this area added to the difficulties experienced in this connection. These conplications have been disentangled, and the numerous outcrops can now be referred to their correct positions in the coal measures.

Because the beds dip to the north-west they rise to the south-east and outcrop at various elevations along the face of the hill. Where the beds are covered with detritus and soil their positions are indicated by lines of bull-rushes, which grow in the ground soaked by water issuing from the seams. Following these indications the coal beds can be traced without difficulty, and have been exposed here and there along the lines of outcrop for 2 miles.

The beds occur in three groups, separated by considerable thicknesses of felspathic sandstone and shale. Beds Alpha and Beta exposed in the main workings are enclosed in and separated by fireclay, which here is fully 25 feet thick. Their continuity eastward and westward is interrupted by faults, but they outcrop again in small affluents of Slide Creek, the faulting of the strata raising them above their correct altitude.

The middle group, consisting of Gamma, Delta, and Eta beds is separated from the uppermost group by over 300 feet of felspathic sandstones and shales, containing occasional bands of coal and clod. This group is also enclosed in fireclay, but with an intervening band of fine-grained sandstone. The horizon of these beds may be traced along the hillside 50 chains to the east, where they are exposed in the new workings. Below these, 45 feet, the lowest and least important group of coal beds commences. They are distributed through 25 feet of strata consisting largely of shale and fireclay, with thin bands of felspathic sandstone. These likewise can be traced in an easterly direction 60 chains along the hillside. They recur on the western side of the fault, ending abruptly against a large mass of intrusive diabase. Succeeding these beds are 300 feet of felspathic sandstone and shale, containing thin seams of coal of poor quality.

SANDFLY COLLIERY.

Bore A.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface shaft, clay and diabase boulders	14	0	14	0
Brown and grey sandstone	18	1	32	1
Black clod	0	5	32	6
Grey sandstone	2	0	34	6
Blue shale	1	0	35	6
Sandstone, brown 2 ft., grey 7 ft. 8 in., brown 7 ft. 4 in.	17	0	52	6
Shale, brown 9 in., blue 1 ft.	1	9	54	3
Sandstone, grey 14 ft. 3 in., brown 1 ft. 7 in., grey (coal-stained) 7 ft. 11 in., brown 10 in., grey 13 ft. 7 in.	38	2	92	5
Shale, blue and dark bands	4	6	96	11
Earthy coal	0	7	97	6
Blue shale	5	3	102	9
Earthy coal	0	2¼	102	11¼
Dark shale	0	7¼	103	7
Blue sandy shale and soft sandstone	11	6	115	1
Coal	0	9	115	10
Brown shale, with fern impressions	1	0	116	10
Blue sandy shale	2	3	119	1
Sandstone, with occasional coal-markings, grey 15 ft. 2 in., brown 5 ft., grey 65 ft. 3 in.	85	5	204	6
Coaly clod	4	4	208	10
Sandstone, grey 3 ft. 3 in., dark 1 ft. 9 in.	5	0	213	10
Blue sandy shale	3	0	216	10
Grey sandstone	51	1	267	11
Dull coal	0	6	268	5
Fireclay	1	5¼	269	10¼

Bore A—continued.

Strata.			Thickness. ft.	Thickness. in.	Total Depth ft.	Total Depth in.
Dull coal		1 ft.				
Band		9 in.				
Dull coal		10 in.				
Clay parting .		1 in.				
Dull coal		3 in.				
Dark band	Gamma Seam, 5 ft.	2 in.	6	3	276	1¼
Bright coal ...		1 ft. 2¼ in.				
Clay band		2 in.				
Dull coal		4 in.				
Band and coal		1½ in.				
Bright coal ...		1 ft. 4½ in.				
Fireclay			2	10	278	11¼
Fine-grained sandstone			5	3	284	2¼
Blue shale			3	5	287	7¼
Coal		3 ft. 2½ in.				
Clay band	Delta Seam, 3 ft. 5½ in.	1½ in.	3	7	291	2¼
Coal		3 in.				
Fireclay			3	9¾	295	0
Sandstone, dark 3 ft. 6in., grey 33 ft. 6 in.			37	0	332	0
Dark sandy shale			3	2	335	2
Coal		3 in.				
Dark band		1 in.				
Bright coal	Eta Seam, 1 ft. 3 in.	7 in.	1	5½	336	7½
Clay band		1½ in.				
Bright coal		5 in.				
Blue shale, 2 ft. 4½ in., sandy 4 ft. 3 in.			6	7½	343	3
Coal (Theta Seam)			1	1	344	4
Sandy fireclay			2	9	347	1
Black clod			1	0	348	1
Stony coal		2 in.				
Soft coal		1 in.				
Bright coal	Iota Seam, 2 ft.	1 ft. 1½ in.	2	3	350	4
Soft sandstone band		1½ in.				
Bright coal		9 in.				
Hard dark sandy shale			0	9	351	1
Sandstone, dark 1 ft. 2 in., grey 3 ft. 7in.			4	9	355	10
Firm blue sandy shale			2	9	358	7
Coal (Kappa Seam)			1	3	359	10
Blue sandy shale			0	9	360	7
Grey sandstone			45	1	405	5
Very hard blue shale			0	8	406	1
Grey sandstone			50	10	456	11
Dark shale and sandstone, in layers			9	3	466	2
White sandstone			2	10	469	0
Dark carbonaceous sandstone			47	4	516	4
Coal, full of calcite			0	8	517	0
Dark sandstone			4	6	521	6
Shale, with calcite			1	9	523	3
Coal, with calcite			0	2¼	523	5¼
Shale			0	6	523	11¼
Coal, dull			0	3	524	2¼
Shale			0	4	524	6¼
Red clay			0	1¾	524	8
Coal, full of calcite			0	6	525	2
Red clay			0	1	525	3
Coal, dull			0	4	525	7
Sandstone			1	6	527	1
Coal, full of calcite			0	9	527	10
Dark shale, full of calcite veins			4	7	532	5
Dark sandstone			4	3	536	8
Light and dark sandstone			24	4	561	0
Hard grey sandstone, with calcite veins			32	0	593	0
Hard white shale, with conchoidal fracture			9	4	602	4
Firm sandy shale			3	8	606	0
Firm greenish jointy sandstone			33	9	639	9
Altered sandstone			4	1	643	10
Hard fine-grained diabase			27	6	671	4

Bore B.

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Surface shaft, earth, boulders, &c.	12	0	12	0
Very firm grey sandstone	4	0	16	0
Very hard black clod	1	0	17	0
Grey sandstone	9	0	26	0
Blue shale	1	5	27	5
Grey sandstone	12	7	40	0
Brown shale, with petrified wood	2	0	42	0
Sandstone, grey 8 ft., brown 3 ft., grey 22 ft. 10 in.	33	10	75	10
Blue shale	5	0	80	10
Fine sandstone	2	0	82	10
Blue shale	10	7	93	5
Fine sandstone	1	6	94	11
Blue shale, with fern-markings	3	3	98	2
Sandstone	2	0	100	2
Blue sandy shale	5	0	105	2
Coal	0	1	105	3
Clay	0	1½	105	4½
Coal	0	10½	106	3
Shale, dark 1 ft. 9 in., blue sandy 2 ft.	3	9	110	0
Sandstone, grey 35 ft., brown, with veins of calcite, 5 ft. 3 in., hard grey 8 ft. 7 in., brown, with veins of calcite, 7 ft. 2 in., firm grey 32 ft. 2 in.	88	2	198	2
Blue shale	5	6	203	8
Clod and earthy coal	3	4	207	0
Blue sandy shale	0	7	207	7
Hard black clod	0	6	208	1
Grey sandstone	11	4	219	5
Hard dark shale	1	4	220	9
Grey sandstone	41	5	262	2
Clod and coal	4	1	266	3
Clay band } Gamma Seam	0	2½	266	5½
Coal } Gamma Seam	1	7½	268	1
Fireclay	0	8	268	9
Fine sandstone	0	5	269	2
Fireclay	2	0	271	2
Sandy shale	2	0	273	2
Fine sandstone	1	7	274	9
Blue shale	1	9	276	6
Fireclay	0	9	277	3
Clod and coal } Delta Seam	2	6	279	9
Clay band } Delta Seam	0	2	279	11
Bright coal } Delta Seam	0	4	280	3
Sandy shale, dark 2 ft. 6 in., blue 2 ft. 3 in.	4	9	285	0
Shale, with fern impressions, 3 ft. 3 in., blue sandy 2 ft.	5	3	290	3
Grey sandstone	37	10	328	1
Blue shale	3	1	331	2
Clod	0	7	331	9
Coal	0	1	331	10
Light band	0	1	331	11
Bright coal (Eta Seam)	0	1	332	0
Light band	0	1½	332	1½
Bright coal	0	3	332	4½
Shale, dark blue 3 ft. 9½ in., blue 2 ft. 6 in.	6	3½	338	8
Coal } Theta Seam	0	4	339	0
Clay band } Theta Seam	0	2	339	2
Coal } Theta Seam	0	8	339	10
Fireclay	2	7	342	5
Coal } Iota Seam	1	0	343	5
Clay band } Iota Seam	0	0¼	343	5¼
Coal } Iota Seam	0	5¾	343	11
Sandstone band } Iota Seam	0	1	344	0
Coal } Iota Seam	0	6	344	6
Dark shale	0	6	345	0

Bore B—continued.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Sandstone, dark 2 ft. 3 in., grey 4 ft. 8 in.	6	11	351	11
Blue shale	2	4	354	3
Coal } Kappa Seam	0	4	354	7
Clay band } Kappa Seam	0	1½	354	8½
Coal } Kappa Seam	0	9½	355	6
Shale, dark blue 1 ft., blue 2 ft.	3	0	358	6
Fine sandstone	3	6	362	0
Blue shale	1	9	363	9
Grey sandstone	49	3	413	0
Hard grey rock	5	6	418	6
Grey sandstone	16	4	434	10
Coaly clod	1	2	436	0
Hard grey shale	0	6	436	6
Coaly clod	0	4	436	10
Grey sandstone	14	9	451	7
Firm dark sandy shale	6	6	458	1
Dark sandstone	3	4	461	5
Dark sandy shale	5	6	466	11
Dark sandstone	9	6	476	5

Bore C.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Clay and stones	4	11	4	11
Coal	0	8	5	7
Clay band	0	2	5	9
Coal	1	9	7	6
Grey shale	7	0	14	6
Sandstone, fine soft 2 ft., firm grey 15 ft. 4 in.	17	4	31	10
Firm dark-blue shale	8	3	40	1
Hard grey sandstone, with calcite veins	18	11	59	0
Very hard grey rock	1	9	60	9
Hard grey sandstone	22	3	83	0
Conglomerate of shale and sandstone	2	0	85	0
Hard dark shale	1	0	86	0
Hard grey sandstone, with vertical fracture	25	9	111	9
Hard grey rock	1	0	112	9
Firm grey sandstone	6	9	119	6
Grey rock	0	9	120	3
Firm grey sandstone	15	9	136	0
Firm dark shale, with calcite	1	0	137	0
Coal	0	4	137	4
Firm shale, dark 3 ft., blue 2 ft.	5	0	142	4
Grey sandy shale and fine-grained sandstone	9	8	152	0
Fireclay	1	3	153	3
Coal	0	9	154	0
Blue shale	2	6	156	6
Grey sandstone, with vertical fractures and calcite veins	43	1	199	7
Sandstone, brown 6 ft. 3 in., grey 3 ft. 6 in., brown 13 ft., grey 4 ft., brown 4 ft., grey 8 ft. 9 in.	39	6	239	1
Black clod	0	2	239	3
Coal	0	5½	239	8½
Dark shale	1	0	240	8½
Coal	0	1	240	9½
Dark shale	1	1½	241	11
Sandstone, grey, with vertical fractures and veins of calcite, 21 ft. 6 in., very jointy brown 11 ft. 11 in., grey 32 ft. 2 in.	65	7	307	6

Bore C—conitnued.

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Coal }	0	9	308	3
Soft clay band }	0	1	308	4
Coal }	1	7¼	309	11¼
Fireclay	0	6	310	5¼
Dark shale, with fern impressions	1	2	311	7¼
Grey sandstone	2	10	314	5¼
Dark shale, with fern impressions	2	8	317	1¼
Grey shale	0	3¾	317	5
Dull coal	0	5	317	10

Bore D.

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Surface shaft { Clay and stones	6	6	6	6
Surface shaft { Jointy shale	4	6	11	0
Firm blue shale	4	0	15	0
Firm jointy grey sandstone, with hard bars and calcite in joints	55	0	70	0
Grey sandstones	11	1	81	1
Dull coal {	1	3	82	4
Bright coal {	0	8	83	0
Dark grey shale	1	0	84	0
Fine sandstone	1	8	85	8
Firm dark shale	5	6	91	2
Grey fine-grained sandstone	2	0	93	2
Dark shale	5	10	99	0
Grey sandstone }	9	0	108	0
Hard grey rock }	1	9	109	9
Firm grey sandstone }	19	3	129	0
Hard rock }	1	0	130	0
Firm grey sandstone }	20	0	150	0
Dark sandy shale	6	8	156	8
Firm grey sandstone	30	6	187	2
Coal } Delta Seam	0	6	187	8
Band } Delta Seam	0	1	187	9
Coal } Delta Seam	0	8½	188	5½
Dark sandy shale	8	6½	197	0
Firm dark shale	0	2	197	2
Dull coal } Eta Seam	0	9	197	11
Soft clod } Eta Seam	0	1½	198	0½
Clay band } Eta Seam	0	3	198	3½
Coal } Eta Seam	0	2	198	5½
Clay band } Eta Seam	0	1	198	6½
Coal } Eta Seam	0	9½	199	4
Clay band } Eta Seam	0	3	199	7
Coal } Eta Seam	1	3	200	10
Very broken dark sandstone	2	6	203	4
Coal	1	0	204	4
Blue shale	1	4	205	8
Dark sandy shale	23	8	229	4
Dark sandstone	20	5	249	9
Coaly clod	0	9	250	6
Dark shales and sandstones	14	1	264	7
Hard grey sandstone	38	2	302	9
Dark micaceous sandstone	29	7	332	4
Dark micaceous shale	4	6	336	10
White shale	2	0	338	10
Very hard white sandstone	6	6	345	4
Altered sandstone	3	6	348	10
Diabase	9	2	358	0

F.—*The Mining Property.*

(1)—The Sandfly Colliery.

(*a*) *Number and Area of Leases.*—Only two sections are now leased in this area—one (8649-M) of 104 acres, in the name of H. Gill, the other (8652-M), of 50 acres, in the name of G. E. Gill.

Both sections are pegged to take in Gamma and Delta coal beds.

(*b*) *Extent and Method of Mining Operations.*—The system adopted for the mining, handling, and distribution of the product of these mines is crude and unbusinesslike in the extreme. In an enterprise of this kind dealing with an article of comparatively low market value it is essential, in order to ensure success, to deliver the article to the consumer at the lowest possible rate. The necessity for this is more evident when it is realised that the quality of the article is poorer than that procurable from other sources. It follows that the product of the Sandfly mines must be marketed much more cheaply than the coal of higher grade imported from other States.

The chief reasons for the failure of the several companies operating these mines were:—

(1) The inclusion of clay and shale bands in the coal for market.
(2) The lack of a definite mining policy.
(3) Costly system of underground transportation.
(4) Unsuitable surface arrangements.
(5) Excessive cost of transport of coal from Sandfly mines to Margate.
(6) Unloading and loading by hand.
(7) Excessive shipping charges from Margate to Hobart.

Since the beginning of operations here in 1881 these seams have been explored intermittently by several mining companies and syndicates, and during the last decade considerable development work has been accomplished. Of late years attention has been concentrated largely on Beta bed, from which the bulk of the coal shipped to market has been obtained. These are generally referred to as the No. 3 or main workings, and they constitute the only openings of any considerable dimensions on the coal bed. The workings are confined to a small area (about 20 acres in extent) within the limits of two major and several minor faults. The beds have been displaced downwards west of the fault-line. A few thousand tons of coal are still available in this quarter. Operations were resumed here in 1917, following the increased demand for local coals during the period of the shipping strike, but were discontinued in 1919 in consequence of the destruction of the tramway bridges by fire.

The following sections of this coal bed were measured in the main workings at the places where samples were taken:—

No. 434, Beta Bed.

	ft.	in.	
Clay, hardened (roof).			
Coal, bright, hard	0	9	Sampled 2 ft. 9 in.
Clay, soft	0	3	
Coal	0	9	
Clay, hard	0	2	
Coal, bright and tough	1	1	
Clay, hard	0	9	
Coal, very bright and brittle	0	4	
Clay, hard (floor).			

Sample 434 was taken from a fairly fresh face of coal in the western part of the main workings. The 3-inch band of soft clay was excluded, as this can be removed in mining, but the 2-inch binder of hard clay was included in the sample because it cannot be separated so easily. It adheres firmly to the coal, and explodes violently on heating. Portion of this troublesome material is picked out, but a considerable amount finds its way into the coal shipped to market. The 9-inch band of hard clay underlying the main seam of coal is the working floor. The lowest seam of coal (4-inch) is removed only in the headings used as gangways.

No. 435, Beta Bed.

	ft.	in.	
Clay, hard (roof).			
Coal	0	9	Sampled 2 ft. 7 in.
Clay, soft (holing)	0	2½	
Coal, with bright laminæ	0	9	
Clay, hard	0	2½	
Coal, bright	1	0	
Clay	0	9	
Coal, bright	0	4	
Clay, hard (floor).			

Sample 435 was taken from the water tunnel near the air shaft. The upper soft clay band and portion of the hard lower parting were not included. The coal had been exposed to the atmosphere for many years, and consequently did not represent its true quality.

The method of mining adopted is a modification of the pillar and stall.

The main tunnel was driven horizontal 70 feet on a bearing of 344 degrees, thence continued in the same direction on the half-dip 266 feet, whence it was turned to the north-west on the true dip 540 feet. In its course several small faults were passed, and in the end, 910 feet from the entrance, a fault of over 80 feet displacement was encountered. Level headings leading from the dip tunnel to the north-east were discontinued at 630 feet owing to the poorness of the coal bed and the presence of numerous small faults. In the eastern workings similar interruptions caused the stoppage of operations in that direction. The accompanying mine plan gives an idea of the relation of the mine workings to the lines of faulting.

The only other workings on this coal bed are a shallow shaft below Vincent's house, and a short dip tunnel in the bank of a tributary of Slide Creek. From this latter locality a "strike" tunnel would, if uninterrupted by serious faulting of the strata, command the greater part of the coal area east of the creek.

The following section of the coal bed was measured in the tunnel:—

No. 440, Beta Bed.

	ft.	in.	
Clay, hard (roof).			
Coal	0	1	
Clay, soft	0	3	
Coal, firm and hard	1	3	Sampled 1 ft. 3 in.
Clay, hard	0	5	
Coal	0	5	
Clay, hard (floor).			

Sample 440 was taken from an outcrop in the bed of a small tributary of Slide Creek, about 30 chains west of the main workings. The 15-inch coal band only was sampled, but this represents neither the quality nor the size of the seam.

The coal here exposed has been less affected by the intruding diabase. It kindles quickly, burning quietly, with a long yellow flame.

Alpha coal bed has been exposed in a drive off the air shaft in the main workings. At this point the coal is too poor to place on the market, but further underground it may prove of better grade.

The following section was measured at this point:—

No. 445, Alpha Bed.

	ft.	in.	
Clay, hard (roof).			
Coal, stony	1	3	
Clay, soft, band	0	4	
Coal, dull, with bright streaks	0	11	Sampled 3 ft. 3 in.
Clay, hard, band	0	1	
Coal, hard, tough, dull to bright	2	3	
Fireclay (floor).			

Sample 445 was taken from a drive off the air shaft about 40 feet from the surface. The coal had been exposed to the atmosphere for 12 years, and was affected by waters percolating through the fractured rock from the surface. The bed lies between two layers of fireclay replete with fern fossils typical of the period. Crystals of ferrous sulphate occur as incrustations on the stony coal band under the roof, and veinlets of calcite ramify through the lower portion of the seam. This bed contains a hard clay parting which cannot be removed in mining, and is included in the sample.

The coal is dull black, with occasional thin bright streaks; it has a banded structure, and hackly fracture.

The analysis shows a much higher grade coal than its appearance indicates, and this seam, neglected in the past, may prove worthy of attention.

This coal bed has been exposed again in the bank of a tributary of Slide Creek, about 35 chains westward from the main workings. It has been cut into for 30 feet by a drive which goes in level for a distance, then turns down the dip of the seam, holing into an old drive full of water in the face. The dip of the bed here is due north at an inclination of 22 degrees.

The following section is shown:—

No. 439, Alpha Bed.

	ft.	in.	
Fireclay, hard (roof).			
Coal	3	9	Sampled.
Clay	0	1½	
Coal, bright	0	1½	
Fireclay (floor).			

Sample 439 was taken from the side of the drive a few feet from the entrance. The coal had been exposed to the atmosphere and drainage waters for many years. It appears of good quality, but the long exposure has made it soft.

The next most important openings were made in Eta coal bed. From these workings (old No. 7) about 500 tons of coal were removed about 14 years ago. These workings, although abandoned for many years, are still in good repair. This is due largely to the soundness of the fireclay roof and floor, the hardening of which is due to the effects of heat emanating from the underlying diabase.

The workings consist of a tunnel driven level 105 feet on a bearing 40 degrees west of north. From this point the tunnel continues on the dip for 200 feet, and a heading leads off on a general north-easterly course along the line of strike for 200 feet. The extension of this level heading would open up a large area of coal, and enable the operators to produce on a considerable scale without a large initial expenditure. Concurrently with the exploitation of the coal from this heading the dip tunnel could be opened up, and lower-level headings driven in preparation for production from that section of the mine.

Section of coal beds in old No. 7 workings:—

No. 436, Eta Bed.

	ft.	in.	
Very hard fireclay (roof).			
Clay and soft coal (holing)	0	7	
Coal, clean	3	0	Sampled.
Clay band with veins of bright coal ...	0	8	
Coal, cubical, bright, clean	0	3	
Very hard fireclay (floor).			

Sample 436 was taken from the underground workings nearly 200 feet from the entrance. The coal had been exposed to the action of the atmosphere for 13 years, and probably had suffered deterioration by percolating waters. The 3-ft. seam only was sampled. It is reported that the bottom 12 inches of the 3-ft. seam is of much better quality than the upper 2 feet. This is a sub-anthracitic coal, possessing a dull to bright lustre, conchoidal fracture and banded structure. It is hard and brittle, but stands transportation without excessive slacking. The bulk of the ash is intrinsic, and not derived from enclosed clay bands, but there are probably minute films of mineral matter between the laminæ, because the coal decrepitates freely on heating. Cleat faces are imperfectly developed.

Twenty-five chains north-eastward a tunnel has been driven into the bed 30 feet on a bearing 30 degrees west of north. The bed dips at an inclination of 10 degrees.

The following section of coal bed was measured at the place where the sample was taken (No. 10 workings):—

No. 441, Eta Bed.

	ft.	in.	
Hard clay roof.			
Coal, bright, firm	3	2	Sampled 3 ft. 2 in.
Clay, hard	0	3	
Coal, bright, soft	0	2	
Clay, hard	0	5	
Coal, bright, cubical	0	1	
Hard clay (floor).			

Sample 441 was taken from the 38-inch seam 10 feet from the mouth of a short tunnel. Over this width the coal is free from clay bands. These workings have been open to the weather for many years, and the coal has deteriorated considerably. This coal is a dull black variety with numerous bright laminations. It has a cubical fracture, is hard, and weathers well. Ignition is slow, and the coal burns with a short bluish flame.

Thirty chains farther to the north-east are the new workings opened up by R. Slide about four years ago. In the subsequent operations several hundred tons of coal were removed.

The openings consist of two level tunnels driven at right angles to the dip of the beds, and headings east and west on Eta bed. The main tunnel is 100 feet long intersecting Eta coal bed at 80 feet, and Delta in the end.

The western heading terminates at a fault the amount of displacement of which has not been determined. This fault is probably caused by the intrusion of the subsidiary dyke of diabase observed outcropping a few chains to the west of the tunnel mouth. A very considerable quantity of coal is available here for immediate excavation. The mine is in splendid order, and operations could be resumed without any great expenditure in preparatory works. The roof and floor are extremely hard and free from fractures.

The section of this coal bed exposed in the tunnel is—

No. 437, Eta Bed.

	ft.	in.	
Very hard fireclay (roof).			
Soft shaly clay (holing)	0	3	
Hard, tough coal	3	4	Sampled.
Very hard fireclay (floor).			

Sample 437 was taken from a heading driven off the horizontal tunnel about 200 feet from the entrance. These workings are comparatively recent, and the coal has not been subjected to atmospheric deterioration. There are no partings in this seam, which is contained between very hard beds of baked fireclay. A 3-inch band of soft clay under the roof is of great advantage for holing out before mining the coal.

The coal is dull to bright black, slightly banded, and breaks with a hackly fracture. Although difficult to mine it is rather brittle, and tends to break small, but carries without crumbling. It is sub-anthracitic, ignites slowly, and burns with a short, bluish flame.

A Delta coal bed exposed in the end of the level tunnel has suffered appreciable damage by the effects of heat and solutions derived from the adjacent igneous rocks. At present the coal of this bed is of no economic importance. The roof of this seam consists of diabase.

The section of this coal bed exposed in the new workings is—

No. 438, Delta Bed.

	ft.	in.	
Very hard diabase (roof).			
Black coaly clod	0	5	
Coal, dull	0	10	Sampled 3 feet
Clay, hard	0	2	Sampled 3 feet
Coal, earthy, with bright bands	0	4	Sampled 3 feet
Clay, hard	0	1	Sampled 3 feet
Coal, dull, with bright bands	1	7	
Fireclay, very hard (floor).			

Sample 438 was taken at the point where the horizontal tunnel intersects the seam about 100 feet from the entrance. The bed contains several hard clay bands, the greater part of which, having a higher specific gravity than the coal, can be removed by washing machines. These partings adhere firmly to the coal, and cannot be separated in mining.

Most of the coal in this bed is dull-black in colour, with a black streak. It is massive, tough, and slightly laminated. Its heating value is low.

The openings on the third group of coal beds are not extensive. On Theta bed a tunnel has been driven 32 feet, and on Iota and Kappa tunnels have exposed the coal. These workings are near the No. 7, and are quite unimportant. At the time of investigation the openings on these three beds were inaccessible a few feet beyond the entrance, and the information, therefore, relates to outcrop coal. The uppermost of these beds marks the change in character of the coal from altered humic to anthracitic. The coal is not so highly metamorphosed as that of bed Delta, and appears to approach true anthracite in composition and character.

Theta coal bed was opened up many years ago in a short drive (35 feet), now collapsed, and is reported to be nearly 3 feet thick in the end. The section near the outcrop is—

	ft.	in.
Fireclay (roof).		
Coal	1	0
Clay parting	0	2
Coal	0	8
Fireclay (floor).		

The coal bed dips at an angle of 17 degrees to north 5 degrees west.

It is a dull variety with bright laminations, and is considered to be equal in quality to the best coals on the field. Unfortunately it was not possible to obtain a sample.

The following section represents the coal bed exposed near Fault Creek:—

No. 443, Iota Bed.

	ft.	in.	
Shale, hard (roof).			
Coal, dull, dirty	0	3	
Clay	0	7	
Coal, soft, perished	1	0	
Clay, hard	0	3	
Coal, soft	1	0	Sampled 1 ft. 10 in.
Clay, hard	0	7	
Coal, bright, firm	0	10	
Shale, hard (floor).			

Sample 443 was taken from old tunnel workings about 12 feet from the entrance. The coal had been subjected to the action of weathering agents for many years, and its quality had been thereby reduced. In the upper portion of the bed the coal appeared to be perished, and was not sampled. The clay band between the lowest seams was also excluded, as this material can be easily separated from the coal.

This is a dull anthracitic coal, with occasional bright bands.

It ignites very slowly, burning with a short bluish flame until combustion is complete. It is a smokeless coal, and probably would prove suitable for hop-drying purposes.

This section of coal bed (Theta) was measured in the eastern part of the field at what was known as No. 1 outcrop.

No. 444, Theta Bed.

	ft.	in.	
Clay, hard, shaly (roof).			
Coal, stony	0	3	
Clay, hard	0	4½	
Coal, bright	0	4	Sampled 1 ft. 3 in.
Clay, hard	0	6	
Coal, dull, with bright laminæ	0	11	
Clay, hard (floor).			

Sample 444 was taken from an outcrop of dull coal, about 20 chains downhill from Theta, in the bed of Fogarty Creek. The 6-inch band of hard clay between the two seams of coal was not included in the sample, as it can be separated in the operation of mining. The weathered coal is dull black, soft, tough to brittle, massive, without lamination or other marks of bedding.

In the operation of breaking the coal from Beta bed the soft clay band is holed out first and thrown into the gob. The 9-inch seam of coal breaks away easily from the hard fireclay forming the roof, and falls of its own weight. The lower seam of the coal bed, with the hard clay band, is then either drilled and shot out with compressed powder, or pried off with pinch bars.

The coal in Eta bed is shot from the solid with compressed powder after the thin band of shale under the hard roof has been holed out to a depth of 3 feet.

Coal is conveyed to the bottom of the dip tunnel in trucks of 1000 lb. capacity by boys, and steam power is employed in the haulage to the surface.

The headings are of sufficient inclination to provide drainage to the bottom of the dip, where the water collects, and is raised to the surface by means of a Worthington steam pump.

Natural ventilation is obtained by the circulation of air through the main openings past the working faces and up air shafts to the surface.

The coal is delivered on to grizzly screens with ⅞-inch apertures, which separate it into lump and slack. The slack is dumped, and the lump coal is loaded direct into tramway trucks. Very little picking is done either inside or outside the mine.

A 2-ft. gauge tramway connects the mine with a jetty on the west side of North-West Bay, near Margate. From the jetty the tramway crosses gently rising country for 4 miles, thence steep sidelong up to the saddle (1400 feet above sea-level) near the mine. It is well designed and constructed, having generally a firm foundation, easy curves, and grades not exceeding 1 in 28. The tramway has now fallen into a state of disrepair. The sleepers have rotted, culverts have caved in, embankments have subsided, and several bridges have been destroyed by fire. The rails are a nondescript lot, consisting of 4 miles of 40-lb. per yard, ordinary pattern, 1 mile of 40-lb. per yard, chair rails, and 7¼ miles of 20-lb. per yard rails. The rolling-stock consists of two small locomotives, made by Krauss & Co., of München, Germany, and three trucks of 6 tons capacity, quite unsuitable in design for this purpose.

The cost of railage from the mine to the jetty—grades with the load all the way—amounted to 3s. 6d. per ton, or 3½d. per ton per mile. Each train consisted of three trucks, and required the attendance of two brakesmen. Accidents on this rough and uneven railroad were not infrequent, although the speed of running seldom exceeded 6 miles per hour. The locomotive was uncoupled at the summit and sent ahead. At the jetty the trucks were hauled to the top of the bins and emptied of their contents by hand. This operation cost 1s. per ton. From the bins, barges were loaded through chutes at a cost of 3d. per ton, and freightage to Hobart (20 miles distant) amounted to 6s. 6d. per ton. The total cost of delivery from the mine bins to the wharf at Hobart was not less than 12s. 6d. per ton, or over 4½d. per ton per mile.

These high rates placed the Sandfly coal in an unfavourable position in the markets compared with the better Cornwall and Mt. Nicholas coals, which are delivered 145 miles by rail at a cost of 12s. 3d. per ton.

Under present conditions Sandfly coal cannot be mined and delivered at Hobart under 26s. per ton. The costs are made up as follows:—

	Per ton. s.	d.
Mining	8	6
Underground haulage	2	0
Supervision and general charges	2	0
Rates and wharfage	0	6
Transport costs	12	6
Repairs, &c.	0	6
Total costs	26	0

It is doubtful whether the mine is of sufficient importance to warrant the expenditure of the large sum required to put the tramway and rolling-stock in working order. However, in the event of the proposed Huon railway passing through this property the value of the mine would be greatly enhanced, and a profitable future assured.

(c) *Quality of Coal.*—The quality of the coals of this area varies from anthracitic to humic. Although the variation is due in part to the action of the intruding diabase, there is an inherent difference in the physical character and chemical composition between the coals of the several seams. For instance, it has been noted that the gradation from humic to anthracitic is in descending order, so that anthracites occur in the lowest and humic coals in the uppermost beds. Moreover, the anthracites are not in all cases metamorphosed humic coals, but are in some cases unaltered iron-black coals of high carbon content, possessing a bright lustre and conchoidal fracture. Local variation in the same seam is due to heat from the diabase intrusive. The fireclay roof and floor of the seams in the new workings at the end of the adit and in the west heading have been converted into extremely hard rock, and the enclosed coals, originally of humic character, have been almost completely anthracitised by the action of the overlying diabase. In this instance anthracitisation was doubtless due to the effect of hot gases emanating from the igneous rock, but this agent was not responsible for the change in all cases.

No particular description is applicable to all the coals, but generally they have a pitch-black colour, vitreous to brilliant lustre, brownish-black to black streak, an irregular to conchoidal fracture, and a dense texture. As a rule they are hard, slightly brittle coals, and are capable of withstanding the effects of weather, and possess good storing properties. They ignite at a high temperature, burning slowly to cinders, and some varieties when retorted, yield a coherent coke.

The analysis of samples from the various seams are given in the Composition Table (pages 28-30), and as indicated above have the following numbers:—

Seam.	Sample No.
Alpha	445, 439
Beta	434, 435, 440
Delta	438
Eta	436, 441, 437
Theta	444
Iota	443

(d) *Production.*—A complete record of the output of coal from the Sandfly Mine is not available. It has been estimated that the production from the main workings on Beta coal bed exceeds 20,000 tons. From the No. 7 workings on Delta bed 400 to 600 tons only have been shipped, and about 1500 tons have been taken from the same bed out of the new workings.

(e) *Quantity of Coal Available.*—Although this coal area occupies over 1000 acres, the extent of workable ground is very much less. Consideration, in the estimate of quantities, has not been given to coal beds containing seams aggregating less than 30 inches in thickness. Again, only the portions of the area proved by boring or mine openings have been taken into account.

On the 30-inch basis, and assuming the rate of workable coal at 1200 tons per foot thickness per acre, the available coal from the various seams is put at:—

	Tons.
Beta bed	768,000
Gamma bed	1,382,400
Delta bed	49,000
Eta bed	2,160,000
Total	4,359,400

The other coal beds were not considered of workable thickness. Alpha bed is poor in quality, and might be excluded in the estimation of available coal.

(2)—Mt. Cygnet Area.

A.—*Location and Extent.*

The coal area about to be described is situated on the north side of Port Cygnet and extends in that direction for 5 miles. This is the only coalfield being worked in the southern districts, and, with the exception of Sandfly, is the most adjacent to Hobart, from which it is distant in a south-west direction about 38 miles. The area of coal-bearing rocks already proved in this locality is 600 acres, and extensive additions eastward in the valley of Garden Island Creek, and north-westward in Nichols Rivulet valley are indicated by other outcrops.

B.—*Access.*

The coal beds are readily accessible from the valley of Nichols Rivulet, on the east side of which outcrops are exposed for 5 miles. Because the strata dip to the south-east the beds rise toward the north, but at all places along the outcrop, the hill-slopes are moderate, and approach to the coal is relatively easy. The rise from the Mt. Cygnet Mine to Berry's workings (3 miles northward), is only 510 feet. A tramway 3 miles long connects the Mt. Cygnet Mine with the jetty at Gardiner's Bay, an inlet of Port Cygnet. This tramway could be extended on easy grades up to Heaney's Mine, and beyond if required. Communication is maintained by steamers plying regularly between Gardner's Bay and Hobart.

C.—*Previous Reports.*

The earliest official records of the occurrence of coal in this area is contained in a report ([23]) by G. Thureau to the Secretary for Mines in 1881. At the time of that investigation very little development work had been accomplished, and not much information was obtained.

In 1902, W. H. Twelvetrees ([24]) visited and reported on the coal beds. During the intervening period the mine had been opened up, and large quantities of coal had been shipped to market. At the time of Twelvetrees' visit the annual production had increased to 3000 tons, and the popularity of the coal had become firmly established. The dip-tunnel had been advanced to 900 feet, and headings were being driven east and west in preparation for an icreased output.

Twelvetrees' remarks refer only to the Cygnet Mine.

D.—*Topography.*

(1)—General Description.

The topographic features of this area are essentially similar to those of the adjacent Sandfly area just described. It is an exceedingly hilly, even mountainous, tract, minutely dissected by torrentinl streams. The formation of this hilly country consists of large fault blocks of strata uplifted to various altitudes by intruding diabase. These faulted strata occur both in the outer high ranges, and in the lower foothill country, and are distributed in most erratic fashion. A long period of intense erosion has greatly modified the original topography.

([23]) G. Thureau: Report on the Coal Mines in the vicinity of Gardner's and Randall's Bays, 25 August, 1881. Legislative Council Paper No. 91.

([24]) W. H. Twelvetrees: Report on Gold and Coal at Port Cygnet, 31 May, 1902. Secretary for Mines Report, 1901-1902.

(2)—Relation to Mining.

The chief outcrops of coal are found high on the eastern side of the valley of Nichols Rivulet. As the seams dip to the south-east they rise to the north-west, and flatten as the hill contour approaches the strike. The direction of the contour at Heaney's is such that the coal beds can be operated from "strike" tunnels, thus ensuring gravity drainage and transport. In other parts of the area the tunnelling facilities are equally convenient.

Another great advantage to mining operations is the easy access of the coal beds at every mine from the shipping port.

The topographic conditions generally are decidedly favourable.

E.—*Geology.*

(1)—Geological Map.

Reference was made in the report on the Sandfly area to the relationship of the diabase and alkali syenites and porphyries to the intruded sedimentaries, and as the same remarks are applicable to the association of these formations here no further note need be made. The geological map shows the extraordinary manner in which the sedimentary rocks have been disrupted and tilted at various angles and in all directions. The whole formation has been uplifted and block faulted along lines following the outline of the intrusive igneous rock, showing, in addition to the great structural fault-lines, numerous minor faults in the sedimentary strata.

(2)—The Permo-Carboniferous—Trias-Jura Section.

Although vestiges only of the upper coal measure strata remain, they were originally continuous with the formation of this age occurring in contiguous areas, but denudation has reduced these measures, and even in places entirely removed them, till in certain cases isolated areas only of the lowest members remain. No trace of the coal-bearing felspathic sandstones and shales of Trias-Jura age can be found, and areas of small dimensions only of the underlying Ross sandstones and grits are left to mark the occurrence of this once extensive formation. The Permo-Carboniferous strata likewise have been greatly reduced in thickness, but in places nearly all members are found tilted at appreciable angles, and are thereby protected from complete destruction. Generally, however, the angle of tilt is very small, and the lower members are exposed in deep ravines only. A complete section of the Permo-Carboniferous is nowhere exposed, but an idea of the thickness of the upper members can be obtained.

These coal beds, from the fossil plants *Gangamopteris* (a dwarf form), and *Vertebraria australis*, preserved in the coal-bearing shales, are referred by R. M. Johnston to an upper horizon in the Permo-Carboniferous, *i.e.*, somewhat younger than the Mersey coal beds or the Greta coal measures. Stratigraphically also these coals occur at a much higher horizon, and may be correlated with the upper measures at Mt. Pelion, or, in other words, the Tomago or Newcastle series of New South Wales.

(3)—The Mode of Occurrence of the Diabase.

Intrusive sheets and dykes of igneous rock, so characteristic of the Upper and Lower coal measures, crop out here in enormous masses. Probably the complete removal of the Trias-Jura over such a large extent of country is responsible for the comparatively large portion of the area occupied by this rock. The injection was mainly at the base of the Trias-Jura, for members of this formation have not been found underneath the diabase, which apparently rests on the upper members of the Permo-Carboniferous. Undoubted sills of this igneous rock occur here, but whether or not the main mass of diabase composing Mt. Cygnet is a sill or a dyke has not been determined. The conclusion is drawn with hesitation that the mass represents a sill, with a central dyke-like feeder from the subjacent laccolithic mass. It is not unlikely that the outcrops of coal in Garden Island Creek valley represent the slightly disturbed seam in that direction. It is quite evident, however, that the large sill-like masses are not regular, but have in their intrusion into the sedimentaries broken from one stratigraphic horizon to another.

(4)—Structure.

(*a*) *Faults.*—Faulting at Mt. Cygnet has had a detrimental effect on the successful exploitation of the coal seams, limiting the workable ground from any particular mine opening to a small area. Three of these faults have a north-westerly course, with displacements of 15 and 30 feet to the north-east. Another was met in Gordon's Mine, coursing a few degrees south of west, with displacement of over 30 feet to the south. There are indications of another extensive fault between Heaney's Nos. 1 and 2 mines, but no dislocation of the strata could be detected at surface. Further north-westward, near Margate-road, the country is faulted very badly, and outside the coal-bearing areas dislocations on a large scale are common.

(*b*) *Dip of Coal Seams.*—The direction of the dip of coal seams in the main workings of the Mt. Cygnet Mine is 147° 30′, and the average rate of inclination is 1 in 5·77, or 11 feet 4 inches per chain. At Heaney's workings the strike is 75°, and the dip is toward south-east, at angles varying from 8 to 11 degrees. North-west of Heaney's, beyond the stone house, the strata are faulted to the west, and the dip changes to that direction. In the valley of Garden Island Creek the dip is generally towards the south-east, but numerous local variations occur. At Gordon the direction of dip is contrary to the general trend throughout this coal area, having a south-westerly course. The seam on the sea-coast dips 240°, at angles varying from 5 to 8 degrees.

(5)—The Coal Seams Represented in the Area.

Two coal beds occur in Mt. Cygnet area, and there are indications of two more. The upper, or Lamba, seam only has been developed, although it is stated the lower, or Mu, seam contains coal of superior quality. But the comparative thinness of the lower seam at the outcrop has discouraged exploration. Lamba seam can be traced along the outcrop on the hillside over 3 miles, and Mu seam has been exposed here and there in trenches over 2 miles. Naturally the mine openings were selected where there was the best showing of coal at the surface, and the average thickness at these points is 3 feet. Towards the northern workings on Berry's land it gradually thins out until it is only 15 inches thick. Mu seam, 12 inches thick, is 20 feet lower, and 12 feet below that is a small 2-inch seam. Two to three hundred feet above the main workings is an unexplored bed of fireclay, containing indications of coal.

These seams have been exposed again in faulted position at the head of Nichols Rivulet, beyond Irishtown; in the valley of Garden Island Creek; in the vicinity of Gordon, on the sea-coast; at Coal Mine Bay; and indications have been observed in Welling Creek, near Cradoc, and in Snug River valley.

These coal beds on fossil and stratigraphic evidence have been assigned to an upper horizon in the Permo-Carboniferous.

F.—*The Mining Properties.*

(1)—The Mt. Cygnet Coal Mine.

(*a*) *Number and Area of Leases.*—This mine, owned and operated by the Electrolytic Zinc Company of Australia Ltd., is contained within Section 73P-M, of 270 acres, charted in the name of E. H. Butler.

(*b*) *Extent and Method of Mining Operations.*—Mining operations have been carried on here in an intermittent manner since 1881. During the intervening period the ownership of the mine changed hands several times, and it cannot be claimed that success has attended the efforts of any one company of operators. However, the future holds brighter prospects in this regard, since the coal has proved eminently suitable for use in the metallurgical processes involved in the extraction of zinc oxide from zinc residues, for which purpose it is particularly required by the present owners. Hitherto the work of the operating company has been more exploratory than developmental; but the results, having proved satisfactory, a more ambitious scheme has been drawn up, with the object of exploiting the coal seams on a commercial scale. The extent of the existing workings made this a comparatively easy matter.

This coal bed has been opened in trenches and in dip and strike tunnels at widely separated points along the outcrop, over a distance of 3 miles.

The entrances to the main workings of the mine are by dip tunnels, the No. 1 being 1160 feet, and the No. 2 over 300 feet long. The general design of the workings is by single entry pillar and stall system. From the main headings driven along the strike the stalls are turned up the rise and extended to the next heading above. Pillars 20 yards square are considered sufficient to hold the main roadway of the dip tunnel. In the worked-out areas the pillars are drawn by the retreating method. It was, evidently, the intention of the late management to discontinue work from the No. 1 pit, as the pillars have been removed over a large area, and the coal on both sides of the dip tunnel has been taken out also, thus jeopardising the safety of the mine. Despite the removal of the supporting pillars there has not been a serious fall near the tunnel, and, except for a slight lateral movement westward, the highly resistant sandstone roof has remained undisturbed.

No. 1 dip tunnel follows a due south course on the half dip for 800 feet, then turns toward the true dip, and continues to the bottom 300 feet further on a bearing of 136 degrees. It is proposed to continue the straight section of the dip tunnel in order to allow of rapid haulage, and at the same time provide facilities for the removal of the intervening coal. On the west side the seam looks well, but very little work has been done in fear of meeting with a fault in that direction. Operating against the cleat the coal is difficult to mine, but with headings well advanced this can be obviated by working back toward the tunnel.

It is fortunate for the present safety and future working of the mine that very little coal was removed from the west side of the tunnel. Nearly 20 acres of coal-bearing country has been excavated eastward to the end of the longest heading, which, at 1000 feet, encountered a fault. Part of this worked-out ground has collapsed, but the lower workings are still intact.

The following section of the coal-bearing bed was measured at the bottom of the dip tunnel, 1160 feet from the entrance:—

No. 478, Lamba Coal Bed.

	ft.	in.	
Sandstone, hard, quartzose (roof).			
Shale, black carbonaceous	0	2	
Coal	2	4	Sampled
Shale, clayey	0	1	Sampled
Coal	1	0	Sampled
Shale, bright carbonaceous (floor).			

Sample 478 was taken from a fresh face of coal a few feet from the west side of the dip tunnel, at the place where the measurement was taken. The coal here is hard and black, with vitreous to dull lustre, conchoidal to splintery fracture, and possesses a fine banded texture. In some places it has contorted laminæ and slickensided faces; in others the banding has been completely destroyed by shearing movements. Jointed structure is lacking for the same reason.

Throughout the workings the coal is overlain by a massive, quartzose sandstone, but at some places a dark carbonaceous shale intervenes. Where it occurs the shale is made to serve as the roof of the mine; elsewhere the roof is hard, unbroken sandstone. This sandstone is very sound, and forms a safe protection for the workings. The shale, which occurs on the roof at isolated points only, everywhere constitutes the floor of the seam, and one particular band directly below the coal is used for holing underneath. This underlying shale is not jointed, and the lamination is more or less destroyed by crushing or shearing, as exhibited by the numerous slickensided surfaces.

Rolls occur in the roof down to the end of the straight section of the dip tunnel, thence the roof is remarkably regular and firm. The coal parts readily from the roof, and breaks in large blocky lumps.

No. 2, or Gordon's, workings consist of a dip tunnel, from which several headings have been driven at right angles. At the bottom of the tunnel a transverse fault having a 30-feet downthrow to the south was intersected, thus limiting operations from this opening. Two headings have been driven 500 feet to the north-east. One commenced at 190 feet from the entrance to tunnel; the other at 256 feet. These headings passed through several rolls and slips, but no faults were met. On the south-west side headings have been driven 150 feet. Work was discontinued in this direction owing to the occurrence of another fault.

The following section was measured near the bottom of dip tunnel:--

	ft.	in.
Sandstone, hard, quartzose (roof).		
Shale, carbonaceous	0	3
Coal	2	1
Shale	0	1
Coal	0	10
Shale, bright, carbonaceous (floor).		

Analysis 478A represents the average of 15 samples taken from various parts of these workings.

(c) *Quality of Coal.*—This coal was originally of humic character, but an anthracitic nature has been induced by the action of the rise in temperature, and the pressure emanating from the intrusive sheets of igneous rock traversing the measures. The anthracitic nature of the coal varies with the degree of dynamic and thermic action, to which the beds have been subjected. This change in condition from the original humic nature cannot be attributed wholly to the effects of heat. It is probable, and the texture of the coal indicates it, that it has been subjected to severe shearing stresses.

In general, the coal in this area has a dull appearance, with occasional bright laminations, and is hard and compact. It breaks down in large masses, and the percentage of slack is very low. It is capable of withstanding the shock of severe handling, and is not greatly affected by weathering agents. The ignition point is high, and combustion is slow, and is not accompanied by decrepitation. In the furnace it gives out great heat.

(d) *Production.*—It has been variously estimated between 60,000 and 70,000 tons of coal have been obtained from the 20 acres of ground worked out in the No. 1 mine. From the No. 2, about 4000 tons have been broken out and shipped to market.

(e) *Quantity of Coal Available.*—The coal bed has been proved to extend over 180 of the 270 acres constituting the area of the section owned by the Electrolytic Zinc Company of Australia. Throughout this area the average thickness of the main seam has been computed at 2 feet 9 inches. On this basis the gross tonnage amounts to 485,000 tons. If from this quantity the 70,000 tons of coal already mined be deducted, the net tonnage available amounts to 415,000.

In the event of the continuation of the seam under the diabase cover this estimate will be greatly augmented.

(2)--Heaney Mine.

(a) *Number and Area of Leases.*—This property of 100 acres is held under lease 72P-M, by J. L. Frizoni.

(b) *Extent and Method of Mining Operations.*—The coal bed is opened up on this property by means of two "strike" tunnels, Nos. 1 and 2, driven on a bearing of 75 degrees. No. 1 workings have been extended to 500 feet from the entrance, exposing a seam of clean coal 30 inches in thickness. These mine workings, after 20 years' inattention, are still in very good order. The hard even roof consists of sandstone for 270 feet, thence a dark carbonaceous shale displaces the sandstone. From this heading bords have been sent up the rise, and considerable coal has been mined.

The No. 2 workings, about 15 chains further to the north-east, are not so extensive. A strike tunnel or heading has been driven 200 feet on the seam, exposing coal of equal quality to that in the other workings. Between the No. 1 and No. 2 tunnels a fault of considerable displacement is indicated.

In the design of future operations it has been considered advisable to drive a strike tunnel from a gully 26 chains south-east of No. 1 workings. This tunnel would command the greater part of the coal on this section, and a very considerable area beyond it.

(c) *Quality of Coal.*—The quality of the coal here is essentially similar to that opened up in the Cygnet Mine. The seam is free of bands, and is perhaps a little brighter and harder than it is in the main mine.

Sample 480 represents the average grade of coal mined here. The analysis shows a coal of slightly higher quality than that obtained from the Cygnet colliery.

(d) *Production.*—It is estimated that 2000 tons of coal have been mined in these workings and shipped to market.

(e) *Quantity of Coal Available.*—Coal has been proved to extend over the whole area of this lease. The several workings show an average thickness of 30 inches, and the bulk of the coal can be mined without difficulty under the good conditions prevailing here.

The total quantity available, on the basis adopted in this work, amounts to 300,000 tons.

G.—*Unleased Coal-bearing Areas.*

The coal seams are continuous north-westward of Heaney's for a mile, and the upper seam has been opened up on Berry's property in a small tunnel driven north-eastward 40 feet into the hillside. The seam here is only 12 to 14 inches thick, but the coal is of excellent quality. Sandstone forms the roof, and 12 inches of bright black shale the floor. Beneath this is 8 feet of dull shale resting on sandstone 20 feet thick, which is succeeded in turn by mudstone.

Two miles north-westward from Berry's workings the seam has been exposed again in sledge ruts on the hillside 40 chains east of Nichols Rivulet.

Sample 479 was taken from the seam at the mouth of Berry's workings, and had been exposed to the weather for many years. It is essentially similar in composition to the coal on Heaney's and Mt. Cygnet properties.

In the valley of Garden Island Creek, on the east side of Cygnet Range, the seam has been exposed in sledge ruts on Winter's land, but no work has been done to prove its thickness and extent. It is not at all likely that the great mass of diabase forming the backbone of Cygnet Range occurs wholly in the form of a sill, therefore the uninterrupted continuity of the coal seam from the Cygnet Mine to this point is doubtful. This unexplored area, however, is worthy of careful attention.

Indications of the seams were observed in the bed of Deep Creek on Merchant's land, and again near Coal Mine Bay.

(3)—Gordon Coal Area.

On the coast-line near Gordon settlement the upper Cygnet seam outcrops again. The outcrop shows an 8 to 10 inch seam supporting a roof of sandstone, and resting on a 6-feet bed of carbonaceous shale. The dip of the seam, 60° west of south, at an angle of 10 degrees, is contrary to the general direction. There is in this locality a large area (about 800 acres) of coal-bearing country, but very little development work has been attempted to prove the thickness and value of the seam.

About 44 years ago a tunnel from the sea-coast was driven on the seam, and several shafts inland were sunk, to test the bed, in most cases without reaching the coal. According to reports the seam in the face of the tunnel is 18 inches thick. This statement could not, however, be verified.

Sample 482 was taken from the outcrop on the beach. It had suffered deterioration by the action of sea-water, and by the atmospheric agencies, and consequently does not represent the true quality of the coal. Unfortunately, some foreign material was broken with the coal and included in the sample.

Chapter IX.

THE UPPER DERWENT COALFIELD.

(1)—Lawrenny Area.

A.—*Location and Extent.*

This coal area is contained within the boundaries of the well-known estate of the same name owned by Brock Bros. Ltd., and probably extends over 1000 acres, of which 250 are proved to be coal-bearing. It is situated on the east side of the Derwent River, between the townships of Hamilton and Ouse, and is 53 miles by road from Hobart.

B.—*Access.*

Perhaps the greatest obstacle to the advancement of this field has been due to its remoteness from a railway. The Derwent Valley Line, connecting with the main trunk railway at North Bridgewater, follows the east bank of the river to Macquarie Plains, thence crossing to the other side continues in a westerly direction to Fitzgerald. As the mine is on the east side, the railway beyond Macquarie Plains station, for all practical purposes, does not serve the settlements situated in the main valley. Some years ago a branch railway extension from Macquarie Plains, passing through Lawrenny, was surveyed. This railway, if constructed, will pass within 40 chains of the mine, thus affording good transportation facilities. The present connection is by road, which continues on to Lake St. Clair.

C.—*Previous Reports.*

The first official record of this coalfield is contained in a report by G. Thureau in 1883.(39) In this work Thureau describes the relationship between the several geological formations, paying particular attention to the coal-bearing strata. At the time of his visit the workings were under water, and the seams could not be inspected.

In 1894 A. Montgomery (40) visited the field and made a detailed survey. A considerable amount of development work had been done during the period intervening these visits, but Montgomery was likewise unfortunate in not being able to examine the underground workings. Although he had to rely largely on the record of the officer in charge of the boring plant and on the observations of others for information relating to the nature and thickness of the seams exposed in the shafts, he has, nevertheless, been able to present a very reliable account of these occurrences.

A considerable amount of the information contained herein has been obtained from his report.

D.—*Topography.*

(1)—General Description.

The surface of this area consists of rolling, scantily timbered, grass-covered country dissected by the Derwent River and its tributaries. Although the general aspect is decidedly hilly, the relief is not very great, showing a difference in altitude

(39) G. Thureau: Report on the Hamilton and Ouse Coal Deposits, 14th August, 1883. House of Assembly Paper No. 111.

(40) A. Montgomery, M.A.: Report on the Lawrenny-Langloh Coalfield. Secretary for Mines Report 1893-1894.

not exceeding 1000 feet. The only really level land is that in the flood plains and terraces of the Derwent and the elevated plateau. The gentle slopes of the broad valley of the Derwent are in strong contrast with the deep, sharply-carved channels of its tributaries, the Clyde, Ouse, Dee, Broad, and Repulse rivers. In Tertiary time the major stream was even then one of considerable magnitude, and during this period the deep and extensive deposits of lignite-bearing clays and sands were laid down. Near the debouchure of the Ouse the rivers are still engaged cutting through these beds.

It is noteworthy that the erosion-resisting igneous rocks (diabase and basalt) occupy the highlands, while the comparatively soft sandstones are found almost invariably at much lower altitudes. Viewed as a whole the dissection has not been minute. This is accounted for by reason of the low rainfall.

(2)—Relation to Mining.

It does not always follow that a district of high relief is necessarily of very great advantage to mining. That the conditions existing here are generally suitable is due more to the fact that the seams dip westerly in conformity with the general slope of the hills than to any other cause. Unfortunately, however, the dip is generally greater than the hill slope, so that outcrops, even if the soil-cover were removed, would be few. Then again, on the west fall, where the seams should outcrop near the bottom of the hills, the slopes are so gentle that, in operating from strike tunnels long distances would have to be driven before attaining any considerable depth below the surface. In prospecting operations the very deep soil-cover is a decided hindrance.

Although the conditions are not ideal, the mine can be advantageously operated from the direction of easiest access.

E.—*Geology*.

(1)—Geological Map.

The geological map (Plate XXIII.) accompanying this report embraces the whole of the known coal-bearing country in this area, and conveys a clear conception of the distribution of the various formations and of their relationship one to the other. The map is based on the land chart of the district, but details have been added as considered necessary.

The oldest rocks represented in the district are the Permo-Carboniferous sandstones, mudstones, and limestones cropping out on the west side of the Derwent. In this area no seams of coal have as yet been found in them. The Trias-Jura coal-bearing sandstones and shales conformably succeeding them occupy the greater part of the surface on the east side, while only remnants of this formation are found on the other side. Terraces of clays, sands, and soft sandstones intercalated with numerous seams of lignite mark the broad bed of the Tertiary Derwent. The log of Bore "E" gives a complete section of the Tertiary strata in this basin. In the bed of the Ouse River, about 30 chains above the point of confluence with the Derwent, is an outcrop of brownish-black lignite 4 to 6 feet thick. These deposits of lignite are seamed with thin bands of grey clay, and contain distinguishable remains of leaves, branches, roots, and stumps of coniferous trees—the latter in their original position. Quaternary gravels, sands, and white clays, 6 to 20 feet thick, occupy the river flats or flood-plains of the Derwent.

The map shows this coal area almost surrounded by igenous rocks, diabase forming the hills to the north-east, east, and south, and basalt occupying the highlands to the north-west and south-east. These masses of scoriaceous and vesicular basalt represent the remnants of Tertiary outflows found at intervals up the Derwent

Valley and in particularly large bodies in the neighbourhood of Macquarie Plains. The basalts contain beautiful radiating crystals of natrolite, one of the zeolites.

(2)—The Permo-Carboniferous—Trias-Jura Section.

The coal-bearing strata of this area, consisting of greyish-blue shales and yellowish-brown, felspathic sandstones, belong to the Trias-Jura system. Because of their peculiar appearance, these soft sandstones are easily identified, and they are invariably found in association with the coal seams of this age. In this locality numerous fragments of roots, stems, and branches of fossilised conifers, still showing the original structure of the wood, are found in them. The shales underlying the thick-bedded sandstones contain numerous impressions of fern plants typical of the period. In addition, blocks of silicified coniferous wood, some of large size, are found strewn over the surface, having been liberated from their softer-enclosing matrix of sandstone by weathering agencies. Underlying the coal-measure strata are beds of hard, even-grained, siliceous sandstones, composed almost entirely of quartz grains with secondary sericite. They are named Ross sandstones, because they are characteristically developed in that locality. In these coal has not been found. They outcrop in the village of Hamilton—where they have been extensively quarried for building purposes and for the manufacture of grindstones—and were penetrated by the drill near the bottom of Bore "D." These lower members, consisting of siliceous sandstones and grey shales, crop out again in Derwent Valley on both sides of the River, ultimately giving place on the south-west side to Permo-Carboniferous strata.

The coal measures are about 400 feet thick, and the lower members of the formation about 300 feet thick.

Underlying these, towards Russell Falls River, are the grits, sandstones, mudstones, and fossiliferous limestones of the Permo-Carboniferous system. This formation is not prominent in Lawrenny area, consequently the thicknesses of the several members could not be determined.

(3)—The Mode of Occurrence of the Diabase.

This field, consisting of an isolated area of coal-bearing rocks, once formed part of a very much larger body of Trias-Jura coal measures, but was severed from the main mass by the intrusion of diabase. Apparently the diabase, in breaking through the sedimentaries, carried up with it large blocks of these rocks, completely dislocating the strata and dividing the great measures into comparatively small fields. Thus are found isolated masses of the coal measures strata at Lawrenny, Macquarie Plains, Plenty River, and elsewhere in the neighbourhood. The irregular degree and direction of the inclination of the strata are largely due to the uneven outline of the intruding diabase. Moreover, the faulting of these measures is directly attributable to this agent, and probably the variation in altitude of the several coal areas is the result of the readjustment of the formations following the cooling and contraction of the diabase.

Although the diabase does not completely surround the coal area, it occurs in every segment of the circle and underlies the field at no great depth. Moreover, narrow subsidiary dykes protrude here and there through the measures, causing however, no serious displacement of the strata. At Langloh and Kimbolton all the bores bottomed on this rock, which rose to different heights in the strata, completely cutting out some of the lower seams in the northern part of the area. It is possible that the intrusive mass is in the form of a sill, and that it cut obliquely across the strata, but there is no definite proof of this. No attempt has been made to bore through the diabase in order to determine whether or not it occurs in sill form between the Trias-Jura and Permo-Carboniferous formations. It is possible also that in its ascent the molten mass resorbed a part of the overlying strata, leaving only the remnants that now constitute the coal areas. However, the only metamorphic effect of the intrusive is a hardening and baking of the sandstones and shales, and the diabase appears fairly fresh and homogeneous near the contact, and on this evidence it does not appear likely that resorption has taken place to any considerable extent.

(4)—Structure.

(*a*) *Faults.*—Although faulting has been considerable the displacements in the coal area are only of a minor character and will not seriously affect mining operations. Outside this area, between the Main-road and Derwent River, the faulting has been intricate and of much greater magnitude.

(*b*) *Dip of Coal Seams.*—The average dip of the coal seams, as determined by Montgomery, is S. 86° 46' W., at an inclination of 2° 53', or 1 in 19·93. In the coalfield proper the dip is fairly regular, but in the southern part the rocks have been intensely dislocated, and the dips are variable in degree and direction. On the east and south sides the continuity of the coal measures has been interrupted by intrusive masses of diabase. On the southern side of the Derwent the sedimentary rocks are upturned at high angles, and dip towards the north-east, with local variations to east and south-east. For several miles between the Derwent and Russell Falls Rivers the strata have a general north-easterly dip, having been less disturbed here than in any other part of the district. It appears that the westerly dip of the coal measures is local, for on the western border, in the neighbourhood of a small dyke of diabase, the exposed strata have a northerly dip.

(5)—The Coal Seams Represented in the Area.

No less than eight distinct seams have been discovered in the operation of boring through the coal measures. Of these only three give promise of becoming economically important—the others are too small and are badly seamed with clay and stony material. From the boring log it will be found that the seams not only vary greatly from point to point, but are separated by variable thicknesses of sandstone or shale. Towards the north end of the field, near Langloh homestead, seams 1 (Alpha) and 2 (Beta) coalesce, forming a bed of coal over 7 feet thick. At this point they are separated from seam 3 (Gamma), containing 4 feet of coal, by a band of fireclay only 3 feet thick, and seam 4 (Delta) is only 6 feet further below. Eighty chains south-west from the homestead the seams are not only much thinner, but are widely separated. The fireclay band between seams 1 (Alpha) and 2 (Beta) has decreased in size to 6 inches, and 12 feet of sandstone and shale have intervened; between seams 2 (Beta) and 3 (Gamma) nearly 20 feet of sandstone and shale appear, and the divergence of all seams in this direction is general. It is possible that some of the smaller beds of coal form more or less distinct lenses which may merge into principal seams forming beds of greater thickness than at present visible.

The following is a section of the strata penetrated by Bore " A. " :—

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface soil and clay	16	0	16	0
Felspathic sandstone	36	8	52	8
Black clod	0	10	53	6
Coal, with ¼ in. band of clod	1	1	54	7
Dark fireclay	2	6	57	1
Felspathic sandstone	58	5	115	6
Diabase	5	2	120	8

The following section represents the character of the country passed through by the drill in Bore "B":—

Strata	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Surface soil	4	0	4	0
Hard, brown, felspathic sandstone	22	0	26	0
Grey felspathic sandstone	39	5	65	5
Greenish-coloured shale	4	7	70	0
Shale and felspathic sandstone	38	6	108	6
Fireclay	0	5½	108	11½
Coal (Alpha seam)	0	1½	109	1
Fireclay (Alpha seam)	0	3½	109	4½
Coal (Alpha seam)	2	8	112	0½
Stony band (Alpha seam)	0	2	112	2½
Coal (Alpha seam)	1	3	113	5½
Fireclay band	0	6½	114	0
Coal (Beta seam)	3	1	117	1
Fireclay	3	10	120	11
Coal (Gamma seam)	1	3	122	2
Stony band (Gamma seam)	0	2	122	4
Coal (Gamma seam)	0	5	122	9
Stony band (Gamma seam)	0	0½	122	9½
Coal (Gamma seam)	1	7½	124	5
Black clod band (Gamma seam)	0	4	124	9
Coal (Gamma seam)	0	10	125	7
Fireclay	5	11	131	6
Coal (Delta seam)	0	6½	132	0½
Stony band (Delta seam)	0	0½	132	1
Coal (Delta seam)	1	7	133	8
Dark shale, with plant impressions	1	3½	134	11½
Felspathic sandstone	5	0½	140	0
Blue shale, with fern impressions	5	6	145	6
Grey felspathic sandstone	37	6	183	0
Shale and felspathic sandstone	1	1½	184	1½
Coal (Eta seam)	1	3½	185	5
Shale	1	6	186	11
Felspathic sandstone	80	7	267	6
Shale and sandstone with coal	1	0	268	6
Coaly clod	0	10	269	4
Coal (Theta seam)	1	5	270	9
Dark band (Theta seam)	0	8½	271	5½
Coal (Theta seam)	1	11	273	4½
Fireclay	6	8½	280	1
Felspathic sandstone	17	11	298	0
Black clod, with fern impressions	9	0	307	0
Coal (Iota seam)	0	1½	307	1½
Black clod	1	10½	309	0
Shale and felspathic sandstone	9	3	318	3
Coal (Kappa seam)	0	5	318	8
Hard black shale, with fern impressions	4	9	323	5
Hard sandstone	16	0	339	5
Diabase	2	0	341	5

Bore C.

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Surface soil	9	0	9	0
Sandstone, brown felspathic	45	4	54	4
Clod, black	0	1	54	5
Sandstone, hard felspathic	44	6	98	11
Clod	0	7	99	6
Coal	0	9½	100	3½
Fireclay	2	0	102	3½
Sandstone, fine-grained	1	7	103	10½
Shale, sandy	1	8	105	1½
Sandstone, hard felspathic	58	8	163	9½
Clod, hard	0	2	163	11½
Sandstone, with shale containing pyrites and calcite	48	3½	212	3
Shale, hard dark	0	9	213	0
Sandstone	0	8	213	8
Coal } Alpha seam	3	5½	217	1½
Band } Alpha seam	0	1½	217	3
Coal } Alpha seam	1	2	218	5
Fireclay	2	3	220	8
Coal, (Beta seam)	3	4	224	0
Shaly sandstone	11	1	235	1
Clod, hard, black	1	6	236	7
Shale, greenish, sandy	3	5	240	0
Coal } Gamma seam	0	11½	240	11½
Band } Gamma seam	0	2	241	1½
Coal } Gamma seam	0	5	241	6½
Band } Gamma seam	0	1	241	7½
Coal } Gamma seam	2	6½	244	2
Shale and felspathic sandstone	2	2	246	4
Coal, with bands (Delta seam)	1	10	248	2
Shale	3	0	251	2
Sandstone, felspathic	48	10	300	0
Coal and clod (Eta seam)	1	6	301	6
Shale, hard, dark	10	7	312	1
Sandstone	73	3	385	4
Diabase	2	6	387	10

Bore D.

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Surface soil	12	0	12	0
Sandstone, brown felspathic	6	0	18	0
Shale, hard, brown	8	3	26	3
Coal, with ½-inch band (Alpha seam)	2	2	28	5
Clay, soft	0	6	28	11
Sandstone, with shaly material	11	10	40	9
Coal, with ½-inch band (Beta seam)	2	6½	43	3½
Sandstone and shale	19	10	63	1½
Coal (Gamma seam)	1	7½	64	9
Shale	4	5½	69	2½
Coal	0	6	69	8½
Sandstone and shale	17	6	87	2½
Clod	0	10	88	0½

Bore D—continued.

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Coal (Delta seam)	2	8	90	8½
Shale and sandstone	50	0	140	8½
Coal (Eta seam)	0	9	141	5½
Sandstone and shale	53	6	194	11½
Coal (Theta seam)	0	4	195	3½
Sandstone, felspathic	22	2	217	5½
Clod, black	3	3	220	8½
Sandstone, felspathic	13	2	233	10½
Shale, dark	4	5	238	3½
Sandstone	23	8	261	11½
Coal	0	7	262	6½
Sandstones and shales	19	9	282	3½
Coal with 2-inch bands	0	10	283	1½
Sandstone and shale	67	0	350	1½
Shale, firm, dark	7	7	357	8½
Sandstone, with shale	24	6	382	2½
Shale, white	10	4	392	6½
Sandstone, hard, white, siliceous	6	7	399	1½
Diabase	0	4	399	5½

Bore E.

Strata.	Thickness. ft.	Total Depth. ft.
Sand	10	10
Clay	60	70
Sandstone, soft	5	75
Clay	12	87
Lignite	1	88
Clay	24	112
Lignite	0·6	112·6
Clay	3	115·6
Lignite	1·4	117
Sandstone	3	120
Clay, with lignite bands	70	190
Lignite	2	192
Clay, with lignite bands	104	296
Lignite	2	298
Clay, with lignite bands	62	360
Sandstone, hard	10	370
Shale	1	371
Clay	43	414
Sandstone, soft	6	420
Clay, grey coloured	33	453
Lignite	1	454
Clay	30	484
Lignite	2	486
Sandstone	6	492
Clay, with sandstone and lignite bands	111	603
Shale, greenish-grey	3	606
Sandstone, hard	—	—

F.—*The Mining Properties.*

(1)—The Lawrenny Coal Mine.

(*a*) *Number and Area of Leases.*—The owners of this land under the provisions of the old "Crown Lands Act," hold the coal-mining rights. This area is contained within the boundaries of Langloh and Kimbolton estates, which lately have been absorbed in the larger Lawrenny property.

(*b*) *Extent and Method of Mining Operations.*—It may be said that exploratory work only has been carried on in this mine. The workings consist of two shafts and a well, in addition to a number of holes drilled to test the nature of the coal and the extent of the area. The shafts are very shallow (40 to 60 feet), and have intersected Nos. 1 and 2 seams only. The Langloh shaft was sunk for the purpose of obtaining water for domestic uses.

Another well sunk near Kimbolton homestead passed through a small seam, but did not reach Nos. 1 and 2. A shaft, 20 chains north-eastward of Kimbolton, was sunk 40 feet through felspathic sandstone, cutting No. 1 seam only.

At present the owners are engaged on exploratory work in this locality. As the coal rises to the eastward it is expected that no difficulty will be encountered in locating the outcrop by trenching through the deep soil cover along the edge of the hill. From a point nearly 1000 feet south-east from bore-hole "D" a strike tunnel is to be driven due north on No. 2 seam. This tunnel would pass 20 chains west of Bore "C" and command the greater part of the coal area. Before such work is undertaken it seems advisable to prospect the coal beds from the shaft in the direction of the proposed tunnel, or, better still, to sink prospect holes along the line of outcrop in the low ground to the south-east. Although development and exploitation of the seams from this quarter present distinct advantages they are much thinner here and unprofitable.

(*c*) *Quality of Coal.*—As these coal seams do not outcrop, and as the workings were inaccessible at the time of this investigation, no samples for analysis were obtained. In order to form an idea of its quality the earlier work of A. Montgomery has been consulted. In his report the results of analyses of samples taken from the shaft and from borings are given, and are now quoted here:—

Seam.	Locality.	Moisture at 110°.	Fixed Carbon.	Volatile Hydro-carbons.	Ash.	Sulphur.	Authority.
Alpha and Beta	Shaft	3·02	63·40	24·02	9·53	0·62	Danvers Power
--	"	4·0	66·30	23·50	6·20	...	"
---	Bore "B"	4·7	55·90	18·00	21·40	...	Montgomery
Gamma............	"	4·1	62·40	20·50	13·00	...	"
Delta	"	5·3	42·50	21·20	31·00	...	"
Theta..............	"	3·5	52·60	9·90	34·00	...	"
Alpha and Beta	Bore "D"	6·4	52·95	24·27	15·80	0·58	"
Gamma............	"	5·3	53·87	25·60	14·20	1·03	"
Delta	"	5·4	57·10	21·2	15·60	0·7	"
Theta..............	"	6·2	52·90	23·65	16·40	0·85	"

It is quite evident that the samples from the shaft are not representative, and consequently are of little value in arriving at the marketable grade of the coal. The samples from bore-holes "B" and "D" were obtained by breaking pieces from the drill core, and more accurately approach the true quality, but it is considered that the average ash content exceeds 20 per cent.

In appearance the coal is dull-coloured, with occasional bright laminations. It is fairly tough and hard, and withstands weathering by exposure for long periods.

In addition to the clay and clod bands, the only impurity discovered is pyrites, which is found in only negligible quantities.

Steaming tests carried out under the direction of officers of the Railway Department proved the coal to be equal for this use to that of the Mt. Nicholas mines. Tests show that the quantity of gas contained in this coal amounts to 10,400 cubic feet per ton and it is of 11·06 candle-power.

Under normal conditions it ignites readily, and burns with a long, yellow flame. It is a good household coal, but like all coals of this age in Tasmania the ash content is high. It shows no tendency to coke, and is not a good blacksmithing coal.

It is apparent that the quality of the coal has been more or less affected by the heat emanating from the intruding igneous rock that underlies and penetrates the coal measures of this area.

(*d*) *Production.* Alpha and Beta seams only have been exposed by mine workings, and the production from them has been very small. The total output consists of a few tons for testing purposes.

(*e*) *Quantity of Coal Available.*—In the consideration of the quantity of coal available in this area seams of workable thickness only have been taken into account. Under existing conditions it is considered that a seam of coal of this grade less than 30 inches in thickness cannot be profitably mined. It is on this basis that the estimates given hereunder have been made. The data available are not reliable, as the average thickness of the several seams depends on measurements obtained by drilling. However, an endeavour has been made to arrive at a correct estimate by ample allowances against increased measurements registered in this manner.

By referring to the log of the boring operations it will be noticed that the seams vary greatly in thickness, and in three cases only are they of workable size throughout the explored portion of the area; not only so, but the intervening rock varies also from point to point. Tabulating the results a comparison of the seams is obtained:—

Seam.	Bore "D."		Bore "C."		Bore "B."		Bore "A."		Shaft.	
	Thickness: ft.	in.	Thickness: ft.	in.	Thickness: ft.	in.	Thickness: ft.	in.	Thickness: ft.	in.
Alpha	2	2	4	7½	3	11	—	—	} 5	0
Beta	2	6	3	4	3	1	—	—	}	
Gamma	1	7½	3	6	3	8	—	—	—	
Delta	2	8	1	10	2	1½	—	—	—	
Eta	0	9	1	6	1	3½	1	1	—	
Theta	0	4	2	2	3	4	—	—	—	

At a glance it would appear that nearly all the seams are of workable thickness in parts, but owing to numerous included bands in the other seams only Alpha and Gamma are of economic importance. For the purpose of this estimate it is assumed that the seams are continuous within the compass of a circle described from a point midway between bores "B" and "D," with a radius equal to half the distance between them. On this assumption the coal-bearing area is 250 acres in extent.

A bed of coal 1 foot thick contains, after making a liberal allowance for losses in working, 1200 tons per acre. On this assumption, and the 30-inch basis outlined above, the tonnage works out as follows:—

	Tons.
Alpha seam	1,075,000
Beta seam	800,000
Gamma seam	875,000
Total	2,750,000

(2)—MACQUARIE PLAINS AREA.

In the valley of Derwent River, near Macquarie Plains Railway Station, outcrops of coal were discovered many years ago in strata of Trias-Jura age.

About 60 chains above the station a tunnel was driven on the seam without disclosing payable coal. At this point the seam is thin (from 12 to 18 inches thick), and the coal is not of high grade.

Additional works consist of shallow shafts sunk in the low ground. These works likewise were not productive of good results.

(3)—PLENTY AREA.

This coal area is situated 2 miles beyond Plenty Station, on the Derwent Valley railway. The seam outcrops in the bed of Derwent River, and is visible at low water, a distance of 20 chains, but is nowhere accessible. It is probable that the total coal-bearing area does not exceed 200 acres. The seam passing under the railway-line is very easily accessible by shaft, and this fact counts largely in its favour if it proves to be of sufficient thickness to mine economically, and if the quality of the coal is such that it can compete with other coals on the market. Being only 35 miles by rail from Hobart, and so close to lines of transport, the low cost of delivery will offset to some extent the comparatively high cost of mining.

Dividing this and a neighbouring area of equal dimensions is a dyke of diabase, which rock probably also underlies the coal measures.

Exploration by drilling should precede development work of any kind.

Quality of the Coal.

A few specimens broken from the seam, on examination proved to be of fair quality. Their soft condition probably was due to the effects of long immersion in water. Analysis revealed a high ash content, and a high proportion of fixed carbon.

Quantity of Coal Available.

An attempt to estimate with exactitude the quantity of coal available in this area is quite out of the question. In the first place, owing to the inaccessibility of the outcrop, the thickness of the seam could not be measured; and, again, the extent of the productive measures, covered with Tertiary clays and gravels and basaltic lava flows, could not be determined. It is reported that the seam is 2 feet thick, but this has not been officially verified.

Chapter X.

THE COLEBROOK - RICHMOND COALFIELD.

(1)—The Colebrook (Jerusalem) Area.

A.—*Location and Extent.*

This area is situated in the open valley of the Wallaby Rivulet and its tributary, the Coal Mine Rivulet, which occurs around and to the north of the township of Colebrook. The extent of this area is about 2½ square miles. It is bounded on the west and north by diabase hills; on the east by a large fault; while on the south the boundary is indeterminate, though diabase hills in that direction will be the extreme boundary.

B.—*Access.*

Colebrook is situated on the main Hobart to Launceston railway, being 39 miles distant from Hobart, so access to the area is readily obtained. A good main road, 22 miles in length, also connects Colebrook with the Hobart to Launceston road at Brighton.

C.—*Previous Reports.*

Count P. E. Strzelecki: Physical Description of New South Wales and Van Diemen's Land. 1845.

J. Milligan: Papers and Proceedings of the Royal Society of Van Diemen's Land; Reports on the Coal Basins of Van Diemen's Land, Richmond, and Jerusalem. 1849.

C. Gould: Coal South of Oatlands. 1869.

R. M. Johnston, F.L.S.: Geology of Tasmania. 1888.

D.—*Topography.*

(1)—General Description.

The area is generally one of low relief, though it alters considerably to the north and west. The valley of the Wallaby Rivulet forms the lowest part of the area, being 600 feet above sea-level at the Colebrook township. Hills to the heights of 800-1200 feet flank this stream. The surface along the Coal Mine Rivulet rises rapidly to heights of 1200 feet. Flat-top Hill to the north is 2200 feet above sea-level.

(2)—Relation to Mining.

The coal generally occurs in the more level country, and would have to be worked by means of shafts, with resulting haulage and drainage arrangements. In one case along the Coal Mine Rivulet a seam outcropped in a cliff, and was worked by adits.

E.—*Geology.*

(1)—The Geological Map.

A geological map of the area is given in the accompanying Plate XXV.

(2)—The Permo-Carboniferous—Trias-Jura Section.

To the east of the area Permo-Carboniferous strata outcrop, and on these rest the lower sandstone series of the Trias-Jura, which attain a thickness of at least 600 feet. The felspathic sandstone series are faulted down against the lower sandstones, and attain a thickness of 340 feet, as revealed by a bore,[41] while the total thickness is at least 500 feet.

About 20 feet of normal sandstones overlie the felspathic sandstones in a cliff section along the Coal Mine Rivulet. These have been referred to the upper sandstone series,[42] but may represent a sandstone bed in the felspathic sandstone series.

(3)—The Mode of Occurrence of the Diabase.

The diabase in this area occurs in the form of small and large dyke-like masses.

(4)—Structure.

(*a*) *Faults.*—Faults, especially minor ones, are probably numerous, but are difficult of detection. A large north-west south-east fault forms the eastern boundary of this area, roughly along the line of the Wallaby Rivulet. The down-throw is to the south-west, and at least 600 feet in amount.

(*b*) *Dip of Coal Seams.*—The dip of the coal seams varies in different portions of the area. In the extreme northern portion of the area, near the Horseshoe Bend of the railway, the only outcropping seam in which dips can be measured, gives a dip of 5 degrees to 10 degrees to the north-west. A short distance to the south the "2-foot" seam was reported by the early observers to dip to the south and pass below creek-level south of the old workings. A very small outcrop at the Glebe also suggests a southerly dip. The seams in the Tasma Mine, near Colebrook, are reported to dip to the east or north-east.

(5)—The Coal Seams Represented in the Area.

The outcrops of coal seams in this area are very few, but numerous seams have been shown to exist by bores and shafts which have intersected them.

In the southern portion of the area near the township of Colebrook three seams have been proved to exist by the Government bore of 1891 and the shaft of the Tasma Coal Mine. A complete section of the seams is given in the report of the bore,[43] from which the following brief summary is taken:—

	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
No. 1 seam	3	0	98	9
No. 2 „	4	11½	151	11¼
No. 3 „	2	10	162	11½
No. 4 „	0	4	227	3¼
Diabase met with at	...		337	0½

(41) Report of Secretary for Mines, 1891-1892.
(42) C. Gould: Coal South of Oatlands, 1869.
(43) See page 188.

In the shaft three seams were cut at depths of 100 feet, 160 feet, and 180 feet, and represent the No. 1, No. 2, and No. 3 seams of the bore respectively. The seams in the mine are reported to dip easterly. Two miles to the north, at the junction of Coal Mine Rivulet and Hollow Tree Bottom, a shaft has been sunk on the east bank of the former to a depth of about 60 feet. This shaft is reported to have cut three seams, the top one being from 2 feet 9 inches to 3 feet thick.

Further north a seam outcrops in the bed of the Coal Mine Rivulet, opposite the Glebe. This seam appears to have a southerly dip, and is said to be 2 feet thick.

Coal is next encountered at the old workings on the east side of the Coal Mine Rivulet. A "2-foot" seam outcropped in the cliffs, but has been mainly worked out. This seam is reported to have dipped to the south at a grade of 1 in 17 or 18 (or 3 degrees), and to have passed below creek-level. At the outcrop this seam was 2 feet 6 inches thick, but it thinned out to 9 inches and less as the workings progressed eastwards.

Below this seam a 40-foot shaft is reported (44) to have struck another 2-foot seam, which would therefore be about 50 feet below the former. A bore (45) put down in this vicinity gave the following section:—

Strata.	Thickness.		Depth.	
	ft.	in.	ft.	in.
Coal seam	2	0	9	0
ditto	0	9	25	0
ditto	1	3	61	0
ditto	2	9	64	0
No further coal to	...		210	0

Proceeding further upstream, a diabase dyke is passed over, and within a short distance a coal seam outcrops in the creek bed. This seam dips to the west or north-west at an angle from 5 degrees to 10 degrees. It has been picked up by numerous prospecting shafts around the Horseshoe Bend, and is said to be 4 feet thick. A bore (46) put down in the vicinity cut this seam, and gave the following section:—

Strata.	Thickness.	
	ft.	in.
Greyish and yellow sandstones, with fine dark streaks	4	8
Carbonaceous shale	0	2
Coal	0	9
Band	0	1
Coal	1	3
Band	0	1
Coal	1	0

This section shows a 3-feet 2-inch seam with 2 inches of bands.

Another seam outcrops in the railway cutting above the previous outcrop. A seam is also reported to have been met with by a tunnel and shaft along a small

(44) J. Milligan: Proc. Royal Society, Van Diemen's Land, 1849

(45) and (46) C. Gould Coal South of Oatlands, 1860.

tributary (Flat-top Rivulet) of the Coal Mine Rivulet north of the Horseshoe Bend. This latter seam has been stated (47) to be identical with the "2-foot" seam at the old workings.

The correlation of these seams is a difficult matter, and no very definite conclusions as to the number of seams can be arrived at.

It has been seen above that the "2-foot" seam at the old Jerusalem Coal Mine workings dips to the south at 3 degrees, and the section below it has been revealed by a bore to a depth of 210 feet. Between this seam and the 3-feet 2-inch seam a diabase dyke occurs, and there is a change of dip, the latter seam dipping north-west to west at 5 degrees to 10 degrees. This points to faulting accompanying the diabase, but no idea of the nature and extent of such faulting can be obtained. If no faulting exists the latter seam should overlie the "2-foot" seam by about 40 feet. The bore below the "2-foot" seam did not reveal any seam comparable with the 3-foot 2-inch seam, so it may be taken that the latter seam overlies the "2-foot" seam.

In the absence of faulting the seam in the Flat Top Rivulet would overlie the 3-foot 2-inch seam, and so could not represent the "2-foot" seam. The seam in the cutting seems to correspond with the one in the Flat Top Rivulet.

The "2-foot" seam, on being traced southwards, is reported to have dipped below creek-level, and would underlie the 2-foot seam at the Glebe. This latter seam has been considered (48) to represent the 3-foot 2-inch, though differing in actual section from it. This is quite possible, as the workings in the "2-foot" seam show how the thickness of a seam varies in a short distance.

The top seam in the shaft near the junction of the Coal Mine Rivulet and Hollow Tree Bottom is probably to be correlated with the seam at the Glebe. It is about 3 feet thick, and would thus correspond with the thickness of the 3-feet 2-inch seam. No information is available in connection with the other two seams in the shaft.

Thus, along the Coal Mine Rivulet the coal seams apparently form the following series in descending order:—

Local Name.	Probably Correlated with—
2-foot seam	Gamma
3-foot 2-inch seam	Delta
2-foot seam	Eta
9-inch seam	Theta
15-inch seam	Iota
33-inch seam	Kappa

Regarding the seams near Colebrook, the lowest (No. 3) seam can be correlated with the lowest seam of the above series. These seams have thicknesses of 34 and 33 inches respectively, and bores have proved that thicknesses of 146 and 174 feet respectively of a non-coal-bearing strata exist below these seams. The sections above these seams is different in the two localities, however, and individual seams cannot be correlated. Whether these are the lowest or uppermost six of the eight seams, Alpha to Kappa, cannot be definitely stated, but the probability is that they are the seams Gamma, Delta, Eta, Theta, Iota, and Kappa.

(47) J. Milligan: Proc. Royal Society, Van Diemen's Land, 1849.

(48) C. Gould: Coal South of Oatlands, 1860.

Report of Strata Passed Through in Boring for Coal at Jerusalem, 1891.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface shaft—hard, cemented gravel	37	6	37	6
Course grey felspathic or tufaceous sandstone, with carbonaceous markings	22	11	60	5
Light grey shale	3	9	64	2
Grey tufaceous sandstone, with mud, pebbles, and carbonaceous markings	13	8	77	10
Grey clod showing fossil plants	3	0	80	10
Grey tufaceous sandstone, with coaly markings	14	11	95	9
Coal, No. 1 seam	3	0	98	9
Grey tufaceous sandstone	16	10	115	7
Grey shale, with fossil plants	4	6	120	1
Grey tufaceous sanestone, with carbonaceous markings	21	1	141	2
Hard grey sandstone, with calcite veins and carbonaceous markings	5	2	146	4
Dark clod with carbonaceous streaks	0	8	147	0
Coal (No. 2 seam)	0	1	147	1
Dark clod (No. 2 seam)	0	5½	147	6½
Coal (No. 2 seam)	0	0½	147	7
Dark clod with coal streaks (No. 2 seam)	1	9½	149	4½
Coal (No. 2 seam)	0	10½	150	3
Band (No. 2 seam)	0	0½	150	3½
Coal (No. 2 seam)	1	8	151	11½
Grey clod and tufaceous sandstone	8	2	160	1½
Coal (No. 3 seam)	1	8	161	9½
Band (No. 3 seam)	0	9	162	6½
Coal (No. 3 seam)	0	5	162	11½
Fine grey tufaceous sandstone	2	6	165	5½
Grey clod	2	10	168	3½
Course grey tufaceous sandstone, with a few veins of calcite and carbonaceous markings	58	8	226	11½
Coal, No. 4 seam	0	4	227	3½
Grey clod, with fossil plants and calcite veins	7	8	234	11½
Fine-grained sandstone, hard and splintery, with calcite veins	6	8	241	7½
Course fespathic sandstone, with specks of carbonaceous matter	25	6	267	1½
Black shale with cubical iron pyrites	0	4	267	5½
Grey tufaceous sandstone, with specks of carbonaceous matter	22	5	289	10½
Dark shale, hard boring	7	6	297	4½
Black siliceous fine-grained sandstone	3	0	300	4½
Black clod showing fossil plants	4	0	304	4½
Grey tufaceous sandstone, with carbonaceous markings	25	8	330	0½
White calcareous shale, sharp and brittle, with plant impressions	7	0	337	0½
Hard greenstone, fine-grained at top, a little courser in grain at bottom	6	10	343	10½

F.—*The Mining Properties.*

(1)—The Tasma Coal Mine, Colebrook.

(*a*) *Number and Area of Leases.*—This mine is situated on 350 acres of freehold property belonging to Ambrose Fox, "The Meadows," and leased to the company.

(*b*) *Extent and Method of Mining Operations.*—The extent of the mining on this property has been very limited, as it has been worked for a couple of short periods only.

A shaft has been sunk to a depth of 180 feet, and mining has been carried on from it. The shaft was located too close to the diabase to the west of the field, and the coal in the vicinity of the mine on that side of the shaft has been worked out. The coal is reported to dip easterly, and in working the coal in that direction water trouble was encountered.

(c) *Quality of the Coal.*—Owing to the mine being closed down, no sampling of the seams could be undertaken. The shaft was unwatered to the No. 1 seam and an attempt made to work this seam at the beginning of 1921. Four or five truck-loads were brought to the surface, and a bulk sample was obtained from these, the analysis being given below. The other analyses[49] are those of the core-sections from a bore:—

...	I.	II.	III.	IV.
Water	8·12	8·4	4·6	2·6
Volatile hydro-carbons	22·10	26·9	28·3	29·1
Fixed carbon	34·44	42·3	50·7	33·0
Ash	35·34	22·4	16·4	34·4
Sulphur	0·56	...	...	...

I. Bulk sample, No. 1 Seam. Analysis by W. D. Reid. Reg. No. 516.
II. Bore sample, No. 1 Seam. Analysis by W. F. Ward.
III. ,, No. 2 Seam. ,, ,,
IV. ,, No. 3 Seam. ,, ,,

These analyses prove the seams to be similar to other Tasmanian coals of similar age. The ash-content is high, and also the fixed carbon, but the volatile hydro-carbon matter is low. Judging by the above results the No. 2 seam has the best quality.

(d) *Production.*—The mine has been worked for two short periods only, the production being as follows:—

Year.	Tons.
1910	482
1911	96
1918	500
1919	1659
Total	2737

(e) *Quantity of Coal Available.*—There are three seams on the property, but only the two lower ones (No. 2 and No. 3) have been worked, and it is not likely that the upper seam will ever be worked owing to its very bad quality. In the No. 2 seam there is 2 feet 6½ inches of workable coal, and in the No. 3 seam 2 feet 3 inches of workable coal.

The coal-bearing area is practically restricted to the country between the railway-line and the Wallaby Rivulet. The western limit is the diabase hills parallel to the railway-line, which may be taken as the boundary in that direction. The eastern boundary is a large fault, parallel to, and a short distance east, of the Wallaby Rivulet. Approximately 250 acres of this property exists within these limits, and may be taken as the coal-bearing area.

Taking 4 feet 9 inches of coal over 250 acres, the coal reserve will be 250 × 4¾ × 1200 tons, which is equal to 1,425,000 tons.

(49) Report of Secretary for Mines, 1891-1892, page 63.

(2)—The Jerusalem Coal Mine.

This mine does not exist at the present time as a coal-mining property, but it has been extensively worked in the past, and considerable quantities of coal removed from it. Coal was known to exist as early as 1843, and was worked about that date. The mine was, however, abandoned from some date prior to 1849 until 1879. It was then worked under the above name until 1890, since when it has again been abandoned.

(*a*) *Number and Area of Leases.*—During the latter period of working this property consisted of 300 acres held under coal leases. Since being abandoned it has been thrown open for selection, and is now freehold property.

(*b*) *Extent and Method of Mining Operations.*—During the first attempt to work the mine it is stated ([30]) that "this coal has been mined by a horizontal gallery of 6 feet by 6 feet, running about north-east by east, the roof of which is supported by timber . . . The length of the main gallery is 120 yards. At 50 or 60 yards from the mouth there is a branch gallery to the right, along which the coal has been worked to the dip of the seam. About 40 yards further there is another branch-passage driven in the same direction . . . About 10 or 12 yards from the extreme end of the main gallery a short working has been effected to the left."

The workings carried out during the latter period of operations are inaccessible, but it is stated that they were fairly extensive.

The mine was worked both from tunnels and a shaft. The tunnels were driven from cliffs along the Coal Mine Rivulet, where the coal outcrops. The shaft was put in to the east of the tunnel mouth as the workings progressed, but was not deep, being only 40 feet to the coal. Headings were driven off the main tunnel at intervals of 30 yards and at a distance of 12 feet they were opened out to right and left, thus leaving a pillar of coal 12 feet wide along both sides of the tunnel.

(*c*) *Quality of Coal.*—The seam worked in the mine was the "2-ft." seam. No samples were obtainable owing to the absence of outcrops, and the impossibility of entering the long-abandoned workings.

The following are some old analyses of Jerusalem coals from this seam:—

—	I.	II.	III.
Water	...	2·8	4·1
Volatile hydro-carbons	...	12·5	20·6
Fixed carbon	...	56·8	57·4
Ash	19·22	27·9	17·9
Sulphur	1·12	...	...
Carbon	68·17	...	...
Hydrogen	3·97	...	...
Nitrogen	1·62	...	...
Oxygen	5·90	...	...

I. "Analysis of Tasmanian Coal," by H. T. de la Beche.
Report of Lieutenant Governor, 1849.
Johnston's "Geology of Tasmania," p. 201.
II. and III. "Geology of Tasmania," by R. M. Johnston, p. 200.

The method of obtaining the above samples is not given, and they are probably in the nature of "grab" samples, and not absolutely representative. These analyses prove the coal to be similar to other Tasmanian coals, with an ash content of 20 per cent. and over, a fairly high fixed carbon, and low volatile combustible matter content.

([30]) J. Milligan: Proc. Royal Society, Van Diemen's Land, 1849.

The coal is said to have been a good burning coal, and was used on the railway for steam-raising purposes, and also for household and general purposes.

(*d*) *Production.*—Considerable quantities of coal must have been produced from this mine, but no records are available. All the mine records were burnt in a fire which destroyed the mine office, and no official records exist.

(*e*) *Quantity of Coal Available.*—The seam worked was the "2-ft." one, which is 2 feet 6 inches thick in the cliff section, and gradually thinned out to the east to 9 inches in thickness, so no workable reserve exists in that direction. A reserve of coal may exist to the north of the workings, but it will depend as to whether the seam has been faulted along the diabase dyke which occurs in that direction.

As regards other seams, one workable seam at least has been proved to exist by a bore.(51) It is 33 inches thick, and occurs 55 feet below the "2-ft." seam. No further seams exist to 210 feet below the surface, but others may possibly exist below that depth.

Owing to the uncertainty of the extension of the seams and the absence of mine plans, no estimation of the quantity of coal available can be given. Further, the property as a coal mine does not now exist, and is included under the "Unleased Coal-bearing Area," described below.

G.—*Unleased Coal-bearing Area.*

(1)—Total Area.

There is an area of about 2 square miles of coal-bearing felspathic sandstones occurring along the Wallaby and the Coal Mine Rivulets.

(2)—Number of Seams.

The number of seams existing in the Colebrook Area has been fully discussed above(52) In the vicinity of the township three seams are known to exist, but of these only two may be considered as workable seams. These two seams are the No. 2 and No. 3 seams of the Government bore.(53) In the Coal Mine Rivulet portion of the area, it has been seen that there are probably six seams, four of which have a thickness of 2 feet or more, and which may prove to be workable seams.

(3)—Quality of Coal.

The quality of the coal in the Wallaby Rivulet area will be the same as that discussed under the Tasma Coal Mine.(54) This will also apply to these seams in their extension into the Coal Mine Rivulet area, if such extension exists. Of the other seams in the Coal Mine Rivulet area the quality of the "2-foot" seam has been discussed above, under "The Jerusalem Coal Mine."(55)

The remaining seams outcrop in only a few places, and under such conditions that representative sampling was impossible.

(4)—Quantity of Coal Available.

Along the Wallaby Rivulet.—The seams known to occur in the Tasma Coal Mine should extend over, approximately, 1 square mile outside this property. The No. 2 seam contains 2 feet 6 inches of coal, and the No. 3 seam 2 feet 3 inches,

(51) C. Gould: Coal South of Oatlands, 1869.
(52) Page 185 *et seq.*
(53) Secretary for Mines Report, 1891-1892.
(54) Page 189.
(55) Page 190.

making a total of 4 feet 9 inches. This will make the quantity of coal available equal to 640 × 4¾ × 1200, or 3,648,000 tons.

Along the Coal Mine Rivulet.—With the data available no reliable estimate of the quantity of coal available in this portion of the area can be given.

(2)—The Richmond Area.

A.—*Location and Extent.*

This area is situated around the township of Richmond, near the mouth of the Coal River. The extent of the area is not ascertainable, as the coal-bearing strata are almost completely covered by Tertiary sediments and basalt.

B.—*Access.*

Richmond can be reached by good roads from Campania (a distance of 5 miles), on the main Hobart to Launceston railway, and Bellerive and Risdon (both connected by ferry with the Hobart side of the Derwent).

C.—*Previous Reports.*

Count P. E. Strzelecki: Physical Description of New South Wales and Van Diemen's Land. 1845.
J. Milligan: Papers and Proceedings of the Royal Society of Van Diemen's Land—Reports on the Coal Basins of Van Diemen's Land, Richmond, and Jerusalem. 1849.
C. Gould: Coal South of Oatlands. 1869.
R. M. Johnston, F.L.S.: Geology of Tasmania. 1888.

D.—*Topography.*

(1)—General Description.

This district is occupied by the mouth of the Coal River, with its open valley about a mile wide, and bounded on the east and west by hills rising to 600 feet above sea-level.

(2)—Relation to Mining.

Any mining operations carried out will be on the level low-lying country, and will be conducted by means of shafts. Considerable amounts of water will also have to be dealt with.

E.—*Geology.*

(1)—Geological Map.

A geological map of the area is given in the accompanying Plate XXV.

(2)—The Permo-Carboniferous—Trias-Jura Section.

The section exposed in this area comprises Permo-Carboniferous strata, and the lower sandstone and the felspathic sandstone series of the Trias-Jura strata. About 500 feet of the lower sandstone series overlie the Permo-Carboniferous strata. The felspathic sandstone series are faulted down against the Permo-Carboniferous strata, and about 100 feet of them are visible, but 500 feet are revealed by boring.

(3)—The Mode of Occurrence of the Diabase.

The diabase in this area occurs in the form of large dyke-like masses, which form the hills on both sides of the Coal River.

(4)—Structure.

(*a*) *Faults.*—A large north-west—south-east fault runs roughly parallel to the hills on the western side of the Coal River. The downthrow is to the north-east, and is at least 500 feet in amount, bringing the felspathic sandstones down to the level of the Permo-Carboniferous strata.

(*b*) *Dip of the Coal Seams.*—The coal seams and containing felspathic sandstones exposed in the Coal River dip west at 15 degrees to 20 degrees.

(5)—The Coal Seams Represented in the Area.

The short section of felspathic sandstones along the Coal River exposes two coal seams. The lower one is 9 inches thick, but peters out in the cliff section. The other seam is about 2 feet thick, and is 40 feet above the lower. A bore [56] was put down about 30 yards west of the old filled-in shaft, which was used to work the above 2-feet seam, and gave the following section:—

Coal and shale...	1′ 4″	at 27′ 5″
Coal and shale...	1′ 8½″	at 253′ 4″
Coal with 3½″ clod	2′ 3″	at 436′ 2″

The 1 foot 4 inch seam corresponds to the 2-feet seam exposed in the river, while the other two seams occur at a lower position in the series, and do not outcrop. Thus there are three seams of the above thicknesses respectively represented in this field.

F.—*The Mining Properties.*

No mining properties now exist in the area, and all the land is held freehold. Mining operations were carried out on a small scale prior to 1849, but have not been renewed since. These operations were carried out to the east of the township of Richmond, where the coal outcrops along the Coal River. It is stated [57] that "the coal has been worked by a drift (tunnel) carried from the water's edge into the steep face of the river's bank, obliquely to the line of dip; but the works have long been abandoned, in consequence of their having been inundated from the river during a flood . . . . An attempt has been made to win the coal by sinking a shaft a few yards from the margin of the river; but, from failure of means or enterprise on the part of the projector, it has fallen short of success."

G.—*Unleased Coal-bearing Area.*

(1)—Total Area.

This is difficult to estimate owing to the geological structure of the area. The felspathic sandstones which contain the coal seams outcrop only over a 150-yards section in the Coal River. To the east they are cut off by diabase. The basalt dyke has not cut off these sandstones, as they extend southwards from it until hidden by Tertiary strata. To the west and north small patches of diabase outcrop, and represent small dykes. What effect these have had on the felspathic sandstones cannot be determined, as beyond these dykes the surface is completely occupied by Tertiary strata. The main fault in the area occurs between a half and three-quarters of a mile to the west of the small area of outcrop dealt with above, and the felspathic sandstones may extend below the Tertiary strata over this distance. To the north and south of Richmond Tertiary strata and basalt cover the entire surface. Thus no estimate can be given of the coal-bearing area in this vicinity.

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(56) See page 104.

(57) J. Milligan: Proc. Royal Society, Van Diemen's Land, 1849.

(2)—Number of Seams.

As seen above,(58) three seams are present in this area.

(3)—Quality of Coal.

The 2-ft. seam is the only one that outcrops, and as its outcrop is subject to the action of tidal water, and is much decomposed, no representative sampling to determine its quality could be undertaken. It is stated (59) that the coal "has the property of great durability as a fuel; burning without flame, and emitting but little smoke. The mineral when newly broken has a shining lustre, and a greyish-black colour, and is compact; but it does not weather well, frittering down into a gritty powder." Thus it appears that this coal was of the type familiar in some of the Tasmanian mines, with a high ash and fixed carbon contact, and a very low content of volatile hydrocarbons.

(4)—Quantity of Coal Available.

With the very limited data available no estimation of the quantity of coal can be given.

Strata passed through in boring for coal at Richmond.(60):—

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface shaft	23	0	23	0
Grey clod and shale	4	5	27	5
Coal and shale	1	4	28	9
Grey clod and sandstone	34	3	63	0
Grey sandstone, showing black and grey clods, decayed wood, and coal streaks	190	4	253	4
Coal and shale	1	8½	255	0½
Black clod, showing coal streaks	7	2	262	2½
Grey sandstone, showing decayed wood and coal streaks	121	1½	383	4
Grey sandstone, showing black and grey clod and streaks of black shale	52	10	436	2
Coal	1	6	437	8
Grey clod	0	3¼	437	11¼
Coal	0	5¾	438	5
Black and grey clod and sandstone	33	5	471	10
Grey sandstone	28	2	500	0

(58) Page 193.

(59) J. Milligan: Proc. Royal Society, Van Diemen's Land, 1849, page 68.

(60) Report of Secretary for Mines, 1888-1889.

Chapter XI.

THE BAGDAD - KEMPTON COALFIELD.

Felspathic sandstones outcrop over a considerable proportion of the surface of the country between Bagdad and Kempton, but very few outcrops of coal are known. One seam is exposed in a railway cutting 1¼ miles south-south-east of Dysart. It is 22 inches thick, and dips to the west at 10 degrees, and occurs within a bed of mudstones interbedded with the felspathic sandstones. The mudstones forming the roof of the seam are crowded with fossil plants, *Cladophlebis australis* and *Phœnicopsis elongatus* being the predominating forms. The outcrop coal was sampled, and gave the following result on analysis:—

	Moisture.	Volatile Hydro-carbons.	Fixed Carbon.	Ash.	Sulphur.
Reg. No. 517	18·46	23·74	23·86	33·94	0·32

The moisture content is high, due to the sample being taken from the outcrop coal. The ash content is high, and proves the coal to be of poor quality.

Another outcrop occurs about half a mile to the north-west in another cutting. This seam is not so thick as the above, and probably represents a seam higher in the series.

The area occupied by these seams is small. Normal sandstones of the lower sandstone series occur to the immediate west of the felspathic sandstones, and a fault with a downthrow to the east of at least 500 feet forms the boundary of the coal in that direction.

Outcrops of coal and carbonaceous shale have been reported around Kempton and to the north of Melton Mowbray, but the seams are very thin and generally of poor quality.

Chapter XII.

MIKE HOWE'S MARSH COALFIELD.

A.—*Location and Extent.*

This area is situated at Mike Howe's Marsh, which occurs along the Blackman's River 4 miles south-east of Lake Crescent.

There are 10 square miles of Trias-Jura sandstones in this area, but the occurrence of coal is probably restricted to the marsh itself.

B.—*Access.*

This area is reached by means of the main road from Oatlands to Interlaken, Oatlands being on the main Hobart to Launceston road, and the terminus of a 4-mile branch line from the Hobart to Launceston railway.

C.—*Previous Reports.*

W. H. Twelvetrees: Report on Country on the East Shore of Lake Sorell and on a Discovery of Coal near Oatlands.

D.—*Topography.*

(1)—General Description.

The Blackman's River flows through the area and has built up an extensive alluvial flat at an elevation of 2000 feet above sea-level, forming the marsh by which the area is named. The country to the north-west of the river rises steeply to the level of the Central Plateau (3000 feet). South-east of the river Mike Howe's Lookout and Flat-top rise to 2600 feet, but the saddle between them does not exceed 2200 feet above sea-level.

(2)—Relation to Mining.

The coal-bearing area corresponds roughly with that of the marsh, and mining operations would have to be carried out by means of vertical or inclined shafts. Considerable quantities of water would have to be contended with in the workings under the marsh.

E.—*Geology.*

(1)—Geological Map.

A geological map of the area is shown in Plate XXIX.

(2)—The Permo-Carboniferous—Trias-Jura Section.

The section exposed in this area consists of 400 feet of Trias-Jura sandstones, but whether of the Lower or Upper Sandstone Series cannot be determined.

(3)—The Mode of Occurrence of the Diabase.

The diabase in this area occurs in the form of large intrusive masses, that on the north-west of the river being part of the main mass of the Central Plateau.

(4)—Structure.

(*a*) *Faults.*—No faults have been detected so far in this area.

(*b*) *Dip of the Coal Seams.*—The coal seams are reported to be dipping north-west at angles of 10 to 25 degrees

(5)—The Coal Seams Represented in the Area.

Probably two seams are represented by outcrops in this area in association with the normal sandstones. This association is unusual, and the seams cannot be correlated with those of other areas.

F.—*The Mining Properties.*

No coal-mining leases have been taken up, and all the land is held as freehold. Except for the few pits put in on the outcrops, no work has been carried out in this area.

G.—*Unleased Coal-bearing Area.*

(1)—Total Area.

The total coal-bearing area will correspond approximately with that of the marsh, and cover an area of 1 square mile.

(2)—Number of Seams.

Judging by the very limited number of outcrops it is probable that two seams exist in this area.

(3)—Quality of Coal.

Owing to the pits having been filled with water and fallen in, no sampling could be carried out, and the following assays are taken from the previous report(61):—

Constituents.	The Brightest Pieces from the Saturated Walls	Somewhat Drier Samples.
	Per cent.	Per cent.
Moisture	25·4	8·4
Volatile hydrocarbons	20·2	18·4
Fixed carbon	33·4	62·4
Ash	21·0	10·8

The report adds: "If the latter assay be taken as a guide, the coal would appear to be a strong one, capable of giving out a good heat, but of no use for making coke, as no coke was found in either assay. The fixed carbon is high enough and the ash low enough in the latter sample to make the coal suitable for steam purposes; but to be sure of this the iron and sulphur contents would require determining."

(4)—Quantity of Coal Available.

The amount of data in connection with this area is so small that a reliable estimation of quantity of coal is impossible.

Systematic boring of the area should be a preliminary step before any mining is attempted, in order to ascertain not only the area and number of seams but also the quality.

Assuming the 3 ft. 6 in. seam extends under the marsh, the amount of coal available will be 2,688,000 tons. The thickness of the other seam is not known, and no estimation of quantity is possible.

(61) W. H. Twelvetrees: Report on Country on the East Shore of Lake Sorell, and on a Discovery of Coal near Oatlands.

Chapter XIII.

THE YORK PLAINS COALFIELD.

A.—*Location and Extent.*

This district is located around York Plains in the Midlands, and is situated about half-way between Hobart and Launceston.

The extent of possible coal-bearing area is approximately 20 square miles.

B.—*Access.*

Access to the district is readily obtained, York Plains being on the Main Line Hobart to Launceston Railway. Further, the Main-road from Hobart to Launceston passes within 2 miles of the district, and a good branch road passes through the area.

C.—*Previous Reports.*

C. Gould: "Coal South of Oatlands," 1869.
R. M. Johnston: "Geology of Tasmania," 1888.

D.—*Topography.*

(1)—General Description.

The district is generally one of low relief, due to denudation of the soft Trias-Jura strata. The York Rivulet and the headwaters of Kitty's Rivulet drain the area, and have produced much flat country at an elevation of about 1000 feet above the sea. The Mt. Pleasant (1800 feet)-Handsome Sugarloaf (1600 feet) ridge forms the divide between the two systems. Vincent's Hill (2000 feet), Joe Wright's Sugarloaf (1800 feet), and Coal Mine Hill (1800 feet) occur to the west of the area, while Mt. Seymour (2400 feet) occur to the south, Murderer's Tier (2000 feet) to the south-east, and the Eastern Spur (1800 feet) to the north of the area.

(2)—Relation to Mining.

Mining operations are greatly facilitated when the seams occur on hilly country, as at Coal Mine Hill, and mining can be carried out by means of adits, thus simplifying haulage and drainage. The more level country may prove to be coal-bearing, and in this case mining would have to be carried out by shafts, and more costly haulage and pumping arrangements would be required

E.—*Geology.*

(1)—Geological Map.

A geological map of the area is given in the accompanying Plate XXX.

(2)—The Permo-Carboniferous—Trias-Jura Section.

The section of these strata exposed consists of 400 to 500 feet of the felspathic sandstone series of the Trias-Jura strata.

South of the area these overlie at least 600 feet of the lower sandstone series.

(3)—The Mode of Occurrence of the Diabase.

The general mode of occurrence of the diabase is in the form of large dyke-like masses. One narrow dyke, averaging 8 to 10 feet in width, can be traced from the north side of Coal Mine Hill in a general south-south-easterly direction for a distance of 3 miles towards Nala. The diabase capping Mt. Pleasant occurs in the form of a sill overlying felspathic sandstones.

(4)—Structure.

(a) *Faults.*—A very definite fault is visible on the north side of Coal Mine Hill, felspathic sandstones occurring to the west and normal sandstones to the east. This fault has a general north-north-west to south-south-east direction. The downthrow is to the west, and has a magnitude of at least 250 feet. This fault probably extends southwards from the Coal Mine Hill, but cannot be detected, as the felspathic sandstones have been denuded off the underlying sandstones, leaving similar rock-types on both sides of the fault. The direction of the continuation of this fault would be parallel to, if not actually along, the line of the narrow dyke described above.

Another fault occurs along the valley of the York Rivulet, where felspathic sandstones and normal sandstones occur at the same elevations. The downthrow is to the east and must exceed 350 feet. This fault has a general north-north-west to south-south-easterly direction, but its actual direction or location cannot be ascertained, due to a covering of alluvium.

A further fault occurs about half a mile north-west of Nala, where it has intersected the narrow diabase dyke described above. The dyke has been cut off and "heaved" about 30 feet to the north-east. The fault has a north-east to south-west direction, and the downthrow is probably to the south-east.

(b) *Dip of Coal Seams.*—The strata generally appear to be horizontally bedded, but there is a slight dip of the strata to the north, sometimes amounting to 5 degrees. The coal seams in the York Plains Mine dip to the north-east at 2 degrees.

(5) The Coal Seams Represented in the Area.

Coal outcrops in only a few localities in this area, and the number of seams present is small. Two seams outcrop on the southern side of Coal Mine Hill, with a thickness of about 50 feet of strata between them. The lower seam is 3 feet 2 inches thick at the present workings, and has a floor of clay and a roof of bluish felspathic sandstones. The upper seam is reported to be 4 feet thick, and to have shales and clays both under and over it. These seams occur a short distance above the base of the felspathic sandstone series.

Coal is reported[62] to outcrop in the York Rivulet, about 1½ miles north-east of Coal Mine Hill, and the seam stated to be at least 15 inches thick. This outcrop is about 200 feet below those on Coal Mine Hill, and a faulted area of normal sandstones occur between them. This seam either represents the upper seam on Coal Mine Hill or else a seam above the latter and not outcropping on the hill.

The only other known outcrop in the district occurs in the cutting of the York Plains-Eastwood road, where it passes over the saddle to the south of Mt. Pleasant. This seam is 12 to 15 inches thick, and occurs in a series of clays and mudstones. It occurs at an elevation of 100 feet above those on Coal Mine Hill and 300 feet above that in the York Rivulet, and probably represents a seam about 300 feet higher in the felspathic sandstone series than those on Coal Mine Hill.

F.—*The Mining Properties.*

(1)—The York Plains Coal Mine.

(a) *Number and Area of Leases.*—This mine is situated on freehold property belonging to the family of the late J. C. Gregg.

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[62] C. Gould: Coal South of Oatlands, 1869.

(*b*) *Extent and Method of Mining Operations.*—Mining has been carried out on a small scale only, owing to the limited market for the coal. Numerous adits have been driven into the hill along the south and south-east sides. Mining has been carried out from each of these in turn by a long-wall system until water trouble is met with, due to the beds dipping into the hill. Another adit is started to the east and worked as before, and helps to unwater the old workings, which will be worked again later on.

(*c*) *Quality of Coal.*—The seam being worked at present is a 3 ft. to 3 ft. 6 in. seam, with a floor of soft clay and a roof of felspathic sandstone. This seam was sampled and the analyses are given below. Another seam, about 4 feet thick, outcrops 50 feet higher up the hill, but is not worked now. An old analysis([63]) of this coal is given below.

Analysis of York Plains Coal.

Constituents.	I.	II.	III.
Moisture at 100° C	1·80	1·19	1·70
Volatile hydrocarbons	13·28	13·55	15·80
Fixed carbon	57·32	60·74	56·80
Ash	27·60	24·52	25·70
Sulphur	0·46	0·48	—

I. Reg. No. 519. Lower Seam: 3ft. 2in. thick, with ½in.-1in. clay band near centre. Analysis by W. D. Reid.

II. Reg. No. 520. Lower Seam: 3ft. 2in. thick, with the clay band removed. Represents maximum purity and present output. Analysis by W. D. Reid.

III. Upper Seam: 4ft. thick. Analysis by Ward.

These analyses prove the two seams to be of much the same composition. The ash content (approximately 25 per cent.) is high and detrimental to the quality of the coal. The fixed carbon content is high compared with the volatile matter, being about 4½ to 1. In appearance the coal is a bright, hard-looking, banded variety, suggestive of a much better quality than indicated by the analysis. It burns with a small, clean flame, and while of little use for steam-raising purpurposes, it has a special use in breweries for the drying of hops, owing to the cleanliness with which it burns.

(*d*) *Production.*—Small quantities of coal were produced prior to 1902, but only incomplete records are available. Complete records([64]) exist from the year 1902 until that of 1919, and show a total production of 9489 tons for the 18 years, or an average annual production of about 527 tons. The maximum production was reached in 1914, with 847 tons, but decreased to 219 in 1917, though it is increasing since then.

(*e*) *Quantity of Coal Available.*—With the data available any reliable estimation of the quantity of coal is impossible.

The coal has been sought for on the north side of the hill, but has not been located. The prospecting shafts have been sunk to shallow depths only, and it is likely that the dip of the seams (if not faulted) carry them below these shafts. Whether the seams have been affected by the diabase and basalt which occur on the hill, or by faults other than those described above, cannot be determined. Providing the seams extend throughout the faulted block of felspathic sandstones and exist north of the hill, the quantities of coal available on the property would be—

Upper Seam—4 feet coal over 40 acres = 192,000 tons.
Lower Seam—3 feet coal over 40 acres = 144,000 tons.

([63]) R. M. Johnston: Geology of Tasmania, 1888. Page 183.

([64]) Reports of Secretary for Mines.

G.—*Unleased Coal-bearing Area.*

(1)—Total Area.

About 20 square miles of probable coal-bearing strata (felspathic sandstones) exists in the York Plains district.

(2)—Number of Seams.

Apart from a very small area north-west of Coal Mine Hill which may contain the two seams known on this hill, no information can be given as to the number of seams present. Coal outcrops in only two other places, and these have been discussed above.[65]

(3)—Quality of Coal.

No representative sampling was possible, and no previous analyses exist, so the discussion of quality is impossible. The coal in any extension of the seams of the Coal Mine Hill to the north-west can be taken of similar quality to that given for these seams.

(4)—Quantity of Coal Available.

With the very small amount of data available no estimation of the quantity of coal is possible. Provided that the two seams which occur at the base of the felspathic sandstones on Coal Mine Hill occur throughout the district where felspathic sandstones outcrop, then considerable quantities of coal exist. Before an attempt is made to exploit such areas a systematic drilling campaign should be undertaken to determine the existence, thickness, number, and quality of the seams.

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(65) E.—(5) The Coal Seams Represented in the Field. Page 199.