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Tasmania

DEPARTMENT OF MINES

GEOLOGICAL SURVEY

MINERAL RESOURCES No. 7

The Coal Resources of Tasmania

By

THE GEOLOGICAL SURVEY OF TASMANIA

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Issued under the authority of
The Honourable J. B. HAYES, C.M.G., Minister for Mines for Tasmania.

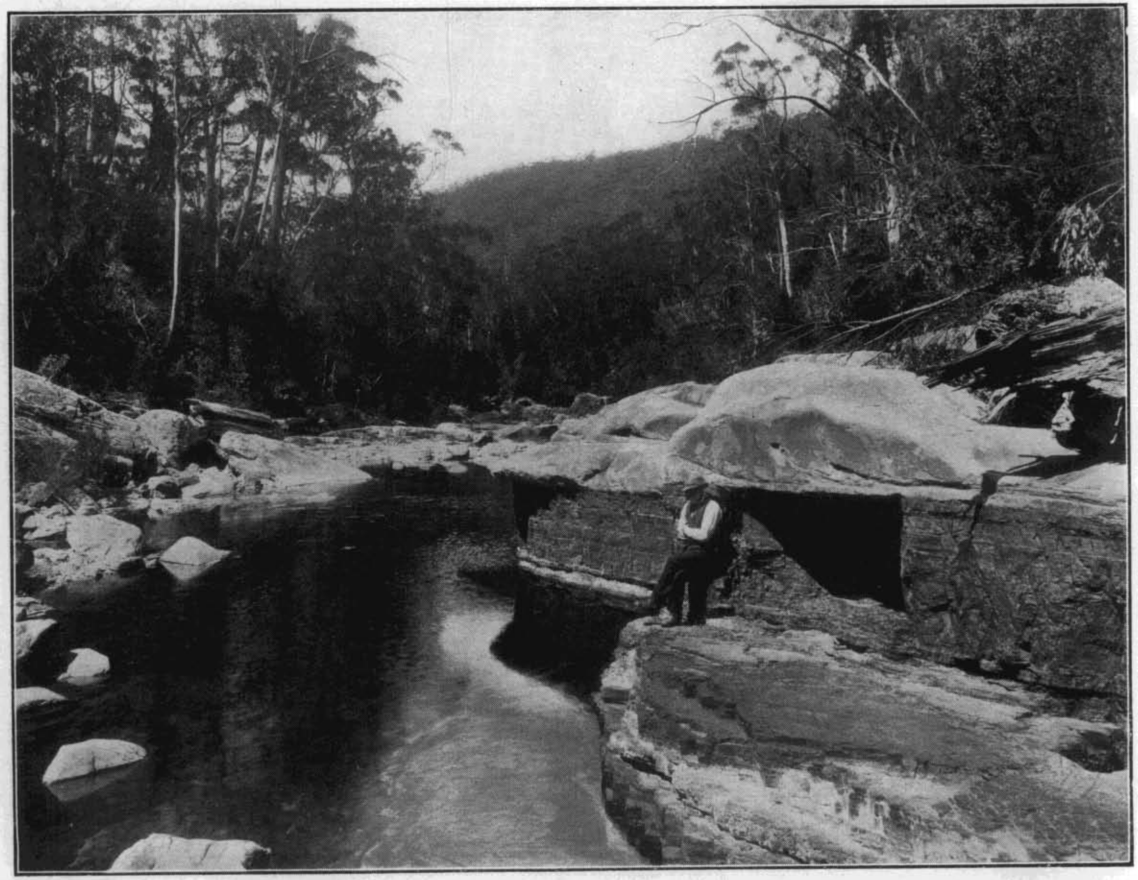
Tasmania:

JOHN VAIL, GOVERNMENT PRINTER, HOBART

7604

1922

Wholly set up and printed in Australia by
John Vail, Government Printer, Hobart, Tasmania
1922



TYPICAL COAL OUTCROP, EAST COAST, TASMANIA. [*S. Spurling Photo.*

Preface.

THIS publication is in reality a symposium by the Geological Survey staff of Tasmania. The general scope and outline of the work having been decided upon, the various portions of it were allotted to different officers of the Survey.

In connection with the field work, the greater portion was accomplished by Mr. A. McIntosh Reid, Government Geologist, who dealt with the area extending southwards from Triabunna, and, in addition, the whole of the Ben Lomond area.

The field work of the East Coast, as far south as Triabunna, was carried out by Mr. H. G. W. Keid, M.Sc., Government Geologist.

The coalfields of the Midlands area were dealt with by Mr. P. B. Nye, M.Sc., B.M.E., Government Geologist.

The remainder of the field work was conducted by myself.

The whole of the analytical investigations were under the direct supervision of Mr. W. D. Reid, Government Assayer, in charge of the Geological Survey Laboratory.

In compiling the publication itself, various portions were allotted to the respective officers after the outline and details of the publication had been determined and arranged.

Mr. A. McIntosh Reid prepared the following chapters:—

Part I. Chapter V.

Part II. Chapters II. and VII.

Part IV. Chapters IV. (Buckland Area), V., VI., VII., VIII., IX., XIV., XV., and XVI.

Part V. Chapters II., IV.

Part VI. Chapters II., IV., V., VI., and VIII.

Mr. W. D. Reid was allotted the following chapters:—

Part II. Chapters III., IV., V., and VI.

Part III. Chapter III. (Table I.).

Part VI. Chapters I., III. (Table No. VIII.), and VII.

Mr. P. B. Nye prepared the following:—

Part IV. Chapters X., XI., XII., and XIII.

Chapters I., II., III., and IV. (Triabunna Area) of Part IV. have been prepared with the assistance of Mr. H. G. W. Keid.

The plans and sections have been prepared under the geologists' supervision by Mr. G. J. Edwards, Draughtsman of the Geological Survey.

I am responsible for the remaining chapters of the publication, viz.:—

Part I. Chapters I., II., III., and IV.

Part II. Chapter I.

Part III. Chapters I., II., and III.

Part IV. Chapters XVII., XVIII., XIX., and XX.

Part V. Chapters I. and III.

Part VI. Chapters III. and IX.,

as well as for the initiation, design, and co-ordination of the whole of the work and the preparation of the whole publication.

In presenting this publication as a statement of our present knowledge of the coal resources of Tasmania, I desire to point out that the method of treatment evolved for the purpose is somewhat original, but I hope will prove to be effective.

The compilation of the publication, and its completion in detail as a co-ordinated whole, has entailed an immense amount of labour, and I desire especially to record my appreciation of the very great assistance given, and the enthusiasm and efficiency displayed by Messrs A. McIntosh Reid and W. D. Reid, both in the carrying out of the investigations and the compilation of the publication. To Mr. G. J. Edwards is due recognition for the pains he has taken in preparing the 36 plates for reproduction. I desire to thank Miss M. F. O'Keeffe, of the Geological Survey staff, for considerable assistance in dealing with the manuscript and preparing it for publication.

LOFTUS HILLS, M.B.E., M.Sc.,
Director, Geological Survey.

Launceston,
19th May, 1922.

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(Bound Separately).

Summary.

SCOPE.

THIS publication deals with the coal resources of Tasmania considered from all points of view. It describes the geology of the coal formations, the geologic structure of the coalfields, the general character, composition, and calorific value of the coals, and, in addition, deals with the commercial and industrial applications and its market value. It finally discusses the relationship of the coal resources of Tasmania to the important mineral deposits and hydro-electric power stations, and the bearing of this relationship on the industrial development of Tasmania.

SUBDIVISIONS OF THE PUBLICATION.

The publication is divided into six parts.

Part I. deals with the general geographic and geologic factors in connection with the coal deposits of Tasmania, and concisely describes the geology of the coal-bearing formations as developed in Tasmania. In addition, it summarises our present conception of a very important economic question of the relation of the diabase to the coal-bearing formations. This diabase cuts through the coal-bearing strata, and it is obviously important to determine what proportion of the area is occupied by diabase to the exclusion of the coal seams. There is also discussed in this part the general conclusions as to the relation of the faults to the coal seams and the main coal-bearing areas.

Part II. gives a summary of the general principles on which the description of the coal has been based in preparing the publication. The general question of the classification of coals is dealt with, as well as a description of the origin and character of the ash of coal in general. There is also explained what is meant exactly by the calorific value and evaporative power of coal, and also the ignition point of coals. This part also presents details as to the methods of sampling and analyses used during this investigation.

Part III. deals with the classification of the types of coal occurring in Tasmania—their character, composition, and calorific values. It is shown that the important coal deposits of Tasmania are confined to the Permo-Carboniferous and Trias-Jura systems. The classes of coal represented by these important coal deposits are the sub-anthracites and non-caking humic (bituminous) coals, and the humic kerogenites and kerogenites or cannel coals. This part of the publication concludes with a table showing the complete analytical determinations on samples of coal taken throughout the whole of Tasmania and representative of all our coalfields.

Part IV. contains a detailed description of the respective coalfields of Tasmania. These coalfields are defined as follow:—

(1) The Mt. Nicholas-Fingal-Dalmayne Coalfield.
(2) The Seymour-Douglas River-Denison River-Mt. Paul Coalfield.
(3) Swansea-Schouten Island Coalfield.
(4) Triabunna-Buckland Coalfield.

(5) Tasman Peninsula Coalfield.
(6) The Sandfly-Cygnet Coalfield.
(7) Bruny-Strathblane-Catamaran Coalfield.
(8) New Town Coalfield.
(9) The Upper Derwent Coalfield.
(10) The Colebrook-Richmond Coalfield.
(11) The Bagdad-Kempton Coalfield.
(12) Mike Howe's Marsh Coalfield.
(13) The York Plains Coalfield.
(14) The Avoca Coalfield.
(15) Longford Coalfield.
(16) The Mersey Coalfield.
(17) George Town Coalfield.
(18) Preolenna Coalfield.
(19) Barn Bluff-Pelion Coalfield.

Each coalfield is divided up into various areas, and under each area the mining properties contained therein are dealt with, and the nature and extent of the workings are described.

In the general description of each coal area the following aspects are dealt with:—

A. Location and Extent.
B. Access.
C. Previous Reports.
D. Topography:
  (1) General Description.
  (2) Relation to Mining.
E. Geology:
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  (b) Extent and Method of Mining Operations
  (c) Quality of Coal.
  (d) Production.
  (e) Quantity of Coal Available.
G. Unleased Coal-Bearing Area:
  (1) Total Area.
  (2) Number of Seams.
  (3) Quality of Coal.
  (4) Quantity of Coal Available.

Part V.—This portion of the publication is a very important one, summarising, as it does, the extent of our coal reserves, their present rate and method of exploitation, and the method of exploitation that must be adopted to ensure efficient development. The total amount of coal available has been calculated from two points of view—

(1) The total tonnage available for payable extraction, according to existing industrial and economic conditions in the respective fields.

Calculating on this basis the coal reserves of Tasmania consist of, approximately, 135,000,000 tons.

(2) The total coal reserve, calculated and classified on the basis laid down by the International Geological Congress.

This statement has been presented to enable the coal reserves of Tasmania to be known from the point of view of their international importance. From this international view-point, coal which could not be included in a calculation based on payability under existing conditions may constitute an important national asset.

The total coal reserve of Tasmania on this basis is shown to consist of 125,000,000 tons actual reserve, and 123,000,000 tons probable reserve, with fairly large possible reserves at present not capable of indication by figures.

The history of coal discoveries and coal-mining in Tasmania is dealt with. There is then presented a statement of the total production of coal in Tasmania since 1880, the date from which figures are available. This shows that coal to the amount of, approximately, 1,900,000 tons has been produced in Tasmania. The present rate of production is 66,000 tons per annum.

Part V. of the publication concludes with a delineation of the method of developing and exploiting the coal reserves based on the geologic structure. It is shown that failure to base the laying-out of the coal-mining works on such a basis has been responsible for failures in the past, and these will be repeated in the future if the all-important factor of geologic structure is not properly allowed for in the initial lay-out of works. It is shown how the major faults have brought about the existence of blocks of coal-bearing ground which can be exploited as a self-contained proposition. The major faults are shown in this publication, and using this information the next step should be the boring of such a self-contained block systematically in order to determine the location of the minor faults. When this has been done the lay-out of the working scheme may be proceeded with.

Part VI. deals with the commercial value of the coal and its various industrial applications.

A complete description is given of the ash content, its amount, character, and fusing point, and also the extent to which it can be eliminated by washing methods. It is shown that the ash content of Tasmanian coal, although somewhat high, is characterised by a high temperature of fusion which will make it especially valuable for use in the powdered form. This method of utilisation of coal is a modern development, and is of undoubtedly great significance to Tasmania, as this investigation has shown that the Tasmanian coals are particularly suitable for use in the powdered form.

The sulphur content of the coals is shown to be low, except in the case of the kerogenites and humic kerogenites. The exact effect of this on the commercial value of the coal is demonstrated, and it is shown that where excessive, it can be eliminated.

The applicability of Tasmanian coal to steam-raising is discussed, and it is shown by tables of comparison with other well-known coals that it is not very far behind them.

The main coal reserve of Tasmania does not constitute a coal for gas-making or coke manufacture. There are, however, in the Preolenna district, appreciable and valuable reserves of coal especially suitable for gas-making, with the production of good coke as a by-product.

The exact value of our coals as a domestic fuel is dealt with.

The cost of production and market value are dealt with, and it is shown that the cost of production of main non-caking humic coals, such as the Mt. Nicholas-Cornwall coal, is in the vicinity of 13s. or 14s., delivered into the railway trucks at the mine. The retail price in the city for this class of coal is 30s. per ton. The price in the same cities for New South Wales coals is 47s. Taking into consideration the relative calorific values, undoubtedly greater value is obtained for the money in buying Tasmanian coals.

The publication concludes with the final chapter of Part VI., which discusses the relation of the coal resources of Tasmania to the mineral deposits and hydro-electric power. It is shown that taking all these factors into consideration Tasmania presents a combination of conditions very favourable indeed for the establishment of manufacturing industries.

These, combined with a climate which is almost ideally suited for the human race, particularly the Anglo-Saxon race, afford justification for the conclusion that great commercial and industrial development in Tasmania in the near future is inevitable if the methods adopted to bring about such development are based on scientific lines.

Coal Resources of Tasmania.

Part I.

Geographic and Geologic Background.

Chapter I.

INTRODUCTION.

(1)—The Tasmanian Environment.

A.—*Geographic Position and Area.*

Tasmania is the smallest of the six States constituting the Commonwealth of Australia. It lies to the south-east of the Australian continent, being distant therefrom about 250 miles, between 40° and 44° of S. latitude.

The total area, including the subsidiary islands, is 26,219 square miles. Exclusive of its islands the area is 24,400 square miles. It is thus, approximately, of the same size as Ceylon, and slightly smaller than Scotland.

B.—*Topography.*

Tasmania is essentially a mountainous country, but the greatest relief is only slightly more than 5150 feet. The dominant topographic features are as follow:—

The Central Plateau.
The North-eastern and Eastern Mountain Systems.
The West Coast Range.
The South-western Mountain System.
The Midlands-Westbury Plain.

The Central Plateau is the most striking of these features. It rises by abrupt escarpments from the Midlands-Westbury Plain to a height of about 3300 feet. Above this general level of the plateau rise mountain peaks to a height of from 4000 to 5000 feet.

Spread at the foot of this plateau on its northern and eastern sides lies the Midlands-Westbury Plain, which varies in height from 400 to 600 feet above sea-level.

The eastern and north-eastern boundaries of this plain are formed by the rugged mountain systems of the north-east and east coasts. The slope from these mountain masses to the sea-coast is abrupt, there being only a very narrow strip of coastal plain.

On the western and south-western sides of the Central Plateau occur the deep gorges which separate it from the extensive rugged and precipitous mountains of the West Coast Range and South-western Mountain System.

With the exception, therefore, of the Midlands-Westbury Plain, the whole of Tasmania is very rugged and mountainous, and is deeply dissected by innumerable deep river gorges. Being characterised by a heavy rainfall on the Central Plateau and the western and south-western mountains, these river valleys carry streams of appreciable size, but in only a few instances are they navigable for any appreciable distances. Thus, the River Tamar is navigable for a distance of 44 miles for vessels up to 3000 tons, whilst the River Derwent is navigable for vessels of similar tonnage for 33 miles.

The high relief, combined with the heavy rainfall, presents conditions favourable for the development of hydro-electric schemes. The occurrence of numerous lakes in the highlands, of glacial origin, present facilities for water conservation, and the proximity of the deep gorges, make the designing of hydro-electric schemes a relatively easy matter.

The coast-line is such as to provide good harbours, especially on the southern, northern, and western sides of the island. The port of Hobart and the subsidiary ports of the D'Entrecasteaux Channel, constitute one of the most magnificent harbour systems in the world; whilst the ports of Launceston and Burnie provide excellent facilities for shipping. On the West Coast, Macquarie Harbour and Port Davey are two magnificent, sheltered bodies of water, capable of floating the best ships, although the former has the drawback of a shallow bar at the entrance.

Internal communication from these harbours has been developed by a system of railways, of 3 ft. 6 in. gauge. These railways are shown on the general map of Tasmania as frontispiece to this publication. Although mountainous, railway-construction in Tasmania is not exceptionally difficult, and it particularly lends itself to a development by light railways and tramways.

C.—*Climate.*

The climate of Tasmania is mild and temperate. It resembles, on the whole, the climate of Cornwall and Devon, but is somewhat milder than that portion of Great Britain. The mean annual temperature is 54° F., and the mean annual range of temperature is from 10° F. to 20° F. The wet bulb varies from 42° to 56° F. The climate of Tasmania is, in fact, exceptionally suitable for the Anglo-Saxon race, and possesses the nearest approach to the ideally perfect climate of any country in the world; this statement particularly referring to the eastern portion of Tasmania.

As regards rainfall, Tasmania may be divided into two halves—the western portion, in which the annual rainfall varies from 50 inches to 150 inches; and the northern, eastern, and southern portions, in which the annual rainfall varies from 18 inches to 30 inches.

(2)—The Circumstances Leading up to the Present Investigation.

It has long been known that Tasmania possesses valuable deposits of coal. With the industrial developments taking place in Tasmania in connection with hydro-electric power schemes, it has become essential that we should know the quantity and quality of our coal resources. It was decided, therefore, to initiate a complete investigation of these, in order to have those data available which are essential in deciding upon the location of manufacturing and metallurgical industries of all kinds. Tasmania is particularly richly endowed with resources of hydro-electric power, but in the development of industries wholly dependent upon such power, other industries come along in connection with which the use of coal is essential. In taking stock of our hydro-electric resources, therefore, we should concurrently take stock of our coal resources. It was the realisation of this that brought about the present investigation.

(3)—The Scope of the Geological Investigation.

At the time of undertaking the investigation the geological survey of the State had been sufficiently far advanced to demonstrate within certain limits the potential coal-bearing areas. These areas were, therefore, submitted to a more detailed and systematic geological examination than had been previously attempted. In the absence of topographic maps as the base for such work, it was necessary to map in the topography concurrently with the geology. No attempt was made for a detailed topographic survey, but in the greater portion of the area examined the contours have been sketched in, using points fixed by aneroid and in railway surveys. The geologic maps cannot claim to be accurate maps in every detail, but the degree of accuracy of the work was designed to be commensurate with the needs of calculating the tonnage of coal available.

Particular attention was directed towards the determination of the relation of the intrusive diabase to the coal-bearing formations, as this relationship must determine the extent of the coal-bearing area. It has been an unsolved problem in Tasmania for years, as to whether the diabase occurring on the higher parts of mountains flanked by the coal-bearing formations was of the nature of a horizontal sill, or consisted of a transgressive igneous mass. In the former case the coal would extend right through the mountain, while in the latter case it would occur only on the flanks. The special objective of the investigation was, therefore, in all the coalfields examined, to determine the relation of the diabase to the coal-bearing formations.

Another very important object aimed at was the systematic sampling of the coal seams where sufficiently exposed to enable this to be done. No systematic sampling of the coal had previously been carried out, and it was deemed to be necessary to determine in an accurate and scientific way the actual composition of the Tasmanian coals. The method employed in this sampling was standardised for the whole investigation, and is described in a subsequent chapter of this publication.[1]

(4)—Acknowledgments.

The writers desire to record their great obligation to those who so generously assisted them in various ways in the furtherance of this investigation. These remarks apply to those who gave of their hospitality equally with others who assisted directly in the field work. The assistance rendered by Messrs. Hood, Ledger, B. H. Whittle, and E. Lohrey, of the Mt. Nicholas fields; E. Butts, of Dalmayne; A. T. Gillies, of Seymour; J. French, of Buckland; R. Gregg, of York Plains; J. McShane and Ambrose Fox, of Colebrook; Brock Bros., of Lawrenny; R. L. Slide, of Sandfly; and J. Gard, of Cygnet—greatly accelerated the work of the investigation.

The writers desire also to gratefully acknowledge their indebtedness to Messrs. G. W. Fulton, E. Fogarty, and H. Press for much valuable information received.

(1) See page 22.

Chapter II.

GEOGRAPHICAL DISTRIBUTION OF THE COALFIELDS OF TASMANIA.

The majority of the coalfields of Tasmania occur in the east and south-eastern portions of the State. The only coalfields which do not occur in this portion of Tasmania are located in the north-western portion of the Central Plateau, near the north-western end of the Midlands-Westbury Plain, and in a portion of the north-western corner of Tasmania. Coal is apparently absent from the western and south-western portions of Tasmania. It was at one period thought that coal extended practically continuously from Mt. Nicholas to Tasman's Peninsula, but the present investigation has shown that this region is not continuously coal-bearing, but contains within it isolated coal-bearing areas. The same features characterise the region extending from Tasman's Peninsula through Hobart to Catamaran and South-East Cape. An important coalfield occurs isolated from the East Coast fields on the southern slopes of Ben Lomond. Other isolated patches of coal occur between the East Coast and the Central Plateau.

The position of all these occurrences can be readily seen marked in black in the general map published as Plate I. to this publication.

Chapter III.

THE GEOLOGY OF THE COAL-BEARING FORMATIONS OF TASMANIA.

(1)—The Permo-Carboniferous System.

The Permo-Carboniferous system of Tasmania possesses the same general characteristics of that system as developed on the Australian Continent. The Carboniferous system proper is absent, the lowest bed of the sedimentary system consisting of the basal glacial conglomerates of the Permo-Carboniferous. These conglomerates constitute the base of the Permo-Carboniferous wherever they occur in Tasmania, but there is a very great variation in its thickness in the various parts of the State, ranging from 15 feet in the Mt. Nicholas area to as much as 1200 feet in the vicinity of Preolenna.

Conformably overlying this basal conglomerate is the Lower Marine series of the Permo-Carboniferous. These consist of limestones, mudstones, and mudstone conglomerates, and vary in thickness from 30 feet at Barn Bluff, to a maximum of about 1000 feet on the South-east coast. The series may be subdivided into a Lower zone, characterised by *Pachydomus* in the southern portion of the island, and *Eurydesma* in the north, and an Upper or *Fenestella* zone.(2)

Succeeding this Lower Marine series there occur sandstones and shales with associated coal seams as a typical fresh-water series, and characterised by the *Glossopteris* and *Gangamopteris* flora. This series, known as the Greta Coal Measures, also has a great variation in thickness, ranging from 30 feet at Barn Bluff to 140 feet at Preolenna, and 850 feet at Bruny Island in the south. It is interesting to note that in certain localities this fresh-water series disappears, and some of these localities correspond to the tasmanite shale areas in which the tasmanite occurs as a marine deposit on the same geological horizon as the fresh-water series.(3)

The coal seams in the fresh-water series are neither numerous nor large, but are of special value in that they consist invariably of some variety of the *Kerogenites*, or so-called cannel coals, valuable for oil distillation purposes and gas-making. The number of seams varies from 1 to 4, the greatest development taking place at Preolenna, where four seams have been definitely proved.

Conformably overlying the fresh-water series are the Upper Marine series, which consist of mudstones and mudstone conglomerates and limestones, characterised by *Spirifera*, *Productus*, &c. This series varies in thickness from 50 feet at Preolenna, 970 feet at Barn Bluff, 100 feet at Mersey, 300 feet at Mt. Nicholas, and 500 feet at Upper Derwent.

This Upper Marine series passes upwards into fresh-water sandstones and shales with coal seams. This series corresponds to the Tomago or Newcastle series of New South Wales. Its thickness varies considerably, and is 550 feet at Preolenna, 740 feet at Barn Bluff, 260 feet at Mt. Nicholas, and 200 feet at Sandfly-Cygnet. It is characterised by the *Glossopteris* flora.

The total thickness of the Permo-Carboniferous system, therefore, throughout Tasmania varies within wide limits. The approximate thickness at various localities is as follows:—2400 feet at Preolenna; 1900 feet at Barn Bluff-Pelion; 500 feet at Mersey; 770 feet at Mt. Nicholas; greater than 1100 feet at Upper Derwent; greater than 550 feet at New Town; greater than 1900 feet at Bruny-Cygnet.

The variation of the total thickness of the Permo-Carboniferous, and also the variation of the several series therein, are shown by the columnar sections on Plate II.

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(2) For further particulars of the palaeontology of this series see R. M. Johnston's "Geology of Tasmania" (1888), pages 117-128.

(3) W. H. Twelvetrees: Geological Survey of Tasmania, Bulletin No. 11.

The rocks of this system show no signs of folding, being either horizontal or having a dip seldom exceeding 25 or 30 degrees. The structure is that of discontinuous blocks at elevations above sea-level varying from zero to 3000 feet. These blocks have reached their present positions through the effect of the upthrust of the diabase or subsequent post-diabasic block faulting.

(2)—The Trias-Jura System

The Trias-Jura system appears to conformably overlie the Permo-Carboniferous, but evidence of a disconformity has been obtained at certain localities. The basal member of the system consists throughout the whole of the island of grit or fine-grained conglomerate. The thickness varies from 1 foot to 50 feet, and is remarkably persistent.

This basal grit is conformably succeeded by what are known as the Ross sandstones. These are distinctly silicious sandstones, characterised by the presence of white mica. They are white to yellowish-brown in colour. They are of fresh-water origin. This series varies in thickness from 200 feet in the Mt. Nicholas area and 700 feet in the Midlands, to 1350 feet in the vicinity of Hobart.

Conformably overlying this series is the felspathic sandstone series. This series consists of felspathic sandstones, shales, mudstones, and coal seams. It is wholly of fresh-water origin, and is characterised by a *Neuropteris*, *Cladophlebis*, *Thinnfeldia* flora. The total thickness of this series varies from 400 feet to 800 feet. This series contains the most important coal seams in Tasmania. These coal seams are associated with a shale zone occupying about the middle of the series. There are a maximum of eight coal seams developed on the eastern and south-eastern areas. These seams have been named, as the result of this investigation, from top to bottom as follows:—Alpha, Beta, Gamma, Delta, Eta, Theta, Iota, and Kappa. In most of the coalfields these individual seams have been recognised, and have been given their names in this publication. This will make for clearness in describing and generally referring to the Trias-Jura coal seams. The seams vary from 1 foot to 16 feet in thickness, and the coal is a typical humite or bituminous coal.

This felspathic sandstone series is in most places overlain by diabase, the presence of which has protected it from erosion. In some places, however, notably at Mt. Nicholas, and at other localities down the East Coast, and at some places in the Midlands, an Upper Silicious sandstone has been recognised, the greatest thickness exposed being 200 feet. This series has obviously been subjected to great denudation, and its complete thickness has nowhere been observed.

The variation in the Trias-Jura system throughout the various parts of the State is shown in the columnar sections on Plate II.

The age of this system is given as Trias-Jura, because the palæontological evidence is such as to make it difficult to decide whether the age is Triassic or Jurassic. Correlation with the mainland formations has not yet been satisfactorily effected, and in view of the fact that these latter have not been finally correlated with European formations, makes it impossible at present to give any more exact determinations than that of Triassic or Jurassic age. The system being conformable to the Permo-Carboniferous system, it naturally is characterised by the same structural features as that system, namely, a complete absence of folding or any other sign of compression, and a general horizontality of the beds within blocks thrown to varying levels by the effect of diabasic or Tertiary tensional block-faulting. Its distribution in Tasmania is that of isolated blocks, separated in most cases by masses of diabase.

(3)—The Tertiary System.

The only development of importance of Tertiary sedimentary rocks in Tasmania is that of some isolated patches of lacustrine sediments, such as soft sandstones, clays, ferruginous mudstones, sands, and lignites. This rock series is most characteristically developed in the Launceston Tertiary basin, which has an area of, approximately, 600 square miles. The maximum thickness of the system in this locality is 900 feet. The series is horizontal, and remains undisturbed in the original position in which it was deposited. The lignite or brown coal beds occur near the base of this system and do not exceed a few feet in thickness. Much smaller areas of similar sediments occur in the Upper Derwent, on the North-West Coast, and in Macquarie Harbour. In each of these localities lignites or brown coals are developed, but the maximum thickness in any case does not exceed 10 feet.

The Tertiary system throughout Tasmania carries a flora characteristic of (4) a warm temperate or sub-tropical climate. In the north-west portion of Tasmania marine Tertiary beds are developed. In the Wynyard area, in the vicinity of Table Cape, the beds are about 50 feet thick.(5) At Marrawah Tertiary limestones of considerable but undetermined thickness occur.

The whole of the Tertiary system in Tasmania, whether marine or lacustrine, was deposited subsequent to the intrusion of the Permo-Carboniferous and Trias-Jura systems by the diabase, and also subsequent to the extensive erosion interval that succeeded the latter event. The Tertiary system, therefore, has sometimes been deposited on the diabase, and sometimes on the Permo-Carboniferous and Trias-Jura systems, but although invariably horizontal it cannot be said to conformably overlie these latter systems.

(4) See R. M. Johnston's "Geology of Tasmania" (1888), pages 268-294.

(5); R. M. Johnston's "Geology of Tasmania," pages 258-264.

Chapter IV.

THE TASMANIAN DIABASE AND ITS RELATION TO THE COAL-BEARING FORMATIONS.

Subsequent to the deposition of the Trias-Jura sediments described in the previous chapter, there occurred over the greater part of Tasmania the intrusion, on an enormous scale, of the igneous rock diabase. The date of intrusion was probably Cretaceous, and coincided with the foundering of portions of the old Gondwanaland continent, lying to the west, the uprising of the molten rock, in fact, being a compensating adjustment to the sinking segment of the old land mass. The diabase thus intruded penetrated rocks of all ages in Tasmania, but its horizontal enlargement took place pre-eminently in the relatively newly-deposited Permo-Carboniferous and Trias-Jura sediments. In fact, the rock reaching the horizon of these sediments has penetrated and disturbed them in all directions, bringing about the effect of the present existence of completely separated blocks of sediments located at any height above sea-level, varying from zero to over 4000 feet.

The study of the geologic structure of the coalfields largely resolves itself into a study of the nature of the diabasic intrusions therein. It is of the utmost importance, for example, to determine whether the diabase is in the form of a sill, a dyke, a laccolith, or an irregular transgressive mass, chonolithic or batholithic in character. This relationship between the diabase and the coal measures was not at all understood when the present investigation was undertaken. As the result of the recent researches, however, much light has been thrown on this question. It is now definitely determined, for example, that there is no structure of the diabase in relation to the sediments which is universally present. The structure varies from place to place, and has to be determined separately for each field.

Sills or intrusive sheets have been definitely shown to exist in various localities, particularly in the case of the diabase occurring at a higher level than the coal measures in the Mt. Nicholas and the Barn Bluff areas.

Only a few forms of typical laccolithic structure have been located, but the greater portion of the diabase in Tasmania, namely, that constituting the Central Plateau, can be best described as an asymmetric transgressive igneous mass of a general laccolithic type. The eastern and main portion of this, to the greatest depth observed, shows no signs of a definite bottom, but its western extension shades off gradually into a typical sill structure, the sills of Barn Bluff, Pelion, and Eldon Range, being portion of this Central Plateau mass. It has been clearly demonstrated that this mass rose upwards under the plateau, lifting the Permo-Carboniferous and Trias-Jura sediments bodily with it. Concurrently the invading igneous mass discovered a plane of weakness in the bedding-planes of the sediments on the western side, and travelled along it to form a typical intrusive sheet. The overlying sediments present during this intrusion have since been almost completely removed by denudation.

The diabase seems to have risen from below in a somewhat similar fashion over almost the whole of northern, eastern, southern, and central Tasmania; but the height to which it rose varied greatly from point to point, there being a range in elevation of the order of 5000 feet. It was this variation in the height reached by the diabase which has caused the present existence of blocks of Permo-Carboniferous and Trias-Jura sediments at such varying heights above sea-level, for it was only those blocks which were raised to the highest levels which have suffered such denudation as to have the sediments removed which lay on the surface of the upwelling molten mass.

A common structure in the relation of the diabase to the sediments is that of a broad and persistent dyke-like mass of diabase, intruded along what is apparently, a fault-plane developed synchronously with the diabasic intrusion, for we find a difference in elevation of the same geological horizon on the two sides of the dyke amounting to as much as 2000 feet.[6]

Numerous other diabase dykes occur in addition to this latter type, and these are generally upward tongues from the larger diabasic intrusions described above.

This relation of the diabase to the coal-bearing sediments assumes such an economic importance that in the subsequent chapters on the various coalfields of Tasmania a special description is included under that heading.

[6] P. B. Nye: Geological Survey of Tasmania, Underground Water Supply Paper No. 2.

Chapter V.

THE FAULTS AND THEIR RELATION TO THE COAL SEAMS.

So far as this investigation has been carried, all the important faults have been carefully surveyed and mapped, and their relation to one another and to the coal seams has been definitely established. The relationship between widely separated fields of the same age, and occurring at different elevations, has, however, not yet been determined. This is due to the fact that the intervening country has not been surveyed. For instance, the Mersey coal measures do not rise 500 feet above sea-level, while the Preolenna are found between 1200 and 1800 feet, and the Barn Bluff at nearly 4000 feet, above sea-level. All of them belong to the Permo-Carboniferous, and, although occurring at different horizons in that formation, their relative positions are accounted for mainly by faulting. Such faulting of the Permo-Carboniferous and the overlying Trias-Jura is of very common occurrence in the districts examined. In the same area are found Permo-Carboniferous strata many hundred feet higher than the younger measures, and in some cases the faulting is most intricate, and very difficult to decipher. The disturbance of the coal measures is due to the dislocation and differential uplift of the strata by the intrusion of diabase, and to normal faulting on a large scale resulting directly therefrom. The diabase was intruded in the form of a laccolith of very great extent, from which sprung forth numerous subsidiary dykes and sills. It is possible to conceive this great viscous mass in its ascent breaking through the lower coal measures, and because of its greater specific gravity insinuating its way between the higher dissimilar members, dislocating and raising them to various elevations. This differential uplift of the strata cannot, in the strictest sense of the word, be considered a true expression of faulting. Normal faulting resulting from the intrusion by the readjustment of the formations, followed the course of the great trend lines of the earlier Palæozoic rocks. Thus it is found that in most cases the faults of greatest magnitude occur at or near the point of contact between Devonian granites and Cambro-Ordovician slates, and follow this line for many miles. In this regard it is interesting to note that diabase has very seldom been found intruding the granites, although great sill-like masses overlie that rock. Therefore, it may be affirmed that almost without exception the great fault-lines coincide with the main structural planes of the country. It follows from the foregoing that the diabase has been affected by true faulting only.

Nearly all the great structural faults have a general axial trend. They vary in direction from the north-west to north-east, and continue unbroken for long distances. There are, however, a few transverse faults of considerable displacement that have a direct bearing on the continuity of the coal seams. Generally the downthrow of the axial faults is to the south of west, but in the Silkstone fault, which continues to the Denison River, the downthrow is in the opposite direction.

A glance at Plate XXXI. will show that a great fault, following the course of a granite dyke, completely severs the Avoca coalfield, the mines on the western being from 1000 to 2000 feet higher than those on the eastern side of the fault. On the western side of this fault the coal seams are exposed high up the hill-sides, while on the eastern, few outcrops occur, and diabase occupies the greater part of the surface. In consequence, the extent of the potential coal-bearing country cannot be ascertained without a considerable amount of exploratory work by boring.

Between the Avoca and Fingal fields there are two important axial faults, one of which, passing close to the Fingal mine, prevents continuous operation on the seams between the two fields. Along the Mt. Nicholas Range the several mines are separated by a series of roughly parallel axial faults, which, fortunately, pass close to the section boundary lines, and hence do not seriously interfere with mining development. All of these major axial faults have been located, with the exception of one which on geological evidence is known to occur between the main openings of the Mt. Nicholas and Cornwall Collieries. The full effect of this fault on future operation cannot be predicted until more precise information has been obtained. The location of the numerous minor faults by boring, in order to design the workings to the best advantage, is out of the question, owing to the thick cover of overlying rock. However, the difficulties presented by these minor faults can be easily surmounted. The Jubilee leases are contained between two major axial faults (the Cornwall and Gould's), inclined to one another at such an angle that they junction near the southern boundary of the property. Apparently there are no serious effects resulting from these displacements, as both throw down to the south of west, and the mine is between them. The Cornwall fault continuing southward passes through the Dalmayne property, then takes an almost due southerly trend. Besides the Cornwall fault, another (the Dalmayne) passes through the eastern end of the property, and is connected with it by Wardlaw fault, coursing due east, with a displacement of 200 feet to the south. This coincidence of faults resulted in a great block movement to the south-east. Lying between the Cornwall and Silkstone faults, the Dalmayne seams within the bounds of the company's leases are not greatly disturbed.

Seymour fault, coursing southward with a displacement of about 100 feet to the east, divides the next coalfield into two distinct groups of mines, namely, Seymour on the east side, and Douglas and Denison River mines on the west. Seymour field occupies the flat country near the sea-coast, while the Douglas and Denison River mines occur in the foothill country, and are bounded on the west by the Denison (Silkstone?) fault, which has a downthrow to the east amounting to 200 feet. Further westward exploration has not been encouraging, owing to the fact that the surface is almost completely occupied by diabase; but southward is the St. Albans field, which is traversed by another almost parallel axial fault.

The effect on working conditions is rather serious, as the seams can be operated by tunnel in one part, and by shaft only in the other part, of the area.

Still further southward, in the Steep Creek and Llandaff fields, and especially in the latter, the strata are so disturbed that the workable area from any particular mine opening is very small.

The coalfields southward of Llandaff, and in nearly every other field in Tasmania, consist of comparatively small disconnected areas, all of which have been subjected to movements producing faulting in both a minor and major degree. Further information in relation thereto in this connection is given under detailed description of the mines.

Part II.

Mineralogic and Chemical Background.

Chapter I.

NOMENCLATURE AND CLASSIFICATION OF COALS.

No universal standard classification of coals has yet been adopted. In fact, the classification of coals is a very difficult question, and is rendered especially difficult, particularly as regards the nomenclature by the world-wide use of terms which are completely misleading as to the character of the coal. In dealing with the coal resources of any country, therefore, it is essential to clearly indicate what classification of coals is adopted before proceeding with the description of the coal deposits themselves.

Coals for many years were subdivided into four main classes, which were indicated by the following terms:—

Anthracites.
Bituminous coals.
Cannel coals.
Brown coals or lignites.

Even assuming that the grouping of the coals indicated thereby is in accordance with their character and composition, the terminology of the groups leaves very much to be desired.

The term "anthracite" cannot be taken exception to, as it is the name given to a type of coal which represents a natural group.

To apply the term "bituminous" to the second class of coals, however, is totally misleading, as these coals contain no bitumen. In fact, the coals of the next group, namely, the cannel coals, approach bitumen more nearly in composition than do the so-called bituminous coals. The composition of a bituminous coal certainly resembles the composition of humic acid more closely than it does that of bitumen. Accordingly, the term "humite" has been suggested as a group name for this class of coal. This terminology is adopted in this publication, and the second group is thus termed "humites." It is realised, however, that the ordinary commercial man has got used to the term "bituminous coal" as meaning a gas-making coal, and to cater specially for his requirements, the word "bituminous" is put in brackets wherever the word "humic" is used, as indicating the variety of coal.

The term "cannel coal," used as indicating the third class of coals, has again very serious objections, in that the original cannel coal was a coal of a character differing in a very marked degree from the majority of coals, which must inevitably be included in the third class of coals under this classification. Patonié proposed the term "sapropelic" to indicate the coals of this group. This word was of Greek origin, and was designed to indicate the fact that the common characteristic of these coals was an origin from material consisting of more or less gelatinous slime of vegetable and animal origin. It has recently been shown by Dr. Theissen(7) and Marie Stokes that this fundamental amorphous constituent of coal, supposed to be derived from such a gelatinous slime, can be resolved into very fine fragments of the spore exines, &c. The application of "sapropelic" to this group of coals, therefore, has no legitimate basis, although it would, having no other application, be very useful for this purpose. Dr. Theissen, in his investigations, has conclusively shown that the bodies previously observed by Bertrand, Jeffrey, and others, and referred to by the former as of algal origin, are actually

(7) Dr. R. Theissen, United States Bureau of Mines, Bulletin No. 38.

spore exines. These spore exines are abundantly developed, and specially characterised in the group of coals we are now discussing, although they are also present to a very much smaller degree, however, in humic coals. It would, therefore, be feasible to adopt Huxley's terminology in regard to this group of coals, and refer to them as "spore coals," were it not for the fact that many of the humic coals contain quite an appreciable number of spore exines. In searching for a term which would suitably designate this group we are compelled to turn to the chemical characteristics, and it is on this basis that a term can be evolved which satisfactorily indicates the natural group. The outstanding chemical characteristic of the members of this group of coals is the fact that on being subjected to destructive distillation they evolve mineral oils, in many cases exclusively, but in others with the simultaneous generation of tar and tar-like products. This generation of mineral oils is dependent, apparently, on the presence of the spore exines. The oils are members of the aliphatic series, and kerosene is among the commercial products. In the oil-shale industry in Scotland the name "kerogen" has been evolved to indicate the mother substance in the oil-shale, which is converted into the oil on distillation. It is obvious, therefore, that a term such as "kerogenite" is an appropriate one to indicate this group of coals, from all of which some oil can be distilled, and which, therefore, contain at least an appreciable amount of kerogen. In this publication the term "kerogenite" is adopted as a group name to include all varieties of cannel coal, bog-head coal, torbanite, kerosene shale, and oil-shales generally.

The use of the term "lignite" or "brown coal" for the fourth class presents no difficulties or objections, as they clearly indicate the general character or origin of the members of the group.

Considering the classification further, and realising the infinite variety of coals that are known to exist, the same difficulty arises as is recognised in regard to the classification of other natural occurrences where the variety is almost infinite. In this no hard and fast groups can be delineated, and the division of transition groups becomes a necessity. This has been recognised in almost all attempts at classifications of coal. Adopting this general practice the following classification seems to the writer to be the most convenient for grouping the various varieties of coal occurring in Tasmania in the present state of our knowledge concerning them.

It must be understood in regard to this classification that the total carbon and calorific values are stated on a pure coal basis; that is, on coal with the ash, sulphur, and moisture removed. Owing to the varying ash, sulphur, and moisture content, this basis of classification is essential. It is obvious, therefore, that all the total carbon and calorific values as indicated in this schedule of classification are higher than the figures ordinarily given for coals, which are, of course, for coals containing ash, sulphur, and moisture. The "fuel ratio" is obtained by dividing the "fixed carbon" content by the "volatile hydro-carbons" content.

Classification of Coals Adopted in this Publication.

Anthracites—

Burn with short blue flame.
Fuel ratio, 12 or over.
Calorific value, 14,500 to 15,000 b.t.u.; 8000 to 8330 calories.
Total carbon, 93 to 95 per cent.
Volatile hydro-carbons, 3 to 5 per cent.

Sub-Anthracites—

Burns with slightly luminous short flame and little smoke. Does not coke
Fuel ratio, 7 to 12.
Calorific value, 15,000 to 15,500 b.t.u.; 8330 to 8600 calories.
Total carbon, 90 to 93 per cent.
Volatile hydro-carbons, 7 to 20 per cent.

Humites—

Non-caking Humic:

Burn with short luminous flame.
Fuel ratio, 1·4 to 7.
Calorific value, 12,000 to 14,000 b.t.u.; 6600 to 7800 calories.
Total carbon, 70 to 90 per cent.
Volatile hydro-carbons, 20 to 38 per cent.

Caking Humic:

Burns with luminous flame.
Fuel ratio, 1·2 to 7.
Calorific value, 14,000 to 16,000 b.t.u.; 7700 to 8800 calories.
Total carbon, 75 to 90 per cent.
Volatile hydro-carbons, 20 to 26 per cent.

Gas-making Humic:

Burns freely with a long luminous flame, and has an extensive use for manufacturing gas.
Fuel ratio, 1 to 1·5
Calorific value, 12,000 to 14,000 b.t.u.; 6600 to 7800 calories.
Total carbon, 70 to 80 per cent.
Volatile hydro-carbons, from 26 to 40 per cent.

Humic Kerogenites—

This group, provided the ash content is not too high, burns with marked intumescence, with a long, highly luminous flame, giving out a characteristic odour resembling to some extent that of burning oil.
Fuel ratio, ·8 to 1·9.
Calorific value, 12,000 to 16,000 b.t.u.; 6600 to 8800 calories.
Total carbon, 60 to 80 per cent.
Volatile hydro-carbons, from 40 to 50 per cent.

Kerogenites—

This class contains a series of coals having a very wide range as regards ash content. They all possess the common characteristic, however, of giving off a smell of burning oil when burnt. They burn with a long, smoky, yellowish, luminous flame. On destructive distillation they yield oils of both the paraffin series and the olofine series, or, in other words, paraffin base oils or asphaltum base oils.
Fuel ratio, ·05 to ·8.
Calorific value up to 16,000 b.t.u., according to the percentage of ash. Up to 8800 calories.
Volatile hydro-carbons. The volatile hydro-carbons always exceed the fixed carbon, as indicated by the fuel ratio.
The kerogenites can be subdivided into several varieties, but the details of this classification need not be developed in this publication, but will be fully delineated in the forthcoming publication on the "Oil Shale Resources of Tasmania."

Sub-Humites—

These coals are generally lustrous black, but occasionally brown, and generally conchoidal fracture. Drying cracks are irregular curved lines. Moisture content at 105° C. varies from 10 to 50 per cent.
Fuel ratio, 0·6 to 1·2 per cent.
Calorific value, 10,000 to 13,000 b.t.u.; 5500 to 7200 calories.
Total carbon, 60 to 75 per cent.
Volatile hydro-carbons, 20 to 45 per cent.

Lignites or Brown Coals—

These coals are generally brown in colour, but occasionally black. Fracture is earthy and dull. Drying cracks generally separate long bedding-planes, and often show fibrous or woody structure. Moisture content at 105° C. varies from 10 to 50 per cent.

Fuel ratio, 0·6 to 1·0 per cent.

Calorific value, 7000 to 11,000 b.t.u.; 4000 to 6000 calories.

Total carbon, 55 to 75 per cent.

Volatile hydro-carbons, 30 to 55 per cent.

Chapter II.

THE NON-COMBUSTIBLE COMPONENTS OF COAL AND THEIR RELATION TO THE ASH CONTENT.

Of the many impurities contained in coal or associated with it, the most important are—

(1) Ash, consisting of intrinsic matter and the extraneous materials, shale, clay, sandstone, calcite, &c.
(2) Sulphur in the forms of pyrite and marcasite.
(3) Moisture.

Ash.—The amount of ash in a coal is one of the determining factors in arriving at its value for industrial uses. Not only does it decrease the amount of combustible matter in coal, but its physical and chemical properties also have an important bearing on the market value. For instance, if the fusibility of the ash is low, or if it clinkers readily, the commercial value of the coal is greatly reduced.

Intrinsic ash is that contained originally in the body of the plants from which the coal was formed, and the quantity was proportionate to the varying amount of ash entering into the bodies of the several kinds of plants. To this quantity, ash was added by the deposition of inorganic matter from solution, by sedimentation, or by wind-carriage, according to the conditions existing at the time of formation.

Shale, limestone, clay, and sandstone partings and binders between layers of coal have been laid down as sediment from surface waters, and in a minor degree by wind carriage. In some cases sedimentation and the accumulation of organic matter took place contemporaneously, the varying quantities of each resulting in all gradations from impure coal to stone containing very little carbonaceous material. In addition, periodic floods caused the deposition of mud from dirty waters in the form of films between the layers of organic matter.

Calcite, silica, and iron (as pyrite and marcasite) were deposited from solutions in the forms of films, veinlets, bunches, nodules, and concretions.

In burning, the calcite (carbonate of lime, $CaCO_3$) component is converted into lime (CaO), losing one molecule of carbonic acid, and reducing the weight of ash proportionately. Likewise the oxidation of pyrite and marcasite in burning results in the replacement of sulphur by oxygen, thereby effecting a further small reduction in weight. However, although these accessory components of coal are nearly always present, the amounts are usually not very considerable. Their indirect effect is more serious. For instance, in combination with one another, or with other constituents, clinkers are formed, and in the correct proportion and under suitable conditions a very fluid slag is produced.

Heat is lost in the conversion of calcite and pyrite into the corresponding oxides.

Sulphur.—Sulphur in combination with iron as pyrite and marcasite, is a common accessory component of coal. It occurs also in the elemental state, but in this condition it is generally inconsiderable.

Sulphur cannot rightly be classed as a non-combustible component of coal, but even when free it has a low heating value, and in combination with iron it tends to decrease the calorific value.

Moisture.—Moisture is contained in coal as (1) extrinsic moisture formed on the outer surfaces or absorbed into the body of the coal by condensation or by soakage of water percolating through the seams; and (2) as intrinsic moisture due to water inherent in the coal, and derived in part from the chemical changes that have taken place in the constitution of the organic matter of which it was originally composed.

Moisture reduces the heating value of coal more than any other constituent, because it is inert, and does not produce heat; and, again, because it not only acts as a diluent of the combustible matter in the coal, but it absorbs considerable heat in its conversion into steam and its removal by evaporation. In order to convey an idea of the loss of efficiency due to excessive moisture in coal, it may be mentioned that each per cent. of moisture decreases the heating value of coal nearly 1 per cent., which is equivalent to a loss of nearly 22 lb. per ton. The direct loss of heat in the evaporation of the moisture contained in the coal is even more serious. In order to illustrate this it may be pointed out that the heat required for the raising of water to boiling point and its conversion into steam amounts to 282 calories per lb.

A small proportion of water has little injurious effect upon the coal, but a large amount, such as that contained in the lignites, for instance, renders the untreated coal of little value for household and power purposes. The lignites, however, after being compressed into briquettes and dried, become suitable for these and other purposes.

In Tasmania it has been noted that the moisture content varies according to the age and nature of the coal, and also according to the degree of metamorphism to which it has been subjected. Thus the youngest coals (Tertiary lignites), containing 15 to 30 per cent. of water, have not been affected by metamorphic agents, while the older Trias-Jura and Permo-Carboniferous coals contain very little moisture, and the anthracite even less than the other varieties.

As a rule, coal that is high in moisture slacks on exposure to air, and sparks freely under forced draught. It is, therefore, of much lower commercial value than coal that is low in moisture.

Chapter III.

THE CALORIFIC VALUE AND EVAPORATIVE POWER.

The calorific value of a coal is the amount of heat produced by burning a unit weight of coal, and is measured by the number of corresponding units of weight of water raised 1 degree in temperature by this amount of heat.

When the Centigrade unit of temperature is used, the unit quantity of heat is termed the Calorie, and when the Fahrenheit unit is used, it is termed the British Thermal Unit. Calories are converted into British Thermal Units by multiplying by 1·8.

The evaporative power of coal is the number of units of weight of water at boiling-point that can be converted into steam at the same temperature by burning one corresponding unit weight of the coal. It is obtained by dividing the latent heat of steam into the calorific value, thus:

$$\text{Evaporative power} = \frac{\text{calorific value in calories.}}{537}$$

$$\text{Evaporative power} = \frac{\text{calorific value in b.t.u.}}{967}$$

The calorific values were determined in an Emerson calorimeter of the "bomb" type.

The following is a brief description of the details of operation:—

The lower half of the bomb was placed in the iron plate-holder, and the fuel-pan support adjusted in proper position.

The fuse wire was connected to the binding-post on the fuel-pan support, and extended across the bomb to the binding-post at the opposite side of the bomb. Sufficient length was allowed so that the wire would dip down far enough to be in contact with the coal which was afterwards placed in the pan. Care was taken that the wire did not touch the fuel-pan.

A one gram sample of 80-mesh coal was poured into the nickel pan in the bomb. The upper half of the bomb was placed in position and screwed down tightly against the lead gasket. Oxygen was forced into the bomb very slowly, until the pressure gauge recording the pressure within the bomb indicated 300 lb. per square inch. The tank valve was closed, and then the spindle valve immediately thereafter.

The bomb was immersed in water at once to detect any possible leakages. It was then placed in the calorimeter can containing 1900 grams of distilled water, at a temperature of about 1½ degree below the jacket temperature. The stirring apparatus was adjusted so that it did not touch either the bucket or bomb, and the thermometer was inserted, so that the bulb was at least ½-inch from the bomb, and was immersed about 3 inches in the water.

The terminals of the electric circuit used for firing were attached, one to the spindle at the top of the bomb, and the other to the outer end of the insulation plug on the lower cup of the bomb.

After the stirrer had been in motion for three minutes to equalise the temperature throughout the calorimeter, the first reading of the thermometer was taken by means of a hand telescope.

During this preliminary period readings were taken one minute apart. At the end of this time the switch was turned on for an instant only. Readings were taken every half-minute from the time of firing. After the maximum temperature was reached, the readings were continued for an additional five minutes, reading every minute.

The data obtained during the run were as follows:—To the temperature in the calorimeter at firing and the maximum temperature, was applied the correction for the errors on the thermometer. The difference between the corrected temperatures at maximum and firing gave the true rise of temperature in the calorimeter, and to which must be added a cooling correction.

The rise of temperature, corrected for thermometer calibration errors, and with the cooling correction applied, was divided by the weight of the fuel used, giving directly the rise in temperature per gram of fuel.

The rise per gram times the weight of water, plus " water equivalent," gave the calories per gram of fuel.

The calorific value of coal determines to a large extent its commercial value. The heat unit method is the only satisfactory way of purchasing coal. In applying it the seller should guarantee certain heat values in British thermal units per lb., with corresponding prices.

If the coal supplied is not in accordance with the standard as set out in the specifications, the purchaser should be allowed a rebate of so much per ton, according to the arrangement entered into.

As the value of a coal for the production of heat cannot be ascertained from its appearance, all consumers who purchase coal on a competitive basis should do so only on the heat unit method.

In addition, if this desirable practice were adopted, colliery owners would be compelled to keep the grade of their coal up to the highest standard possible.

Chapter IV.

THE IGNITION POINT OF COALS.

Tests have been carried out on representative samples from the various coal mines to determine their liability to ignite spontaneously during storage or transport.

From the results obtained, Tasmanian coals under ordinary conditions can be carried or stored with absolute safety.

It will be seen from the figures in the following table that over 60 per cent. of the coals examined have an ignition point of 150° C. These can be considered safe, even under practically dangerous conditions:—

Name of Mine or Locality of Exposure.	Reg. No.	Ignition Point. Degrees Centigrade.
Cardiff Coal Mine	322	125°
Jubilee Coal Mine	325	131°
Silkstone Coal Mine	386	135°
Silkstone Coal Mine	388	over 150°
Bruny Island	114	over 150°
Fingal Coal Mine	494K	140°
York Plains Coal Mine	520	150°
Dalmayne Coal Mine	412	over 150°
Dalmayne Coal Mine	415	over 150°
Douglas River	417	over 150°
Douglas River	418	150°
Denison River	419	130°
Hastings	428	150°
Strathblane	429	over 150°
Sandfly Coal Mine	434	over 150°
Sandfly Coal Mine	436	over 150°
Sandfly Coal Mine	438	150°
Catamaran Coal Mine	464	over 150°
Mt. Cygnet Coal Mine	478	over 150°
Tasman Peninsula	481	over 150°
Buckland	494R	150°
Seymour	624	130°
Mt. Nicholas Coal Mine	628	130°
Cornwall Coal Mine	629	135°
Mt. Christie	688	150°
Merrywood	693	130°
Mt. Paul	746	over 150°
Illamatha Coal Mine	152	over 150°
Spreyton Coal Mine	153	148°
Preolenna Coal Mine	757	over 150°

The method of carrying out the tests referred to was as follows:—

The coal was ground to pass through 100-mesh sieve, and then placed with a thermometer in an ignition chamber 4 inches long and 2½ inches diameter.

The whole was heated in a paraffin oil bath to 100° C., and a current of carbon dioxide was passed through, until the coal was dry. The temperature of the bath was then adjusted until the thermometer inside the ignition tube indicated a specified "initial" temperature, and a strong current of oxygen was substituted for the carbon dioxide. As the temperature of the thermometer in the coal rose, the temperature of the paraffin in the bath was raised to keep pace with it, until the reactions became so intense that the coal caught fire. The lowest "initial temperature," starting from which, under these conditions, the coal ignited in one hour, was taken as a measure of the danger of spontaneous ignition. Coals that did not ignite within an hour with an initial temperature of 150° C. were regarded as practically safe even under dangerous conditions.

According to M. Dennstedt (8) and R. Bunz (9) the liability of a coal to ignite spontaneously is indicated by a high result in the Mauméné test, and by a high iodine absorption; the amount of iodine absorbed depends on the fineness of the sample, and the test must be made by a method of comparison. Their experiments also show that the quantity of moisture in the air-dry coal, and the quantity of moisture absorbed by the dry coal on standing in air, are greater with the more readily inflammable coals; and this moisture is taken up by the organic part of the coal. Neither the mineral constituents, including pyrites, nor the organic sulphur and nitrogen, appear to promote spontaneous ignition. Spontaneous ignition is due to the oxidation of unsaturated organic constituents of the coal.

(8) M. Dennstedt and L. Schaper: Z. Agnew. Chem., 1912, 25, 2625-2629

(9) M. Dennstedt and R. Bunz: Z. Agnew. Chem., 1908, 21, 1825-1835.

Chapter V.

THE METHOD OF SAMPLING THE COAL SEAMS USED IN THIS INVESTIGATION.

Before any samples were taken a preliminary examination was made of the mine to enable the sampler to determine what portion of the seam was excluded in mining, and where best to take the samples so that they would represent the coal mined in that part of the colliery.

The sampling was carried out in a systematic manner with the object of obtaining representative samples of the coal seams.

The haphazard way in which samples have been taken in the past by mine-owners and others has been such as to render the analyses misleading, and of little or no value to the public.

At the place selected the face was squared up, and all loose coal from roof to floor removed for a width of 6 feet. A careful examination was made of the roof, and any pieces likely to fall and contaminate the sample were taken down.

A sampling cloth was then placed on the floor and close up to the seam. In the middle of the cleared area a perpendicular cut, 3 inches deep and 8 inches wide, was made from roof to floor. The bands of slaty coal, shale, &c., discarded by the miners in the ordinary operations of the mine were omitted from the samples also. This method was followed closely, as it was desired to obtain samples that represented the coal produced commercially from the mine under examination.

As soon as the cutting of the sample was completed it was crushed and passed through a half-inch screen.

The sample was then thoroughly mixed, and reduced by quartering, and the opposite quarters rejected. The remaining quarters were mixed, heaped into a cone-shape, and the pile again flattened and quartered. The opposite quarters were discarded and the process of mixing and quartering was continued until the sample weighed about 5 lb. The material finally remaining was put into a receptacle provided for the purpose.

When it was found necessary to ascertain the maximum purity of output, all stone partings ¼-inch thick and over were omitted from the samples. When the impurity to be rejected did not show distinctly it was outlined with chalk before cutting the sample.

The method of cutting the sample, quartering, &c., was carried out as described above.

Chapter VI.

THE SCOPE OF THE LABORATORY AND ANALYTICAL INVESTIGATIONS.

The Geological Survey Laboratory is equipped with the necessary apparatus for carrying out the tests and analyses required in these investigations.

The appliances for crushing and grinding the samples consist of a motor-driven jaw-crusher, and a pulverising machine manufactured by F. W. Braun & Co.

The furnace-room is provided with coke furnaces, and combination muffle and crucible gas furnaces, with air supplied under pressure by means of a motor-driven blower. The chemical laboratory, balance room, and chemical room contain modern equipments. The apparatus includes an Emerson fuel calorimeter, Erlenmeyer combustion furnace, optical pyrometer, electric muffle furnace, mechanically-operated pestle and mortar, Oertling and Ainsworth chemical and assay balances, &c.

The coal samples as received were entered in the laboratory register and given a number. Each sample, which weighed about 5 lb., was crushed, weighed, and allowed to air-dry for 72 hours. The sample was then crushed until it passed through a 10-mesh sieve. It was then thoroughly mixed and reduced by quartering until it weighed about 200 grams.

This quantity, after being ground to 60-mesh, was placed in a well-stoppered bottle, bearing the registered number. The sample was thoroughly mixed before the quantities for the various determinations were weighed. The methods adopted by the U.S.A. Bureau of Mines were those used principally in the proximate and ultimate analyses of the coals examined.

The following is a brief summary of the methods used:—

Determination of Moisture.—The moisture in the air-dried sample was determined by heating 1 gram of 60-mesh coal in a weighed, shallow, porcelain crucible for one hour at 105° C. in a constant temperature oven. The covered crucible was cooled in a desiccator over sulphuric acid, and then weighed. The loss in weight multiplied by 100 was recorded as the percentage of moisture at 105° C. in the air-dried coal.

Volatile Combustible Matter.—A 1-gram sample of 60-mesh coal was placed in a platinum crucible weighing 30 grams and having a tightly-fitting cover. The crucible was supported on a vitreosil triangle, with the bottom 6 cm. above the top of the Bunsen burner. It was heated for seven minutes with a full flame, and was protected from the effects of draughts. The crucible was then cooled in a desiccator and weighed. The loss in weight, minus the weight of moisture, determined at 105° C. times 100, equalled the percentage of the volatile combustible matter.

Ash.—The ash was determined in the residue of dried coal from the moisture determination. A porcelain crucible containing the coal was placed in the muffle furnace, and heated slowly, until the volatile matter was driven off. The ignition was continued at a temperature of 750° C., with occasional stirring, until all parts of carbon had disappeared. The crucible was then removed from the furnace, cooled in a desiccator, and weighed. The ash was moistened with alcohol after each determination, and examined for carbon particles.

Ash determined by this method represented the mineral matter that remained after the coal had been ignited.

Sulphur.—The sulphur was determined by the Eschka method. One gram of air-dried coal was thoroughly mixed in a platinum crucible with two grams of "Eschka mixture" (two parts of light magnesium oxide, plus one part of anhydrous sodium carbonate), and gradually heated in a muffle with free access of air until all the carbon was consumed. The sulphur was extracted with hot water, completely oxidised to sulphate with bromine water, and precipitated and weighed as barium sulphate. The weight of the latter, multiplied by 0·1373, gave the weight of the sulphur, from which the percentage was calculated.

Fixed Carbon.—The fixed carbon was determined as the difference between 100 and the sum of the moisture, ash, and volatile matter.

Carbon and Hydrogen.—The determination of carbon and hydrogen was made in an Erlenmeyer combustion furnace with 25 Bunsen burners.

The apparatus consisted of a purifying train, in duplicate, a combustion tube 40 inches long in the furnace, and an absorption train. The purifying reagents were arranged in the following order:—sulphuric acid, potassium hydroxide solution, soda lime, and calcium chloride. One train was for air and one for oxygen. Both purifying trains were connected to the half-inch diameter combustion tube by a Y tube.

The combustion tube was filled as follows:—A plug of asbestos washed with HCl, and ignited, was placed in the tube 15 inches from the end nearest the purifying train; the next 15 inches was filled loosely with copper oxide wire; a second asbestos plug separated the wire from 5 inches of fused lead chromate, which was held in position by another asbestos plug 5 inches from the end of the tube.

The absorption train consisted of a Marchand tube filled with granular calcium chloride to absorb water. This tube was followed by a Liebig bulb containing a 30 per cent. solution of potassium hydroxide to absorb the carbon dioxide. A 3-inch U tube, containing soda lime on one side and calcium chloride on the other. A plug of asbestos at the bottom of the U separated them. The bulb and the tube were weighed together. This was followed by a guard tube filled with calcium chloride and soda lime.

The gases formed during combustion were drawn through the train by suction. An aspirator was used for this purpose. One-fifth of a gram was weighed into a porcelain boat. The latter and the coal were placed in a glass tube closed with a stopper. The absorption tubes were connected, and the boat and sample transferred to the combustion tube. The first portion of 15 inches was cool, the copper was at a red heat, and the lead chromate was kept at a dull-red heat. The boat was placed near the asbestos plug, and the cork connecting the purifying train was inserted, and the aspiration started with pure oxygen. One burner about 5 inches back from the boat was turned on, and the aspiration continued until practically all the moisture was expelled from the sample. The heat was then increased very gradually until all the volatile matter was driven off. After the carbon was all burned, as shown by the disappearance of the glow, oxygen was continued for three or four minutes. After combustion was completed the burners were gradually turned down and out. About 1200 c.c. of air was then aspirated, and the absorption bulbs disconnected and weighed.

Nitrogen.—The nitrogen was determined by the regular Kjeldahl method. The determinations were made in sets of six, the digesting and distilling apparatus being designed for six flasks.

Fusing Point of Ash.—The requisite quantity of ash for each test was ground to pass through a 120-mesh sieve. It was then mixed with a small quantity of water, to which a little gelatine had been added, and then formed into a cone, 1½ inch high with ⅜-inch base, by pressing the prepared ash into a mould. Each cone was carefully dried before being placed in the muffle. The temperature was measured by an optical pyrometer at the point when the apex of the cone sank to the base.

The Calorific Values were determined by an Emerson bomb calorimeter. This type of apparatus is the most reliable and accurate that can be used in determining the calorific values.

Other Determinations and Tests included phosphorus, vanadium in ash, complete analysis of ash, coal-washing tests, specific gravity, ignition point of coals, &c.

Chapter VII.

DEFINITION OF TERMS EMPLOYED IN COAL-MINING.

Many mining terms are applied so loosely and so indifferently that a multiplicity of synonymous expressions has come into familiar usage in the naming of mine-openings and of minerals. In some cases their application is strictly provincial, in that outside a particular district they are unintelligible to the majority of people. Again, the terms employed to designate openings in coal mines and the various operations relating thereto are quite different from those in general use applied to like openings in metal mines. In consequence of this it has been considered advisable to give an explanation of the meanings of terms applied to coal and coal-mining as generally recognised in Tasmania.

The term "adit" is applied to a horizontal opening from the surface by which a mine is entered. In Tasmania an adit is usually called a "tunnel," though the latter term is more correctly applied to a horizontal opening through a hill.

The term "dip-tunnel" is applied to an opening from the surface, or from another mine opening, following the dip of the coal seams or of the strata. In metal mining such an opening is called an "underlay shaft."

A "heading" is a passage driven with the grain of the coal or along the line of strike. Headings may be driven from another opening or from the surface. Main headings are used as gangways for haulage to the main opening. Back headings are frequently driven between main headings for convenience of working.

"Strike tunnel" is another name for a heading driven along the course of a seam from the surface.

A "bord" is a passage driven up the slope of the seam from a heading or gangway, and hence across the grain of the coal. The name "cut-through" is applied to a similar passage connecting headings.

A "crosscut" is a horizontal passage driven at right angles to the strike of a seam either from the surface or from one seam to another.

The term "shaft," if not qualified, means a vertical opening started at the surface. A shaft that follows the inclination of a bed that is not vertical is sometimes called an inclined shaft.

A "level" consists of all the headings and crosscuts that connect on approximately the same horizontal plane.

Part III.

The Nomenclature, Character, Composition, and Calorific Values of Tasmanian Coals.

Chapter I.

GENERAL STATEMENT OF THE CLASSES OF COAL REPRESENTED.

In describing the several classes of coal occurring in Tasmania the classification as outlined in Chapter VI. will be used.

In Tasmania coal occurs in the Permo-Carboniferous, Trias-Jura, and the Tertiary systems. The variation in the character and constitution of the several coals found in these geological systems is so marked that it is possible to predict with a fair degree of accuracy the kind of coal likely to be found at a given locality. This will be obvious from the following statement of the kinds of coal occurring in the various systems:

Permo-Carboniferous—

Greta Coal Measures.

Kerogenites and humic-kerogenites.

Tomago Coal Measures.

Sub-anthracites and non-caking humic.

Trias-Jura—

Sub-anthracites and non-caking humic.

Tertiary—

Brown coals and lignites.

The whole of the coals of Tasmania are embraced by the abovementioned types.

The Trias-Jura coals constitute the greater portion of the coal reserve of Tasmania. These non-caking humites, or bituminous coals, as they have been termed, as explained in Part VI. of this publication, are very suitable for domestic fuel, and particularly applicable to steam raising in the powdered form. Details as to their use in these and other directions are given in Part VI.

The sub-anthracite coals are of greater value for domestic and steam-raising purposes than the non-caking humic.

The kerogenites and humic-kerogenites, which are characteristic of the Greta coal measures of the Permo-Carboniferous, will find their greatest use and commercial application in the fact that they give oils on distillation. They include varieties of coal and oil shales known as kerosene shale, pelionite, tasmanite, the gas and steam coals of Preolenna, and the ordinary so-called bituminous coal of the Mersey district.

Chapter II.

-THE GEOGRAPHICAL AND GEOLOGICAL DISTRIBUTION OF THE SEVERAL CLASSES OF COAL.

(1)—Geographical Distribution.

Sub-Anthracites.—This class of coal in Tasmania is confined to one locality, namely, the Sandfly-Cygnet area.

Non-Caking Humic.—This class constitutes by far the greatest coal reserve in Tasmania, and is distributed throughout the East Coast coalfield, extending from Ben Lomond and Mt. Nicholas to Tasman's Peninsula, and thence eastwards and southwards to include the occurrences in the Midlands and Upper Derwent, and as far south as Catamaran and South-East Cape.

Humic Kerogenites.—These coals are confined to the northern end of the island, especially Preolenna, Mersey, and Barn Bluff.

Kerogenites.—These, again, are confined to the northern end of the island, and up to the present have been found at Preolenna, Mersey, Barn Bluff, Karoola, and Quamby Bluff.

Brown Coals and Lignites.—These are distributed over various parts of the island, being most largely developed in the Launceston Tertiary basin, extending from Ross to the mouth of the River Tamar. They also occur on the north-west coast, underlying basalt; at Macquarie Harbour, fringing the sea-shore on the north side of the Harbour; in the Upper Derwent, at Lawrenny, at Macquarie Plains, and in the Waratah district.

(2)—Geological Distribution.

Sub-anthracites.—The sub-anthracite coals of the Sandfly-Cygnet district are contained in two geological systems. That at Mt. Cygnet characterises the Tomago coal measures of the Permo-Carboniferous as developed in that area. The sub-anthracites of Sandfly, on the other hand, represent the partial anthracitation of the normal non-caking humic coals of the Trias-Jura coal measures.

Non-Caking Humites.—This class of coal is characteristic of the Trias-Jura coal measures throughout Tasmania, but coals belonging to this class are also developed in the Tomago coal measures at Mt. Pelion and at Preolenna.

Kerogenites and Humic Kerogenites are wholly confined to the Greta coal measures of the Permo-Carboniferous.

Lignites and Brown Coals are confined to beds of Tertiary age in Tasmania.

Chapter III.

TABLE SHOWING CHARACTER, ANALYSES, AND HEATING VALUE OF COAL SAMPLES.

The following table is a complete statement of the present state of knowledge which has resulted from the recent investigation as to the character, analyses and heating values of Tasmanian coals. The locations of the coal seams are shown on the table, the samples having been taken in the manner indicated in Chapter V., Part II. The calorific values and complete ultimate analyses and the specific gravity were only determined on samples which were determined to be generally representative of the class of coal in each particular district.

TABLE I.—CHARACTER, ANALYSES, AND HEAT VALUES OF COAL SAMPLES.

				Proximate.				Ultimate.					Heat Values.			
Page.	Registered Number.	Name of Mine or Locality of Exposure.	Nature of Coal	Moisture at 105°C.	Volatile Matter.	Fixed Carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Oxygen.	Nitrogen.	Calories.	British Thermal Units.	Evaporative Power.	Specific Gravity.
43	319	Cardiff	Non-caking Humic	3·20	28·98	48·90	18·92	0·56	...	...	...	...	...	...	...	...
43	320	Cardiff	" "	4·30	27·08	51·42	17·20	0·47	...	...	...	...	...	...	...	...
43	322	Cardiff	" "	3·88	26·70	50·51	18·91	0·60	4·46	55·03	19·77	1·23	5486	9874	10·20	1·37
43	323	Jubilee	" "	5·00	22·18	50·51	22·31	0·40	...	...	...	...	...	...	...	...
43	325	Jubilee	" "	3·92	28·52	47·46	20·10	0·60	4·50	55·69	17·78	1·33	5363	9653	9·98	1·47
42	382	Cornwall	" "	3·72	23·16	56·76	16·36	0·41	...	...	...	...	...	...	...	...
42	383	Cornwall	" "	3·00	24·80	55·75	16·45	0·38	...	...	...	...	...	...	...	...
41	384	Mt. Nicholas...	" "	4·40	27·78	46·01	21·81	0·44	...	...	...	...	...	...	...	...
41	385	Mt. Nicholas...	" "	4·20	26·64	45·96	23·20	0·40	...	...	...	...	...	...	...	...
43	386	Silkstone	" "	3·14	19·02	56·36	21·48	0·45	4·21	57·24	15·49	1 13	5486	9874	10·20	1·51
43	387	Silkstone	" "	4·90	23·38	51·44	20·28	0·33	...	...	...	...	...	...	...	...
43	388	Silkstone	" "	3·30	23·48	48·52	24·70	0·48	...	...	...	...	...	...	...	...
52	492	Fingal	" "	2·70	26·82	48·18	22·30	0·03	...	...	...	...	...	...	...	...
52	493	Fingal	" "	2·40	26·10	48·29	23·21	0·37	...	...	...	...	...	...	...	...
52	494	Fingal	" "	1·00	24·00	48·80	26·20	0·24	3·85	57·83	10·80	1·08	5068	9122	9·43	...
52	495	Fingal	" "	2·54	26·36	42·00	29·10	0·41	...	...	...	...	...	...	...	...
	513	Fingal	" "	4·69	27·81	52·30	15·20	0·50	...	...	...	...	...	...	...	...

200	519	York Plains ...	„ „	1·80	13·28	57·32	27·60	0·46	...	...	...	...	...	...	...	...
200	520	York Plains ...	„ „	1·19	13·55	60·74	24·52	0·48	3·34	57·68	12·80	1·18	5732	10,317	10·66	...
151	114	Bruny Island	„ „	3·40	10·60	66·50	19·50	0·31	3·04	58·14	17·92	1·09	5437	9786	10·12	...
59	411	Dalmayne......	„ „	4·46	22·22	55·30	18·02	0·69	...	...	...	...	...	...	...	...
59	412	Dalmayne......	„ „	3·56	21·14	54·76	20·54	0·41	4·17	52·50	21·47	0·91	5240	9431	9·75	1·68
59	413	Dalmayne......	„ „	4·81	20·47	50·53	24·19	0·41	...	...	...	...	...	...	...	...
59	414	Dalmayne......	„ „	4·50	18·68	51·40	25·42	0·33	...	...	...	...	...	...	...	...
59	415	Dalmayne......	„ „	5·10	18·52	49·04	27·34	0·34	3·94	49·06	18·42	0·90	5191	9243	9·55	...
92	416	Steep Creek ...	„ „	5·80	23·42	41·58	29·20	0·44	...	...	...	...	...	...	...	...
75	417	Douglas River	„ „	3·40	24·08	42·22	30·30	0·48	4·11	49·49	14·56	1·06	4722	8500	8·79	1·44
75	418	Douglas River	„ „	4·26	23·58	48·51	23·65	0·56	4·24	54·00	16·51	1·04	5314	9564	9·89	1·41
80	419	Denison River	„ „	4·40	24·80	53·50	17·30	0·62	4·36	60·66	16·83	1·23	5707	10,273	10·62	1·46
157	427	Hastings	„ „	2·76	22·46	53·90	20·88	0·62	...	...	...	...	...	...	...	...
157	428	Hastings	„ „	3·08	22·70	52·22	22·00	0·44	4·58	57·68	14·14	1·16	5535	9963	10·30	1·31
155	429	Strathblane ...	„ „	7·94	21·48	50·12	20·46	0·48	4·43	53·94	19·60	1·09	5215	9417	9·73	1·40
164	430	Catamaran ...	„ „	3·46	22·00	58·84	15·70	0·44	...	...	...	...	...	...	...	...
	433	Sandfly	„ „	10·32	18·54	48·64	22·50	0·52	...	...	...	...	...	...	...	...
132	434	Sandfly	„ „	3·40	24·49	49·19	22·92	0·63	4·28	48·81	22·25	1·11	5609	10,096	10·44	...
133	435	Sandfly	„ „	3·32	22·34	49·44	24·90	0·49	...	...	...	...	...	...	...	...
135	436	Sandfly	„ „	2·90	17·46	60·88	18·76	0·41	4·21	60·68	14·64	1·30	6101	10,981	11·35	1·50
136	437	Sandfly	Sub-anthracite	3·10	9·42	63·50	23·98	0·45	...	...	...	...	...	...	...	...
136	438	Sandfly	„ „	2·92	8·00	62·72	26·36	0·59	3·33	56·73	11·94	1·05	5732	10,317	10·66	...
134	439	Sandfly	Non-caking Humic	6·64	16·28	45·78	31·30	0·26	...	...	...	...	...	...	...	...
133	440	Sandfly	„ „	5·38	21·72	45·90	27·00	0·44	...	...	...	...	...	...	...	...
135	441	Sandfly	„ „	2·46	13·18	63·86	20·50	0·42	...	...	...	...	...	...	...	...
	442	Sandfly	„ „	7·40	12·78	37·72	42·10	0·29	...	...	...	...	...	...	...	...
137	443	Sandfly	„ „	6·34	15·10	62·66	15·90	0·61	...	...	...	...	...	...	...	...
137	444	Sandfly	Sub-anthracite	2·96	7·76	59·64	29·64	0·60	...	...	...	...	...	...	...	...
134	445	Sandfly	Non-caking Humic	2·94	19·22	57·24	20·60	0·42	...	...	...	...	...	...	...	...
122	446	Premaydena...	„ „	5·20	7·58	48·72	38·50	0·42	...	...	...	...	...	...	...	...
157	462	Hastings	„ „	2·96	20·28	50·54	26·22	0·41	...	...	...	...	...	...	...	...
163	464	Catamaran ...	„ „	2·04	23·34	61·66	12·96	0·51	4·28	62.59	18·42	1·29	6740	12,133	12·54	1·32
165	465	Catamaran ...	„ „	2·16	24·30	62·08	11·46	0·56	...	...	...	...	...	...	...	...
143	478	Mt. Cygnet ...	Sub-anthracite	1·10	10·36	66·04	22·50	0·41	3·46	64·80	7·46	1·37	6298	11,336	11·72	1·62
144	478A	Mt. Cygnet ...	„ „	1·30	10·70	64·50	23·20	0·50	...	...	...	...	...	...	...	...
145	479	Mt. Cygnet ...	Non-caking Humic	4·50	12·38	63·94	19·18	0·44	...	...	...	...	...	...	...	...
145	480	Mt. Cygnet ...	Sub-anthracite	1·10	8·68	72·58	17·64	0·57	...	...	...	...	...	...	...	...
121	481	Tasman Penin.	Non-caking Humic	3·42	11·08	62·88	22·62	0·41	3·32	60·52	11·81	1·32	5683	10,229	10·57	...
146	482	Cygnet	Sub-anthracite	3·48	10·60	66·66	19·26	0·70	...	...	...	...	...	...	...	...
116	494	Buckland	Non-caking Humic	11·56	24·62	46·34	17·48	0·39	4·06	46·64	30·34	1·09	5043	9077	9·38	...
116	495	Buckland	„ „	9·36	22·02	19·52	49·10	0·34	...	...	...	...	...	...	...	...
	496	Mountain River	Caking Humic	1·42	24·48	60·70	13·40	0·34	...	...	...	...	...	...	...	...
	497	Buckland	Non-caking Humic	4·68	15·26	35·34	44·72	0·44	...	...	...	...	...	...	...	...

TABLE I.—CHARACTER, ANALYSES, AND HEAT VALUES OF COAL SAMPLES—*continued.*

Page.	Registered Number.	Name of Mine or Locality of Exposure.	Nature of Coal.	Proximate.					Ultimate.				Heat Values.			Specific Gravity.
				Moisture at 105° C.	Volatile Matter.	Fixed Carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Oxygen.	Nitrogen.	Calories.	British Thermal Units.	Evaporative Power.	
117	498	Buckland	Non-caking Humic	3·58	16·00	69·24	11·18	0·58	...	...	...	...	...	...	...	...
117	499	Buckland	,, ,,	3·24	16·30	42·64	37·82	0·42	...	...	...	...	...	...	...	...
116	512	Buckland	,, ,,	2·23	23·65	62·93	11·19	0·59	...	...	...	...	...	...	...	...
189	516	Colebrook	,, ,,	8·12	22·10	34·44	35·34	0·56	...	...	...	...	...	...	...	...
195	517	Bagdad	,, ,,	18·46	23·74	23·86	33·94	0·32	...	...	...	...	...	...	...	...
71	624	Seymour	,, ,,	3·14	22·91	50·55	23·40	0·56	4·33	47·84	22·74	1·13	5510	9919	10·25	...
71	625	Seymour	,, ,,	3·14	19·10	49·86	27·90	0·49	...	...	...	...	...	...	...	...
71	626	Seymour	,, ,,	3·14	26·40	54·34	16·12	0.59	...	...	...	...	...	...	...	...
41	627	Mt. Nicholas...	,, ,,	4·54	27·52	50·04	17·90	0·45	...	...	...	...	...	...	...	...
41	628	Mt. Nicholas..	,, ,,	4·88	26·82	47·68	20·62	0·48	4·46	50·59	22·75	1·10	5412	9742	10·07	1·52
42	629	Cornwall	,, ,,	3·80	21·74	54·38	20·18	0·36	4·02	58·63	15·66	1·15	5560	10,007	10·34	1·43
42	630	Cornwall	,, ,,	3·98	22·48	55·22	18·32	0·36	...	...	...	...	...	...	...	...
207	684	Mt. Christie ...	,, ,,	2·74	23·40	55·20	18·66	0·45	...	...	...	...	...	...	...	...
208	685	Mt. Christie ...	,, ,,	2·86	21·34	49·64	26·16	0·45	...	...	...	...	...	...	...	...
211	686	Mt. Christie ...	,, ,,	15·08	25·50	42·50	16·92	0·27	...	...	...	...	...	...	...	...
211	687	Mt. Christie ...	,, ,,	14·50	24·20	38·84	22·46	0·27	...	...	...	...	...	...	...	...
210	688	Mt. Christie ..	,, ,,	1·68	20·32	53·28	24·72	0·46	4·40	56·92	12·30	1·10	5806	10,450	10·80	1·46
210	689	Mt. Christie ...	,, ,,	1·78	19·82	50·34	28·06	0·49	...	...	...	...	...	...	...	...
211	690	Mt. Christie ...	,, ,,	1·96	24·04	44·26	29·74	0·66	...	...	...	...	...	...	...	...
212	691	Brambletye	Caking Humic	2·46	28·66	56·78	12·10	0·75	...	...	...	...	...	...	...	...
213	692	Ben Lomond...	Non-caking Humic	2·38	20·68	46·58	30·36	0·45	...	...	...	...	...	...	...	...
214	693	Merrywood ...	,, ,,	2·66	25·10	53·88	18·36	0·44	4·59	57·76	17·69	1·16	6052	10,893	11·26	1·44
96	745	Mt. Paul	,, ,,	1·58	15·32	49·32	33·78	0·37	...	...	...	...	...	...	...	...
96	746	Mt. Paul	,, ,,	1·00	20·80	51·74	26·46	0·44	4·06	56·51	11·60	0·93	5535	9963	10·30	1·36
234	757	Preolenna	Humic Kerogenite	1·52	32·46	52·30	13·72	5·87	5·30	65·34	8·16	1·61	6780	12,204	12·62	1·25
230	430	George Town	Sub-Humite	9·04	35·76	46·52	8·68	0·67	...	...	...	...	...	...	...	...
230	431	George Town	,, ,,	11·30	32·80	49·46	6·44	0·63	...	...	...	...	...	...	...	...
223	152	Illamatha	Humic Kerogenite	13·58	36·28	45·30	4·84	4·39	6·83	65·02	18·05	0·87	6142	11,056	11·43	1·31
223	153	Spreyton	,, ,,	13·42	35·06	46·88	4·64	4·04	6·13	58·03	26·22	0·94	5950	10,711	11·08	1·32

Part IV.

Detailed Descriptions of the Coalfields of Tasmania.

Chapter I.

THE MOUNT NICHOLAS - FINGAL - DALMAYNE COALFIELD.

(1)—Mount Nicholas Area.

A.—*Location and Extent.*

The district known as the Mt. Nicholas coalfield occupies about 50 square miles of country, situated in the north-eastern portion of Tasmania. The nearest township to the area is St. Marys, from which the area extends in a north-westerly direction for a distance of from 7 to 8 miles. The Mt. Nicholas Range occupies a central position in the area, and is in the form of a fairly high narrow ridge, with a general direction from north-east to south-west.

The main coal mines have their workings and leases on the southern fall of this range, and are situated at an altitude of from 600 to 900 feet above the general level of the Break o' Day Plain, which covers the whole of the southern portion of the area, at an average altitude of, approximately, 800 feet above the sea.

B.—*Access.*

Access to this area from the main centres is gained by means of the Fingal Railway, which leaves the main Hobart to Launceston Railway at Conara, and runs in a general north-easterly direction to St. Marys. The distances, by rail, of St. Marys from Hobart and Launceston are 145 miles and 82 miles respectively. The mine workings are situated from 2½ to 5 miles nearer the main centres than is St. Marys. Sidings and branch lines have been constructed for the two chief mines of the area, and these sidings have been extended as far as the screening plants of each mine, where the coal is loaded direct into the railway trucks. From the tunnel mouth the coal is transported to the screens, a distance in each case of, approximately, 1 mile, by means of a self-acting ground tramway. The difference in altitude (600 feet) between the tunnel mouth and the screens ensures the proper working of the tramway, the full skips, acting under gravity, providing the power necessary to return the empty skips to the mine.

C.—*Previous Reports.*

In 1883 Chas. Gould submitted a report on the Fingal and East Coast Coalfield, in which he discussed what are now known as the Fingal and Mt. Nicholas Coalfields. In the Mt. Nicholas area only one seam was discussed.

In the same year a short report was published dealing with the suitability of the Mt. Nicholas coal for railway purposes, and giving the results of tests carried out on the Main Line Railway. These tests were supervised by the manager of the railway, who reported favourably.

In a report, " The Coal Seams at Thorndale, near Thompson's Marshes and the Jubilee Mine near St. Marys," W. H. Twelvetrees, in 1901, dealt with the mining oprations being carried out at this mine, and a discussion as to quantity and quality is given. Mention is made in this report of Gould's Fault, which traverses Gardiner Creek in a general axial direction. A tunnel 180 feet in length was practically the only work that had been performed up to that date.

No later reports on this area are at present available, but details of the strata passed through by the diamond drill are on record. These bores have been put down to the south of this area, but have been useful in arriving at conclusions as to the probable extent of the various strata. The stratigraphical succession has been more clearly indicated as a result of them.

D.—*Topography*.

(1)—General Description.

The Break o' Day Plain, a plain of denudation, occupies the whole of the area between the Mt. Nicholas Range and the Fingal Range. The only irregularity in this plain is caused by the presence of the Break o' Day River, flowing in a westerly direction from St. Marys, till it junctions with the South Esk River in the vicinity of Fingal.

The Mt. Nicholas Range rises, more or less abruptly, from the northern edge of this plain to a height of from 2500 to 2800 feet above the sea, and from 1700 to 2000 feet above the general level of the plain. The range has a general trend from north-east to south-west, and is in the form of a comparatively narrow ridge of Trias-Jura sediments, capped by a diabase sill, the remnants of which rise abruptly, as massive columns, from the underlying sandstones. The Trias-Jura strata occur on both the northern and southern falls of the range, and fairly good sections of these strata are to be seen in the many small cliff faces which occur. The range forms a divide between a number of small watercourses, some of which flow northward to finally empty themselves into the Scamander River; whilst the remainder have a southerly course, and flow into the Break o' Day River.

The geological structure has affected the topography to a certain extent. The dip of the strata, being towards the south, gives the southern fall of the range a less abrupt outline than the northern fall. A greater number of streams flow in a southerly direction than flow towards the north. The northerly streams, flowing against the dip of the strata, have as a general rule worn more pronounced courses than the southern streams.

The southern streams, almost without exception, have at their sources a spring receiving their waters from the more or less porous sandstones of the range. That this does not apply in the case of the northern streams is significant in that it lends support to the theory that the diabase capping is in the form of a sill, and does not occur as a transgressive mass.

(2)—Relation to Mining.

The problems of mining in the Mt. Nicholas Range have been of the simplest character, due to the relatively youthful topography of the area. The various coal outcrops have been located in creek beds or in cliff faces at altitudes varying up to, approximately, 1300 feet above the level of the plain. The chief outcrops are found at from 600 to 900 feet above the plain. The low angle (3°) at which the seams are found to dip, enables the adit system of mining to be applied in every case in the range. This method has been adopted, and the altitude above the plain at which the main seams are found to occur, coupled with the high relief of the range, enables the coal to be delivered to the plain by means of self-acting ground tramways.

E.—*Geology*.

(1)—Geological Map.

The geological map of the Mt. Nicholas area is included on the general geological sketch map of the Mt. Nicholas-Fingal-Dalmayne Coalfield (Plate V.).

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

The geological systems represented in the Mt. Nicholas area range from Cambro-Ordovician to Recent. In the eastern portion of the area there is a fairly extensive occurrence of Cambro-Ordovician slates extending along a general north-west to south-east line, in the immediate vicinity of St. Marys. On the extreme north-east corner of the area these same strata are again met with. Extensive intrusions of granite into the Cambro-Ordovician strata have taken place, and at the present time granite is found to occur to the east of the slates, and is now found as a continuous mass extending from the eastern boundary of St. Marys township almost to the eastern coastline.

On these granites and slates have been deposited the Permo-Carboniferous strata which are found to outcrop on both the eastern and western boundaries of the area. In the central portion of the area the Permo-Carboniferous strata are not in evidence because of trough faulting. Except in close proximity to fault-lines, the dip of the Permo-Carboniferous strata is fairly constant, and varies from horizontal to, approximately, 3° towards the south.

Two bores were put down in this area into the Permo-Carboniferous rocks on the Harefield and Killymoon Estates. The details of the strata passed through are as follow:—

Harefield Bore.—Situated on Guy Ransom's property at Harefield, 3½ miles from St. Marys:—

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface shaft, clay and drift	9	0	9	0
Surface shaft, sandstone	7	0	16	0
Shale	16	6	32	6
Sandstone	0	6	33	0
Coal and band of shale	4	4	37	4
Coal	1	3	38	7
Shale	2	1	40	8
Sandstone with thin coal seams	29	6	70	2
Sandstone and shale	24	11	95	1
Coal	1	8	96	9
Bands of clay, sandstones and coal	1	10	98	7
Sandstone	18	0	116	7
Black shale	7	6	124	1
Sandstone	3	2	127	3
Coal	2	9	130	0
Black and blue shale and fireclay	22	6	152	6
Sandstone and shale	25	4	177	10
Sandstone	16	6	194	4
Shale and fireclay	15	0	209	4
Sandstone, shale, and coal	71	2	280	6
Conglomerate and hard blue mudstone	19	6	300	0
Blue shale	63	0	363	0
Conglomerate	2	0	365	0
Grey mudstone	6	6	371	6
Greenish sandstone	12	0	383	6
Fossiliferous limestone	28	6	412	0
Limestone and conglomerate	31	3	443	3
Fossiliferous limestone	86	3	529	6
Hard grey mudstone	10	6	540	0
Sandstone and shale	28	2	568	2
Sandstone	28	10	597	0
Conglomerate, shale, and sandstone	34	9	631	9
Coal	1	0	632	9
Shale and sandstone	21	0	653	9
Freestone	15	0	668	9
Sandstone and conglomerate	26	9	695	6
Sandstone with soft slate	11	6	707	0
Slate	17	10	724	10

This bore was put down from an altitude of, approximately, 900 feet above the sea, and is situated a few chains to the west of the bank of the northern branch of the Break o' Day River, and close to its junction with the main stream.

Killymoon Bore.—The record of the Killymoon bore shows the following succession:—

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface shaft	12	6	12	6
Surface soil and drift	27	3	39	9
Shale showing fossils	23	0	62	9
Hard shale	57	3	120	0
Conglomerate	4	0	124	0
Hard limestone	132	11	256	11
Shaly mudstone with seams of carbonate of lime	18	1	275	0
Hard shaly mudstone	7	1	282	1
Shaly mudstone and conglomerate	16	3	298	4
Hard shaly mudstone	43	8	342	0
Sandstone with coal stains	8	0	350	0
Sandstone and conglomerate	39	6	389	6
Sandstone with coal stains	25	0	414	6
Sandstone, shale, and conglomerate	19	2	433	8
Conglomerate	32	4	466	0
Black shale	2	3	468	3
Conglomerate	32	0	500	3
Hard slate	4	3	504	6

This bore was put down from an altitude of approximately 800 feet above the sea and has for the most part penetrated Permo-Carboniferous strata only.

Above the Permo-Carboniferous strata have been deposited a thickness of, approximately, 1200 feet of Trias-Jura sandstones and shales. Capping the Trias-Jura is to be found from 300 to 500 feet of diabase.

The Permo-Carboniferous Trias-Jura section is fairly constant throughout the whole of the Mt. Nicholas area. The greatest variation is caused by the appearance on the eastern half of the area of a diabase sill, situated between the Permo-Carboniferous and Trias-Jura strata. This sill is, approximately, 150 feet in thickness, and on the northern side of the range the baking effect on the overlying sandstones is evident. The stratified rocks, however, show no appreciable variation throughout the whole of the area. The typical section is shown in Plate II.

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

The Mt. Nicholas Range has a capping of from 300 to 500 feet thickness of diabase, extending, except for three small saddles, continuously from one extremity to the other. This diabase has previously been regarded as occurring in the form of a dyke. Had this been the case the quantity, and to a great extent the quality, of the coal in the range would be seriously effected. The evidence collected during the present investigations tends to show that the diabase occurring on the range is the remnant of a sill from which the overlying strata have been denuded by the ordinary agencies.

In three places along the range saddles have been formed as a direct result of faulting. By this same faulting the diabase has been more or less closely fissured, and rendered less resistant to weather than that removed from the fault-line.

Where the faults have crossed the range the diabase has been removed, and the presence of sandstones revealed. In each of the three saddles the Trias-Jura sandstones are found to outcrop.

On the eastern end of the range it is possible to trace the sandstones without interruption from the south to the north side of the range. No diabase is met during this ascent, though some 800 to 900 feet of the measures are passed over. Were this diabase intruding the strata as a transgressive mass it would also occur at the saddles, unless the strata originally overlying the diabase had, as a result of trough-faulting, been faulted down to the level of the saddle. The evidence as to the faulting in the area does not show the presence of any such trough-faulting. Trough-faulting, with bounding-faults widely separated, does occur, but between the bounding-faults an extensive belt of diabase occurs. The saddles are each the direct result of one fault assisted by the agencies of weathering.

The altitude at which the diabase occurs *in situ* is difficult to observe definitely; but where definite observations can be made over any small area, they tend to show that the lower level of the diabase is fairly constant for each section of the range; the range being divided into sections by the faulting previously mentioned.

The mining operations of the past 35 years have resulted in the works being advanced sufficiently far to be within ¼-mile of the position where diabase would occur if the mass were transgressive. With a mass as large as that at Mt. Nicholas, its effect would be noticed, and its presence probably indicated by the occurrence of fine stringers of diabase. The quality of the coal, however, has not varied in such a way as to indicate the presence of diabase, nor is there any other evidence in the workings to show the presence of such a mass.

Consideration of the drainage of the area will also tend to support the conclusion that the diabase is a sill. By far the greater number of streams in the area are situated on the southern side of the range. In almost every case the south-flowing streams originate at springs issuing from the Trias-Jura sandstones. The occurrence of springs on the northern fall of the range is a rarity. The dip of the strata of the area is at 3° towards the south. There can be no doubt that the sandstones, being of a more or less porous nature, absorb large quantities of the water derived from the yearly rainfall. Were the diabase occurring in the form of a dyke this mass would form an effective barrier to the percolation of water from the north to the south side of the range. The angle of dip of the strata is such that the quantity of water collected on the north side would soon be sufficient to produce equilibrium, and the occurrence of springs on the north would then be expected to be almost as great in extent as on the southern fall. That this is not the case seems to show that practically the whole of the percolation is towards the south, and that the whole of the Trias-Jura sandstones are acting as intake beds for the supply of water to the southern streams. It would seem, therefore, that there is no obstruction to the flow of water in a southerly direction, and that the water passes under the diabase from the north to the south side of the range.

The investigations were carried out in this area during the wet season, but even then a great difference in the permanence of the north and south flowing streams was noticed. Residents of the district confirmed the opinion that the southern streams enjoyed a greater degree of permanence than the northern. This can only be explained, as stated above, by the assumption that the diabase of the range is in the form of a capping to the range, and not as a transgressive mass.

A second occurrence of diabase is to be seen in this area. At an altitude of, approximately, 1000 feet below the main diabase mass, another body occurs. Sections of this body are to be seen in two steep gullies to the north of the range. On the eastern end outcrops of diabase are to be seen at a lower level than the main mass, whilst in Gardiner Creek, on the southern side of the range, the diabase is again met at the lower altitude. The metamorphic action of this mass on the overlying sandstones was noted on both the northern and southern fall of the range, and it was also noted that the grits for the most part were the affected strata. There can be no doubt that this body is in the form of a sill situated between the Permo-Carboniferous and Trias-Jura strata.

(4)—Structure.

(*a*) *Faults.*—That the Mt. Nicholas Range has been subjected to faulting is shown by an examination of the present workings of the Cornwall and Mt. Nicholas mines. A number of minor faults have been passed through, but in no case has a fault of greater throw than 30 feet been explored by workings. That major faults do exist is proved by definite breaks in the geological succession at different parts of the area. The correlation of some of the coal seams has also led to the conclusion that faulting of a major character has also taken place.

At the eastern end of the area, in Gardiner Creek, an example of faulting occurs. The Permo-Carboniferous mudstones have here been lowered as the result of faulting, until at present they are below the altitude at which the Cambro-Ordovician slates are encountered. A measure of this fault can be obtained by consideration of the coal seams at the Cardiff and Jubilee mines. The difference in altitude between the two mines is 300 feet, and an examination of the seams in detail has shown that these two mines are operating on one and the same seam. In a short crosscut to the westward from the present Cardiff tunnel this fault has actually been cut, whilst it was reported that the former workings were abandoned after meeting it. It has been proved to have a throw of at least 75 feet, for a winze was put down that depth in the former workings. The direction of this fault coincides with the direction of Gardiner Creek valley, and has a downthrow westward of approximately 300 feet.

This fault was mentioned by W. H. Twelvetrees in his report of 1901, and is referred to by the name of Gould Fault.

Gould Fault can be traced for some distance along Gardiner Creek, until it meets the Cornwall Fault, of which the throw is again towards the westward, and is, approximately, 200 feet in magnitude. The Cornwall Fault crosses the Mt. Nicholas Range at the saddle between the Jubilee and Cornwall Mines, and passes in a general south-easterly direction to a point a little further south than the township of Gray. South of its junction with Gould Fault the Cornwall Fault has a throw approximating 500 feet, but as it passes in a southerly direction the throw becomes less, and south of Gray it measures again approximately 200 feet.

A third major fault has been proved on the western side of the range. At a position between the Mt. Nicholas and Silkstone Mines a series of shallow bores were put down to search for coal. No coal was met, and, as a total depth of over 300 feet of boring was completed, a fault must exist, otherwise coal would have been revealed in some of these bores.

From two tunnels driven at points on the line of this fault it was proved that its throw was approximately 200 feet. The two tunnels, differing in altitude by 200 feet, were both driven on the same seam. A saddle also exists between the two mines, and it is at this saddle that the fault crosses the range. This fault—the Silkstone—has a direction roughly parallel to that of the Cornwall Fault.

Correlation of the seams has shown that the workings of each of the five mines on the range have been driven on the one seam. The workings from east to west of the range are situated at the following altitudes above sea-level:—Cardiff, 1950 feet; Jubilee, 1650 feet; Cornwall, 1450 feet; Mt. Nicholas, 1400 feet; and Silkstone, 1500 feet. The differences between these altitudes are also a measure of the throws of the major faults, with the exception of the Silkstone Fault. This fault has been proven to be 200 feet in magnitude. The difference in altitude of the mines is only 100 feet, so that an additional major fault of at least 100 feet magnitude has to be assumed to exist between Mt. Nicholas and Silkstone. The above are the only major faults of the area that have been proved to exist, and in direction they are in general meridional. No transverse faulting has been proved, and the various geological features can all be explained without assuming their presence.

The mine plans show that minor faulting has occurred to a great extent, causing trouble in the working of the seam. No very large minor faults have so far been passed, the largest shown on either of the plans being 12 feet. In direction the majority of these agrees with that of the major faults, but there are a few which have a transverse direction.

(*b*) *Dip of Coal Seams.*—Slight variations in the dip of the Trias-Jura strata of the Mt. Nicholas Range do occur, but in general it may be regarded as being 3° towards the south. Where variations in dip occur they can as a general rule be attributed to the proximity of faulting. A dip of 9° to the south-west is the greatest angle of dip recorded in the area.

Slight rolls in both the roof and the floor of some of the seams are found, but the area is comparatively free from occurrences of this nature.

(5)—Coal Seams Represented in the Area.

The task of correlation of the seams of the area has been comparatively simple. Variations have occurred in the several seams, both as regards thickness and altitude. The larger variations in altitude of each portion of the many seams has been accounted for in practically every case by the presence of the major faults already discussed. Slight variations are due in most cases to minor faulting, together with the dip of the seam. Slight rolls in the strata may be responsible for some of the variations in thickness of seams. The thickness of the smallest seam recorded in the area is 8 inches, whilst that of the thickest seam is 17 feet 5 inches. Considerable variation in thickness of individual seams is also found. In the case of the Mt. Nicholas mine, the seam that is now being worked has a thickness of approximately 6 feet, whereas when first met it was 16 feet in thickness. Thickness of seam could therefore not be relied upon to any great extent for purposes of correlation. Certain seams throughout short distances show constant characteristics, which have been useful for purposes of correlation. The prevalence of a stratum of shale throughout practically the whole length of the range has been extremely useful in correlating the outcrops of at least one seam. The five mines at present operating in this district are all working the one seam, viz., the Delta seam. In every case the stratum of shale immediately underlies this seam, whilst a sandstone roof is the rule. The seam as shown in the different workings varies in thickness, and in places a few inches of clod occurs between the coal and the sandstone roof. The clod is found to be variable both as to thickness and occurrence. The stratum of shale underlying the seam is also found to vary considerably in thickness, and has been found to thicken sufficiently to eliminate the lower seam over a short distance along the range. The average thickness of this stratum is about 10 feet, but in places a thickness of 35 feet has been proved to exist.

Immediately below the shale stratum the Eta seam is met, and is as permanent as the main or Delta seam. Variation in thickness is again characteristic, and the seam has been shown to actually peter out towards the eastern portion of the area. On the extreme east, however, it again reappears. The maximum thickness recorded for this seam is 5 feet 4 inches.

There can be no doubt as to the identification of these two seams over the greater portion of the area, and their positions have been used as datum points for the correlation of the remaining seams. Little difficulty has been experienced in correlating the various outcrops, worked or unworked, that have been located, and the conclusion has been reached that the eight seams of coal exist throughout the greater portion of the Mt. Nicholas Range area. Only one of these seams has been exploited to any great extent. Two others have been worked sufficiently to enable sections of the seams to be recorded.

The limited amount of prospecting carried out in the area has not exposed the full thickness of the lowest seam of the series.

The full thickness of the Iota seam has been exposed on the northern fall of the western end of the range on Mr. B. H. Whittle's lease. This was the only position where a section of this seam was available, the measurements being as follows:—

Sandstone roof.	
18 inches	clod.
3 inches	dull coal.
27 inches	good bright coal.
2 inches	black stone band.
6 inches	hard stony coal.
1½ inch	white band.
7½ inches	coal.
Sandstone floor.	

This seam was sampled, and the analysis is indicated in the table (page 28) by the registered number 388. The altitude of this seam on the north of the range is 1515 feet above the sea, while the corresponding outcrop on the southern fall of the range is at an altitude of 1300 feet above the sea.

The Theta seam occurs on the southern fall of the range at an altitude of 1385 feet above the sea. A short tunnel has been driven on this seam, and shows a section from roof to floor, as follows:—

Sandstone roof.	
2 feet	stony coal, free of bands.
4½ inches	black stone band.
3 feet 1 inch	stony coal, with floating bands.

This seam has also been sampled, and the analysis is indicated in the table under registered number 386.

The Eta seam has had one or two prospecting tunnels driven on it. Sufficient work has been done to show that the seam is divided into four sections by clay partings. The section of this seam is as follows:—

Shale roof.	
17 inches	poor soft coal.
1½ inch	white band.
12 inches	coal.
2 inches	white band.
10 inches	stony coal.
2 inches	white band.
6 inches	soft coal.
3 feet 6 inches	shale.
Sandstone.	

The tunnels into this seam have not been driven far enough to reach the solid, unaltered coal. The coal shows signs of weathering, but it is probable that the two upper sections at least will ultimately be worthy of attention.

The Delta seam is by far the most important. On it all the mines of the Mt. Nicholas Range are at present operating, with the result that sections have been obtained in many places from east to west.

The following sections are sufficient to indicate the nature of the seam, and will also show the variation in its character from place to place.

At Silkstone the section is as follows:—

Sandstone roof.	
6 inches	clod.
2 inches	shale.
2 inches	coal.
Penny	band.
4 inches	coal.
2 inches	band.
$3\frac{1}{2}$ inches	coal.
2 inches	blackstone band.
5 inches	coal.
$1\frac{1}{2}$ inches	band.
1 inch	coal.
9 inches	band.
$7\frac{1}{2}$ inches	coal.
$3\frac{1}{4}$ inches	band.
2 feet 10 inches coal, with two small bands near bottom.	
Shale floor.	

In the western part of Mt. Nicholas seam, the section is as follows:—

Sandstone roof.	
5 inches	blackstone.
4 inches	shaly band.
18 inches	coal.
2 inches	blackstone band.
$2\frac{1}{2}$ inches	white band.
2 inches	band.
6 inches	coal.
6 inches	blackstone band.
32 inches	coal.
Shale floor.	

On the eastern side of the Mt. Nicholas mine the section of the seam is as follows:—

Sandstone roof.	
11 inches	coal.
5 inches	band.
2 inches	coal.
$\frac{1}{8}$-inch	band.
5 inches	coal.
$\frac{1}{4}$-inch	band.
8 inches	coal.
$\frac{1}{4}$-inch	band.
18 inches	coal.
$\frac{1}{8}$-inch	band.
3 inches	coal.
$\frac{1}{4}$-inch	band.
24 inches	shaly coal.
Shale floor.	

The section as shown in the Cornwall Mine is as follows:—

Sandstone roof.	
Shale in places.	
11 inches	coal.
5½ inches	band (black).
⅛-inch	band.
5½ inches	coal.
⅛-inch	band.
8 inches	poor coal.
24 inches	coal.
⅛-inch	band.
2½ inches	coal.
¼-inch	band.
23 inches	coal.
Shale floor.	

The above sections are sufficient to show that a fair amount of agreement exists between the sections, and indicate that the various mines are undoubtedly working on the same seams.

Of the Gamma and Beta seams, no sections are available, but of the Alpha seam the following section was quoted to the writer:—

9 inches	coal.
Penny	band.
6 inches	bright coal.
24 inches	dull coal.
9 inches	band.
30 inches	coal.
4 inches	band.
15 inches	coal.
36 inches	clod.
5 feet	coal.

A tunnel was at one time driven on this seam, but at the present time no trace of it exists. It is improbable that the large thicknesses of coal, as indicated in the above section, would be free of bands. At an horizon corresponding with the above the writer observed a very thick seam consisting of alternate bands of coal and clay. The total thickness was, approximately, 18 feet, but in no case did the bands of coal exceed 6 inches in thickness, and the clay bands were 1 inch or more.

From the above sections it will be seen that the Theta and Delta seams are certainly worthy of attention. It is expected that the Eta seam will prove of value. The Iota seam has only been opened at one place, and that is on the northern side of the range. There is no doubt that when this seam is opened on the southern fall of the range it will prove to be of fair average quality and thickness. Of the remaining seams only the outcrops have been observed, and no indication as to their thickness or quality could be obtained.

F.—*The Mining Properties.*

(1)—The Mt. Nicholas Coal Mining Company, No Liability.

(*a*) *Number and Area of Leases.*—This company holds 1659 acres, made up of the following three leases:—7000-M, 959 acres; 8036-M, 412 acres; 26-PM, 288 acres.

These leases are situated on the southern fall of the range at a distance of, approximately, 4 miles from the township of St. Marys.

(*b*) *Extent and Method of Mining Operations.*—The present extensive workings of the Mt. Nicholas Coal Mining Company are the results of the operations of upwards of 30 years. The main tunnels have been driven for over half-a-mile, and coal from 100 acres has already been won. For a long time, under the management of the late J. Birrell, the mine was worked on the long-wall system. In an endeavour to safeguard the workings the method of operation has been modified, and what is locally known as the "Step Long-Wall" method is used now. In this method the face takes the form of an irregular curve, with rectangular blocks of coal left protruding like a series of steps. It was hoped that these steps would lend additional support to the faulted roof, but it is doubtful whether any advantage has been gained. The working face is in faulted country, and the roof is insecure.

(*c*) *Quality of Coal.*—A study of the section of the Mt. Nicholas seam reveals the presence of a considerable number of bands of varying thickness. Though attempts may be made to remove these bands by screening, a considerable amount of foreign matter is left in the coal as marketed. The samples taken for analysis represent the grade of the material marketed.

The analyses of the Mt. Nicholas samples are shown on pages 28 and 30 by the registered numbers 384, 385, 627, 628.

(*d*) *Production.*—The following table shows the production of, and the number of men employed in, the Mt. Nicholas mine during the last 10 years. The figures in the last column show the average yearly output per man during the same period:—

Year ending 31st. December.	Tons Raised.	Men Employed.	Tons Raised Per Man.
1911	30,058	79	380·5
1912	28,717	73	393·3
1913	30,903	65	475·4
1914	34,177	73	468·1
1915	37,431	79	473·8
1916	30,624	78	392·5
1917	32,113	88	364·9
1918	29,403	85	345·9
1919	28,053	85	330·0
1920	29,382	82	358·3

The working costs of this mine are not available, but the cost per ton at the railway siding is from 12s. 6d. to 13s. 6d.

(*e*) *Quantity of Coal Available.*—As already pointed out, there are eight seams in this area. Their total thickness is 16 feet. In the 1300 acres of coal-bearing land held by the Mt. Nicholas Company there is a total coal reserve of 24,960,000 tons.

(2)—The Cornwall Coal Company.

(*a*) *Number and Area of Leases.*—This company is at present operating in the Mt. Nicholas Range, and leases 1516 acres, consisting of:—6890-M, 269 acres; 7340-M, 150 acres; 6756-M, 1097 acres.

These are to the east of and adjoining the leases of the Mt. Nicholas Company. About 1100 acres are coal-bearing.

(*b*) *Extent and Method of Mining Operations.*—The tunnels are situated near the centre of the property, and the workings have been driven in a northerly direction. The company has been operating for upwards of 30 years, and, approximately, 80 acres of coal have been removed. The method adopted in the mine is the Bord and Pillar, and results have shown it to be quite successful. In the winning of the coal a fair amount of slack is formed, and most of this is retained inside the mine as filling behind the timbers. The seam is 6 feet in thickness, and lends itself admirably to the system adopted. Minor faults are of frequent occurrence, and interfere with operations underground. Though these difficulties are being surmounted the working costs are necessarily increased, and a fair proportion of the total may be attributed to this cause alone.

(*c*) *Quality of Coal*.—The quality of the coal from the Cornwall mine shows only a slight variation from that produced by the Mt. Nicholas Company. The variations are within the limits to be expected in any seam, and continued variation in the quality may be the means of reversing the present comparative positions in the table. The analyses of the samples from the Cornwall mine are indicated in the table (numbers 382, 383, 629, 630, pages 28 and 30), and reveal the presence of the usual high percentage of ash, with a comparatively low percentage of volatile matter. These analyses represent the quality of the coal as it is broken in the mine. It is possible that the quality of the coal placed on the market is not so high as that indicated in these analyses. The only treatment the coal receives is that of screening before being placed in the railway trucks. This is dealt with in detail under Chapter I. of Part VI.

(*d*) *Production*.—The following table shows the production of, and the number of men employed in, the Cornwall mine during the last 10 years. The figures in the last column show the average yearly output per man employed during the same period:—

Year ending 31st December.	Tons Raised.	Men Employed.	Tons Raised per Man.
1911	24,064	70	343·7
1912	22,353	65	374·5
1913	21,696	58	374·0
1914	24,466	66	370·6
1915	25,470	72	353·6
1916	22,839	61	374·3
1917	27,681	66	419·5
1918	26,900	76	353·9
1919	31,456	75	419·5
1920	38,212	82	446·0

It is estimated that the cost per ton at the railway siding is from 12s. 6d. to 13s 6d.

(*e*) *Quantity of Coal Available*.—The same number of seams of equal thickness are present in the coal-bearing area held by this company, namely, 1100 acres. This gives a total reserve of 21,120,000 tons.

(3)—Jubilee Coal Company.

(*a*) *Number and Area of Leases*.—The newly-formed Jubilee Coal Mining Company are the holders of one lease (number 8718) of 429 acres, situated about 3 miles due north of St. Marys. This lease comprises portions of those held previously by the former Jubilee Company, together with the old Cardiff lease. On both these former properties mining operations had been carried out to a slight extent. On the former Jubilee lease there is no apparent reason why operations should have ceased, but in the Cardiff workings Gould Fault was encountered, and the workings were abandoned.

(*b*) *Extent and Method of Mining Operations*.—Upwards of 10 years ago operations were carried out on both the Jubilee and Cardiff leases. The Cardiff workings were opened on the Bord and Pillar system, and work was carried out till Gould Fault was encountered. A winze was sunk on this fault to a depth of 75 feet without meeting coal.

On the former Jubilee lease a tunnel had been driven for upwards of 400 feet, whence crosscuts were driven to right and left. No further work was done, but it is probable that the long-wall system would have been chosen to work the mine.

What the intentions of the present management are as regards the working of the mine have not been indicated. The seam, however, is one which would lend itself in a satisfactory manner to the Bord and Pillar method.

(*c*) *Quality of Coal.*—The quality of the coal from the Jubilee mine shows a slight variation from that produced from the Cornwall and Mt. Nicholas mines. Reference to the analyses of the coals from these leases (numbers 319, 320, 322, 323, 325, page 28) shows a slight increase in the percentage of volatile matter. This increase in volatile matter is responsible for the slightly better burning qualities of the Jubilee coal, but whether the quality will be constant is problematical, for with the natural variation of the seam conditions may alter and the volatile constituents may fluctuate between limits. It may be safely stated, however, that the coal of the Mt. Nicholas Range will prove to be of an average quality, with but little variation from one end of the range to the other. This seam would also lend itself to washing, for most of the bands would without difficulty be washed away from the coal, with a consequent reduction of the ash content.

(*d*) *Production.*—The works of this company are at present only in the developmental stages, so that the production up to the present time is insignificant.

(*e*) *Quantity of Coal Available.*—Of the 429 acres leased by this company, 300 acres are coal-bearing with the full eight seams, and a total thickness of 16 feet as the average. The coal reserve works out at 5,740,000 tons.

(4)—Silkstone Collieries.

(*a*) *Number and Area of Leases.*—Under the heading of the "Silkstone Collieries" are included those leases at present in the names of G. L. Meredith and B. H. Whittle. These leases are three in number, two of which are in the name of G. L. Meredith, and the third in the name of B. H. Whittle. The numbers and areas of these leases are as follow:—8049, B. H. Whittle, 320 acres; 8050, G. L. Meredith, 319 acres; 8158, G. L. Meredith, 320 acres—being a total area of 959 acres. Of these 959 acres, approximately 800 acres will be found to be productive for most seams. In the case of the Delta seam an area of 360 acres only has been allowed, as the result of uncertainty as to the continuance of the seam on the eastern portion of the lease.

(*b*) *Extent and Method of Mining Operations.*—The mining operations so far carried out on the Silkstone properties have only been of a prospecting nature. On the Delta seam three tunnels have been driven upwards of 100 feet each. In two of these tunnels the full thickness of the seam has been revealed. In the third tunnel only 2 ft. 6 in. of the bottom portion of the seam has so far been exposed.

A tunnel has been driven on the Theta seam to a length of about 250 feet. This seam has shown full thickness throughout the whole distance.

On the Eta seam a few short prospecting tunnels have been driven to prove its thickness. Solid coal has not in any case yet been reached.

(*c*) *Quality of Coal.*—The quality of the Silkstone coal agrees in every way with that from the Mt. Nicholas and Cornwall Mines. The seams have been sampled, and the analyses of the coal are shown by numbers 386, 387, 388, being representative of Theta, Delta, and Iota seams respectively. The percentage of ash is here, as in other cases, high, due largely to the presence of the bands occurring in the seams.

Theta seam is naturally a stony coal, and it is doubtful if the ash content could be reduced to any great extent by treatment.

(*d*) *Production.*—No further production than a few trucks of coal as bulk samples has taken place from these properties.

(*e*) *Quantity of Coal Available.*—The Delta seam has an average thickness of 4 feet 6 inches over an area of 360 acres in this company's property. This gives a reserve of 1,900,000 tons.

The Theta seam averages 4 feet over an area of 800 acres. This constitutes a coal reserve of 3,750,000 tons.

The Iota seam, with an average thickness of 2 feet, over 360 acres gives a reserve of 864,000 tons.

The other seams present have a total thickness of 5 feet as the average, over 800 acres giving a reserve of 4,800,000 tons.

The total coal reserves of the Silkstone Company's property, therefore, are 10,450,000 tons.

(G)—*Unleased Coal-bearing Area.*

(1)—Total Area.

By far the greater portion of the coal-bearing land of the Nicholas Range is occupied by the various companies operating. A small area of unleased land exists on the southern fall of the range between the leases at present held by the Jubilee and Cornwall Companies. The greater portion of the unleased land may be regarded as a narrow strip of $\frac{1}{4}$-mile width stretching from west to east along the northern boundaries of the various leases. The total area of coal-bearing land at present unleased is, approximately, 1200 acres, but it is for the most part inaccessible, and could only be advantageously exploited by the present companies.

(2)—Number of Seams.

Although prospecting has not been carried out in this area it has been shown by the outcrops that the full series of eight seams occur throughout this area. The positions of these outcrops correspond fairly well in altitude with what would be expected with an average dip of 3° to the south, and in some cases correlation of certain outcrops can be effected with certainty.

(3)—Quality of Coal.

As the seams on the northern portion of the range have not, so far, been opened up, it is not possible to arrive at definite conclusions as regards quality. As the eight seams are evidently present, and as the seams which at present are operating show only slight variations in quality, it is reasonable to assume that the continuations of the various seams will also prove themselves to be of the same average quality as the coal at present being produced.

(4)—Quantity of Coal Available.

Accepting the same number of seams and the same aggregate thickness as for the other parts of the Mt. Nicholas field, the 1200 acres of unleased area which is coal-bearing give a coal reserve of 22,960,000 tons.

Summary of Coal Reserves, Mt. Nicholas Area.

Mining Property.	Reserve in Theta Seam.	Reserve in Delta Seam.	Total Reserve in Eight Seams.
	Tons.	Tons.	Tons.
Mount Nicholas	6,240,000	7,800,000	24,960,000
Cornwall	5,280,000	6,600,000	21,120,000
Jubilee	1,440,000	1,800,000	5,740,000
Silkstone	3,750,000	1,900,000	10,450,000
Unleased Land	5,760,000	7,200,000	22,960,000
Total	22,470,000	25,300,000	85,230,000

(2)—Fingal Area.

A.—*Location and Extent.*

Situated to the south and south-west of the Mt. Nicholas area, the southern boundary of which it adjoins, the Fingal area stretches along the northern slope of the Fingal Range from the township of Fingal to the township of Gray. The Fingal railway marks the northern boundary of the area, whilst the Dalmayne area lies immediately to the south-east. Some 80 square miles are included in the area, of which only a comparatively narrow strip on the southern boundary is coal-bearing.

B.—*Access.*

The transport facilities for the Fingal area are identical with those of the Mt. Nicholas area. The Fingal railway will be the means by which the coal from the whole of this area will be transported to the main centres, and is for all parts comparatively easily accessible. As the main workings of the Fingal Range are similarly situated, with respect to the railway, as are the workings of the Mt. Nicholas Range, the arrangements for transporting the coal from the mines to the Main Line will be identical with those employed at present in the northern area. Very little work has so far been done, but in the event of further operations being undertaken it is not anticipated that greater difficulties will be met than have already been overcome in the former area. On the eastern extremity of the Fingal Range the coal is found at a level generally much lower than on the west, and as the altitude of the surrounding country is slightly greater than on the west, the difficulties of transport will be more readily overcome. In no place do the main outcrops occur at a greater distance than 3 miles from the Main Line, and over the greater portion of the area railway sidings could easily be constructed to within a comparatively short distance of the mines.

C.—*Previous Reports.*

In 1849 Milligan published, through the Royal Society, a short report dealing generally with the coal-bearing strata of this area.

In 1888, R. M. Johnston, in "The Geology of Tasmania," refers to this area, basing his conclusions on a report by Selwyn, published in 1855.

In 1887, G. Thureau, F.G.S., published a short report, in which he dealt with the quantity and the quality of the coal to be derived from the various seams examined.

A few short reports dealing with tests of coal from this source, and carried out on the railways, were published in 1883.

Bores have been put down, by means of the diamond-drill, to varying depths. Though the records do not show the presence of any very extensive coalfield, still they have been useful in connection with the present geological survey.

D.—*Topography.*

(1)—General Description.

The topographical features of this area are in many respects identical with those of the Mt. Nicholas Range. The Fingal Range rises more or less abruptly from the southern extremity of the Break o' Day Plain in much the same way as does the Nicholas Range. The maximum altitude recorded on the range is 2800 feet above the sea, at a position about 2½ miles south-east of the Fingal township. The summit of the range is characterised by the presence of a fairly extensive plateau, extending southwards and eastwards for a considerable distance. Small ridges occur on the summit, but in no case does their altitude exceed the general level by more than 200 feet. The general level of the plateau is, approximately, 2500 feet above the sea

The various streams are characteristic of an area with youthful topography, in that their descent from the summit is rapid, and small waterfalls and rapids are of frequent occurrence.

The main streams of the area receive their supply from the flat marsh country of the summit of the range, and are directly dependent on the rainfall for their permanence.

The Break o' Day River has its source on the eastern end of the range, and as tributaries to this stream are found the Lightwood Rivulet, Mick's Creek, and the Fingal Rivulet. Smaller streams have eroded fairly well-cut courses through the Trias-Jura strata, and by their means the drainage is completed.

In every case the summit of the range is denoted by the occurrence of diabase, and it is to this rock that the rugged appearance is due.

Between the two ranges the Break o' Day Plain extends, with an average width of, approximately, 3 miles. Though covered with alluvium, there is no doubt that at a very shallow depth beneath the surface the Permo-Carboniferous strata occur, the plain itself being a plain of denudation, and not, as is generally believed, the result of transverse trough-faulting.

(2)—Relation to Mining.

The relations existing between the topography and the mining problems in this area are identical with those prevailing in the Mt. Nicholas Range. The altitude at which the main coal seams occur is from 700 to 800 feet above the plain. There is no reason to doubt that the narrow-gauge tramways, as used in the Mt. Nicholas Range, will not suffice to transport the coal from the mine workings to the plain. On the eastern portion of the area, where the coal is at a much lower altitude, the ground tramway may possibly be dispensed with, the full-gauge railway being constructed to within a very short distance of the workings.

The various outcrops of this area have in all cases been located in creek-beds, being exposed by the weathering action of the streams. They can thus all be worked by means of adits.

E.—*Geology.*

(1)—Geological Map.

The geological map of the Fingal area is included in the general geological sketch map of the Mt. Nicholas-Fingal-Dalmayne Coalfield. The Fingal mineral chart, the Seymour mineral chart, and the land chart, Cornwall No. 2, have been used with topographic additions as the base for the geologic mapping.

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

Except on the extremities of the area no other rocks than those of the Trias-Jura system are met in this area. On the western extremity Permo-Carboniferous limestones are seen at Fingal and further west. About 3 miles to the west of Fingal the Cambro-Ordovician strata occur, and lying unconformably on these the Permo-Carboniferous limestones occur forming the flanks of the range. The Trias-Jura strata have here been denuded, and the diabase, of which the greater part of the range is composed, has been thereby exposed. Towards the east the Trias-Jura strata appear, showing a gradual thickening eastwards, until the Elephant Pass is reached, where, as a result of faulting, the Permo-Carboniferous strata are again in evidence. Over the greater portion of the Break o' Day Plain the Permo-Carboniferous strata are concealed by a small thickness of alluvium. A few feet of Permo-Carboniferous shales are seen lying immediately beneath the Trias-Jura grits in a small creek crossing Killymoon Estate. The occurrence of these shales is unique for the northern area, and this point at Killymoon is the only outcrop in the Break o' Day area.

The section of the Trias-Jura strata agrees very closely with that prevailing in the Mt. Nicholas area, and, again, may be divided into three sections—the Lower or Ross sandstones, the Middle or Felspathic sandstones, and the Upper sandstones. The thicknesses of the two lower series are in fair agreement with the thicknesses in the Mt. Nicholas Range, but over a large area the Upper sandstones have to a great extent been denuded, and varying thicknesses are now exposed. The Felspathic sandstones are again found to be the only coal-bearing strata of the range.

The thicknesses of the various Permo-Carboniferous strata could in no place be measured, as the basal portions are not exposed. The township of Fingal is built almost entirely on limestone country, and a thickness of over 80 feet is exposed, whilst on the eastern extremity of the area, in the vicinity of the township of Gray, a thickness of over 150 feet is exposed. Duplication of strata as a result of faulting may have taken place, but there is no doubt that there has been considerable original variation.

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

It has been shown previously that the diabase of the Mt. Nicholas Range is a sill, the remnants of which are at present capping the range. The conclusions thus arrived at on scientific grounds coincided with the general belief. This conception as regards Mt. Nicholas diabase was, and still is, held by laymen in regard to the diabase of the Fingal area. For the latter area, however, this is erroneous, for the diabase is in no way a capping to the sedimentaries, but is in every case transgressive with respect to them. Though the actual contact between the sedimentaries and the diabase can in no place be observed, still, over extensive areas the effect of the diabase on the strata has been noted by the occurrence of fragments of cherts or hornstones. The degree to which the strata have been affected varies considerably, and the series from cherts, through quartzites to slightly altered sandstones, has at times been observed. In no case has the metamorphic action of the diabase on the coal seams been noted in the Fingal area.

That the diabase is transgressive with respect to the sedimentaries can be seen in many places in the area, particularly to the westward. In the Fingal Rivulet the diabase is met, *in situ*, at an elevation of, approximately, 100 feet above the township. The rock can then be traced continuously towards the source of the stream, till an altitude of 2500 feet above the sea is reached. The banks of the river are in many places precipitous walls of diabase, reaching a height of over 200 feet. In a branch creek—Waratah Creek—the diabase is again seen, and followed for some distance, when Trias-Jura strata are met. It is in this creek that some of the biggest outcrops of coal in the area are found, and as the diabase has had apparently no effect on the quality of the coal, support was given to the belief that the diabase occurred as a capping. These sandstones do not, however, extend for any very great distance along the creek before diabase is again seen, and from this point, as far as the stream was followed, no other rock was noted.

On the eastern flank of Appetite Hill sandstones were met at an altitude of 1000 feet above the town. Appetite Hill, with an altitude of 1500 feet above the town, is crowned with diabase, and the contact, on its flanks, between the sandstones and diabase, can be traced from an altitude of 1000 feet till an altitude of 1300 feet above the town is reached, in the saddle between the Fingal workings and Waratah Creek. To the east of the workings at Fingal a similar state exists, and a variable altitude for the position of contact of sandstones and diabase is met. From this evidence alone it is apparent that the diabase, at least for this portion of the area, is transgressive, with respect to the Trias-Jura sediments.

The presence also of a number of small dykes tends to show that the chief characteristics of the diabase are transgressive.

A similar occurrence to that at the Fingal Rivulet is found on the eastern portion of the area, at Harefield. Here the diabase is again found at practically the same altitude as the plain country. The sandstones to either side of the creek rise to varying heights, and in one place are found 700 feet above the level of the plain.

At the source of the Break o' Day River there is an occurrence of sandstones completely surrounded by diabase. The northern contact is 300 feet lower than the southern contact, and this patch of sedimentary strata is separated from the main mass by diabase, reaching in width about half a mile.

South of the Cullenswood station a long narrow ridge leaves the main range, and runs, in a direction a little west of north, to a point south of Nicholas Station, and almost as far north as the Break o' Day River. The crown of the ridge is diabase, and represents the irregular surface of a diabase dyke, from which the overlying sandstones have, for the greater part, been removed by weathering.

The fact that the diabase is found, *in situ*, at irregular altitudes along the range, and also that over considerable areas there are no other features present which would be likely to cause these irregularities, tends to show that the diabase is not a sill, but is actually a transgressive mass intruding the whole of the sedimentaries up to, and including, the Trias-Jura strata.

(4)—Structure.

(*a*) *Faults.*—The main faults, as found in the Mt. Nicholas Range, were found to continue into the Fingal Range. The continuation of the Silkstone Fault was found to cross the plain to the east of the Killymoon boundary, and to pass along Mick's Creek into the range.

The Cornwall Fault has been found to pass along the whole of the eastern boundary of the area, and to continue southward into the Dalmayne area, crossing the range at Elephant Pass.[10]

A fault is mentioned by R. M. Johnston ([11]) as passing along the Fingal Rivulet. This fault was not located during these investigations.

Minor faults occur to a slight extent along the whole of the range, but so far the various mine workings have been unaffected by their occurrence.

(*b*) *Dip of Coal Seams.*—Except where faulting has occurred or where the intrusion of diabase has caused variation in the dip of the strata, it is found that the coal seams and their including strata on the Fingal Range are dipping at a small angle towards the south. Variation from 3° to about 5° occurs.

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

The exact number of seams occurring in the Fingal Range is uncertain, but sufficient data have been collected to indicate the improbability of a lesser number occurring than on the Mt. Nicholas Range.

([10]) See Plates IV. and V.

([11]) R. M. Johnston: Geology of Tasmania, page 163.

The undeveloped state of this portion of the field does not afford many opportunities of making measurements of cross sections for purposes of correlation. The number of smudge outcrops would indicate that a greater number of seams exist here than in the former area, but there is a distinct probability that minor faulting has caused repetition of seams. The main seam of the area—the Delta seam—is, however, found over a considerable portion of the field, and, as in the Mt. Nicholas Range, the greater part of the work has been carried out on this seam. Sections of the seam have been taken from west to east along the range, and show variation both as regards thickness and quality, the thickness averaging 10 feet. The continuation of this seam on to the eastern range has also been the scene of operations in the Dalmayne mine. Where sections of the seam were not available, the outcrop was easily located, and its altitude between certain limits was found to be fairly constant, but varied with the major faulting of the area, occurring at a much lower altitude, as the eastern end of the Fingal Range was approached.

The available sections prove beyond doubt that the Delta seam (the main seam of the area) outcrops at various places along the range. In numerous places the outcrop of the seam is visible, and the above conclusion is easily arrived at.

In the Fingal leases, at an altitude of 1450 feet above the sea, another seam outcrops which shows a thickness in this position of 3 feet 6 inches. The top and bottom of the seam are sandstone. The seam is fairly free of bands.

In Cardiff Creek a short tunnel has been driven on a similar seam at an altitude of 1200 feet above the sea. The section of the seam is as follows:—

Sandstone	roof.
2 inches	dull coal.
½-inch	bright coal.
26 inches	dull coal.
1 inch	white band.
9½ inches	dull coal, with two penny bands.
½-inch	white band.
6 inches	dull coal.
¾-inch	blackstone band.
19 inches	dull coal.
Sandstone	floor.

This seam corresponds to the Theta seam of the series.

The Iota and Kappa seams have not been definitely located, but a smudge occurs at an altitude in Cardiff Creek of 1134 feet, and may be representative of one of these lower seams.

The Eta seam of the series has not been definitely located in any position, but it is probable that the greater thickness of the Delta seam in this area is due to them running together to form one seam.

The Gamma seam of the series is fairly prominent in the Fingal area, and is seen as a 4-feet seam at an altitude of 1670 feet above the sea in a creek a little to the east of the present Fingal workings. A prominent white band in the middle of the seam detracts from its value. To the south of this position this seam is again seen at an altitude of 1405 feet above the sea. This difference in altitude is accounted for by the dip of the strata in a southerly direction. The seam in this position is 8 feet thick. A tunnel has been driven, but the entrance has fallen in, and the section of the seam could not be satisfactorily measured.

The Alpha and Beta seams have only been located as outcrops, and no sections could be obtained.

F.—*The Mining Properties.*

(1)—The Fingal Coal Prospecting Syndicate.

(*a*) *Number and Area of Leases.*—The above syndicate is at present the holder of 680 acres situated on the northern fall of the Fingal Range, at a distance of about 2 miles from the Fingal railway. The syndicate has four leases, the numbers and areas of which are as follow:—8607-M, 320 acres; 8621-M, 20 acres; 8690-M, 20 acres; 8724-M, 320 acres. Of these 680 acres, the coal-bearing area has been taken as 500 acres. The remaining area is valueless, due to proximity of diabase.

(*b*) *Extent and Method of Mining Operations.*—The mining operations carried out by the Fingal Syndicate up to the present time have only been developmental in character. At the time of the writer's visit a tunnel had been driven, approximately, 120 feet into the main seam. Since that time a second tunnel has been driven, and it is in this second tunnel that the work is at present being done. The mine has not yet been opened up systematically, but as the seam is one which will easily lend itself to the Board and Pillar system it is probable that this method will be adopted when production on a large scale is contemplated.

(*c*) *Quality of Coal.*—The analyses of the Fingal coal would indicate that its quality is in all respects equal to that of the coals from the Mt. Nicholas Range. The seam at Fingal has been sampled in four sections, with the idea of showing any variations which may exist from top to bottom.

The following sections of this seam were noted at the various positions indicated:—

At the main workings on the Fingal Syndicate's property the section is as follows:—

Sandstone roof.	
4½ inches	bright coal.
½-inch	clay band.
11 inches	bright coal.
1½ inch	shale band.
5 inches	bright coal.
1½ inch	white band.
5½ inches	stony coal.
17 inches	dull coal.
¼-inch	white band.
1 inch	dull coal.
⅛-inch	white band.
2½ inches	dull coal.
Penny	band.
53¾ inches	dull coal.
2 inches	blackstone band.
3 inches	bright coal.
¼-inch	white band.
1¼ inches	bright coal.
½-inch	white band.
3½ inches	coal.
1 inch	band.
18 inches	bright coal, with one penny band.
Shale bottom.	

In Crouch's Creek tunnel the following section is seen at an altitude of 1580 feet:—

Sandstone roof.	
$7\frac{1}{2}$ inches	coal.
$\frac{1}{2}$-inch	blackstone band.
$\frac{1}{2}$-inch	white band.
1 inch	coal.
$\frac{1}{2}$-inch	white band.
1 inch	coal.
3 inches	band.
2 inches	coal.
$\frac{3}{4}$-inch	white band.
3 inches	coal.
$\frac{1}{2}$-inch	band.
$1\frac{1}{2}$ inch	coal.
$\frac{3}{4}$-inch	band.
$4\frac{1}{2}$ inches	coal.
$\frac{1}{2}$-inch	band.
$8\frac{1}{2}$ inches	coal.
$1\frac{1}{2}$ inch	band.
13 inches	coal.
$1\frac{1}{4}$ inch	band.
$1\frac{1}{2}$ inch	coal.
$1\frac{1}{2}$ inch	band.
$9\frac{1}{2}$ inches	coal.
$5\frac{1}{2}$ inches	band.
4 inches	coal.
Penny	band.
$1\frac{3}{4}$ inch	coal.
$4\frac{1}{4}$ inches	blackstone band.
3 inch	white band.
5 inches	coal.
1 inch	white band.

In a creek south of Aulich's property the seam occurs at an altitude of 1490 feet above the sea, and has the following section:—

Sandstone roof.	
12 inches	coal.
8 inches	white band.
4 inches	coal.
$\frac{1}{2}$-inch	white band.
14 inches	coal.
$2\frac{1}{2}$ inches	white band.
4 inches	coal.
$\frac{1}{2}$-inch	white band.
8 inches	coal.
$\frac{1}{2}$-inch	white band.
3 inches	coal.
$\frac{1}{2}$-inch	white band.
6 inches	coal.

Bottom indefinite, but coal could be seen for at least 3 feet lower.

The analyses of these four samples are indicated in the table (page 28) by the registered numbers 492, 493, 494, 495. It is found, on reference to these analyses, that practically no variation in quality takes place in the seam. From the analyses it is reasonable to assume that the whole thickness of the seam is of marketable quality.

The main drawback to the use of this coal is its tendency to decrepit or spit. With each application of fresh coal to a fire this property is exemplified. This is discussed fully in another chapter of this publication.[12]

For use in the kitchen range or any closed fireplace the decrepitation cannot be regarded as a disadvantage, and the quality is equal to the coals of the Mt. Nicholas Range.

(*d*) *Production.*—At the present time only sufficient coal is being produced from this mine to supply the local demand. No transport facilities exist, and no preparation has so far been made to increase the output over a few tons per week.

(*e*) *Quantity of Coal Available.*—Although eight seams are known to exist in the area, insufficient data are available in regard to the thickness of most of them to allow of reliable calculations of coal reserves.

The Gamma, Delta, and Theta seams, however, would give a total thickness of 13 feet over an area of 500 acres held by this syndicate. This would give a coal reserve of 7,000,000 tons, to which will ultimately be added the reserve contained in the remaining seams.

G.—*Unleased Coal-Bearing Area.*

(1)—The Total Area.

The area of the unleased coal-bearing land of this field is, approximately, 2 square miles. It stretches as a comparatively narrow strip from a little east of the present Fingal leases to the township of Gray. The area is not continuous, being broken by diabase masses in places. The former leases at Cardiff Creek, at present held as a prospector's area by one Cheverton, and the old leases at Mick's Creek, are included in this unleased area.

(2)—Number of Seams.

The number of seams for the unleased area is the same as for the area already discussed. Over a greater portion of the area the main seams can be located, and in a few places short tunnels have been driven on them.

(3)—Quality of Coal.

There is no reason to suspect that the quality of the coal for the unleased land will vary in any way from that which is at present being worked by the Fingal Syndicate.

(4)—Quantity of Coal Available.

The coal seams extend over an area of 1200 acres. The details as to the development of the seams, however, are not complete. Gamma and Delta seams are represented with a combined thickness of 10 feet of coal. Theta seam, being not so prominent as in the leased area, is omitted from the calculations. The two seams, therefore, give a coal reserve of 14,000,000 tons, to which must ultimately be added the coal reserve contained in the other seams.

(12) See page 261.

(3)—Dalmayne Area.

A.—*Location and Extent.*

This area is situated between the East Coast and the East Coast Range, and extends from the township of Gray in the north to the township of Seymour in the south. The area comprises some 30 square miles of country.

The main outcrops of coal are in the vicinity of Picanini Creek, and are situated at altitudes of from 800 to 1000 feet above the sea.

The lowlands of this area are not coal-bearing, but to the south they are.

This area adjoins the eastern boundary of the Fingal area, and extends in a southerly direction to the northern boundary of the Douglas River coalfield.

B.—*Access.*

The lack of adequate transportation facilities has been the chief factor retarding the advancement of this area as a mining field. The main road from St. Marys to Swansea passes along the border, but, with this exception, there are no roads leading into the greater portion of the area. A poorly-made road leads from Gray to the Dalmayne mine, a distance of about 6 miles. No other roads exist in the area, and as there are no tramways, the question of transport is really the crucial one as regards the future prosperity. During the operations of the Dalmayne colliery an aerial ropeway was erected from the mine to the coast at Picanini Point, a distance of about 3 miles. A jetty, from which it was intended to load small boats in calm weather, was erected, and had a length of over 600 feet. The greater portion of the jetty has since been destroyed as the result of heavy weather. The ropeway is still in position, and has been kept in good repair. The mine, however, was forced to close owing to the loss of the jetty, as no other facilities for loading were available.

The various small ports along the East Coast are in no way suitable for the handling of the tonnage that would be available from this area, and the weather conditions are such that it would be more or less impossible to guarantee safe anchorage for even small craft.

The nearest suitable port to this area is at Coles Bay, a distance of about 32 miles south from Picanini Point. Suggestions have been brought forward from time to time as to the advisability of constructing a railway from Dalmayne to Coles Bay, and it is believed that a definite proposal is now under consideration.

Coles Bay is situated on the north-eastern corner of Oyster Bay, and is protected on the north and east by Freycinet Peninsula. The Bay is also well-protected from the south, and the only quarter from which it is possible to encounter bad weather is from the west or south-west. The depth of water in the bay has been reported to vary from five to eight fathoms, and little difficulty should be experienced in choosing a site for wharves.

The proposed railway would be the means of providing transport facilities for a considerable area, and no insurmountable difficulties would be met in the course of its construction. The route along which the line would pass would for the greater part be over alluvial flats or Trias-Jura sediments covered by a few feet of alluvium.

The greatest elevation to which the line would rise would be about 200 feet above the general level of the plain. This position is north-west of the township of Bicheno, where a low saddle in the range allows an easy approach to the alluvial flats of St. Albans.

C.—*Previous Reports.*

W. H. Twelvetrees, in a report submitted to the Secretary for Mines in 1901, briefly describes the coal seams at Thorndale and Thompson's Marshes (now Dalmayne), and refers also to outcrops in neighbouring areas. This is the only extant record of former investigations.

D.—*Topography.*

(1)—General Description.

This area exhibits topographical features which are the natural corollary to faulting. The various streams, where their direction coincides fairly well with lines of faulting, have worn deep and narrow gorges. Where the direction of the stream is across the line of faulting, the upper portion of the stream has worn fairly deep and narrow courses, but after crossing the fault the stream is more mature, and flows with a gentler grade to its mouth.

The area is, perhaps, the most rugged in the East Coast district, the various streams having worn their valleys to a depth of, in places, 700 feet. The numerous creeks of the area have resulted in the formation of steep, short ridges, with a general east to west direction, terminating in the main East Coast Range. The range here reaches an altitude of, approximately, 2200 feet above the sea, and the summit is situated about 4½ to 5 miles from the coast.

The youthful topography has resulted in the occurrence of the various coal outcrops in the beds of the many streams.

(2)—Relation to Mining.

The area is one which lends itself admirably to mining by the adit system. The steep mountain slopes, coupled with the low angle of dip of the coal seams, makes it possible in every case to win the coal by horizontal tunnels.

E.—*Geology.*

(1)—Geological Map.

The geological map of this area is included in the general geological sketch map of the Mt. Nicholas-Fingal-Dalmayne coalfield, and is represented by the south-eastern corner thereof.

The positions of the Dalmayne tunnel and ropeway are indicated.

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

In the Dalmayne area fairly good sections of the various formations have been exposed. The presence of faulting has made it difficult to determine with any degree of accuracy, the exact thicknesses of the strata. It is more than likely that duplication of strata has taken place, and in some cases the thicknesses quoted will be exaggerated.

On the sea-coast are found the Cambro-Ordovician slates and Devonian granites. The slates form the lower hills close to the coast, and are found a considerable distance up Wardlaw's Creek. The slates in places reach an altitude of 300 feet above the sea. In Picanini Creek a section of a fault is visible, and as a result of this fault the Permo-Carboniferous strata are exposed at an altitude of a little over 100 feet above the sea, and are found lying unconformably on the slates. Lying conformably on the Permo-Carboniferous strata the Trias-Jura sediments are found to rise to altitudes approximating 2000 feet, where the massive diabase of the range is met.

In Picanini Creek an apparent thickness of, approximately, 400 feet of limestone is seen, but this is due to duplication by faulting, and it is doubtful whether the thickness of limestone is normally greater than 200 feet. The mudstones of the Permo-Carboniferous system are met only in a few places.

The basal grits of the Trias-Jura are evident over a large area, and above these are generally found a thickness of 200 feet of the Lower or Ross sandstones. The Felspathic sandstones of this area agree fairly well in thickness with what is found in other areas. On top of these normal sandstones are found to occur. As in previous areas, it is in the Felspathic sandstones that the various coal seams occur.

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

The diabase of this area is a continuation of the main mass described under the heading of the Fingal area. The same characteristics are evident in this as in the Fingal area.

Doctor's Creek, with its source just south of Thompson's Marshes, was traced from an altitude of, approximately, 1200 feet above the sea, and showed diabase *in situ* at all altitudes to about 200 feet above the sea. A narrow ridge separates this creek from the coastal area, where the Trias-Jura strata are found at altitudes up to 800 feet above the sea. There is no doubt that the diabase occurs as a transgressive mass, and constitutes the western boundary of the coal-bearing area.

(4)—Structure.

(*a*) *Faults.*—Faulting is more evident in the Dalmayne than in either the Fingal or Mt. Nicholas areas. For the most part the faults have occurred to the eastward of the coal-bearing country. The faulting has taken place in the form of a trough, but it is not expected that coal will ever be found in the area that has been faulted. An area of, approximately, 5 miles in length has been trough faulted. The Cornwall Fault marks the eastern boundary of the trough, whilst the Dalmayne Fault bounds it on the west. A third fault—Wardlaw's—has a transverse direction, and has been the means of causing a discontinuity in the general line of the other faults. The Cornwall Fault and the Dalmayne Fault are each, in this portion of the area, of the magnitude of 250 feet, the Cornwall having a throw towards the west, whilst the Dalmayne Fault has a throw towards the east. Wardlaw's Fault has a downthrow towards the south of, approximately, 200 feet in magnitude. The Cornwall Fault is again evident at the township of Seymour, and in this position it has a throw of, approximately, 500 feet.

The mine workings have not so far revealed the presence, to any great extent, of minor faulting. It is, however, expected that minor faulting will be common in this area.

(*b*) *Dip of Coal Seams.*—The dip of the coal seams of the Dalmayne area agrees fairly well with that recorded in Fingal area. The dip in no part of the area is great, and the general direction is southerly.

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

Only seven seams of coal have been located with certainty in the Dalmayne area. The altitudes given for these seams are those which were recorded in positions situated more or less centrally in the area. It is to be expected that the altitudes of these same seams will be greater to the north of the area, and smaller as the southern limit is approached, as a direct result of the angle of dip of the seams. Of the seven seams, sections, more or less complete, have been recorded of four, and these show a great variation from those recorded for the other areas.

At an altitude of 1000 feet above the sea the Delta seam is found. It is on this seam that the Dalmayne Company's tunnel has been driven.

The section of this seam is as follows:—

Sandstone roof.	
$6\frac{1}{2}$ inches	stony coal.
2 inches	coal.
$\frac{1}{2}$-inch	blackstone band.
$22\frac{1}{2}$ inches	coal.
$\frac{1}{2}$-inch	white band.
26 inches	coal.
Penny	band.
$6\frac{1}{2}$ inches	coal.
1 inch	band.
24 inches	coal.
$4\frac{1}{2}$ inches	shale band.
$4\frac{1}{2}$ inches	dull coal.
$\frac{3}{4}$-inch	bright coal.
$2\frac{3}{4}$ inches	white band.
$\frac{1}{2}$-inch	bright coal.
$\frac{1}{2}$-inch	white band.
1 inch	coal.
$4\frac{1}{2}$ inches	dull coal.
$21\frac{1}{2}$ inches	coal.
$\frac{1}{2}$-inch	white band.
32 inches	coal.
Shale floor.	

This section shows a total thickness of 13 feet 7 inches. There can be little doubt that it is the continuation of the main Fingal seam, and, accordingly, the Dalmayne is the Delta seam as found in this area.

About a mile to the south of the position where the above section was taken there is another exposure at an altitude of 1080 feet above the sea. In a position to correspond with the former section the altitude of this second seam would be considerably more than 80 feet greater than the main tunnel. The outcrop was, however, not located in such a position, due chiefly to talus and soils making observation difficult. The section of the seam from top to bottom is as follows:—

Roof indefinite.

24 inches	rubble and smudge.
12 inches	coal.
2 inches	band.
14 inches	coal.
1½ inch	band.
13¼ inches	coal.
½-inch	band.
4 inches	coal.
¾-inch	band.
13 inches	coal.
2 inches	band.
½-inch	coal.
3 inches	white band.
5 inches	stony coal.
4 inches	clay band, varies to 6 inches
3½ inches	coal.
2 inches	band.
6½ inches	coal.
1¼ inches	band.
2 inches	coal.
1½ inch	band.
6 inches	coal.
12 inches	shale band.
1½ inch	coal.
1 inch	band.
4¾ inches	coal.
1¾ inch	band.
6 inches	sandstone.
3 inches	coal.
3 inches	band.
2½ inches	coal.
4½ inches	band.
3 inches	coal.
1 inch	band.
10 inches	coal.
6 inches	band.
9 inches	coal.

Sandstone floor.

The above section shows a total thickness of 16 feet 9¾ inches, but under present conditions of working in the coalfields the seam is more or less valueless, as the result of the many bands present. With the introduction of washing machines this seam should prove to be worthy of consideration.

At an altitude of 940 feet above the sea a tunnel, approximately 100 feet in length, has been driven on a seam, which is at present showing a thickness of 2 feet 6 inches of coal. The seam has not yet reached its full thickness, and solid coal has not yet been revealed. It is probable that this seam is identical with the 4 feet seam of the Mt. Nicholas area. More work will, however, have to be done before this can be determined.

At an altitude of 740 feet above the sea there is a seam the full thickness of which could not be definitely measured. It was estimated that the thickness would be, approximately, 9 feet, of which the section, as far as could be measured, is as follows:—

2 feet	smudge.
6 inches	poor coal.
$\frac{1}{2}$-inch	white band.
9 inches	coal.
$\frac{3}{4}$-inch	white band.
6 inches	coal.
$1\frac{1}{2}$ inch	white band.
18 inches	coal.
2 inches	white band.
3 inches	coal.
Shale ? floor rather indefinite.	

The above section shows a thickness of 6 feet.

Besides the four seams indicated above, definite smudges were located at altitudes of 1340 feet and 680 feet above the sea, whilst a doubtful smudge occurs at an altitude of 965 feet above the sea.

Numerous outcrops were observed, but in the greater number of cases they could be correlated fairly well with the outcrops as enumerated above.

Assuming the series of eight seams to have occurred in this, as in the Mt. Nicholas area, either the Alpha seam has not been located, or the Eta has run into the Delta seam to give the great thickness of 13 feet 7 inches.

F.—*The Mining Properties.*

(1)—The Dalmayne Coal Mining Properties.

(*a*) *Number and Area of Leases.*—These properties comprise an area of 2052 acres situated along Picanini Creek, about 4 miles north of Seymour. Nine leases are at present held by this company, the numbers and areas of each being as follows:—

Holder.	No.	Area.
Dalmayne Collieries...	8135M	... 320 acres
Dalmayne Collieries...	8328M	... 200 ,,
Fullerton	6436M	... 198 ,,
Fullerton	6435M	... 197 ,,
Fullerton	6840M	... 100 ,,
Fullerton	6841M	... 197 ,,
Fullerton	6842M	... 320 ,,
Fullerton	6843M	... 320 ,,
Parker...	7126M	... 200 ,,

On lease No. 8135M Permo-Carboniferous limestones outcrop over the greater portion of the area, but Cambro-Ordovician slates occur on the eastern boundary. In a few places the limestones are concealed by a thin capping of Trias-Jura grits.

These limestones extend well into lease No. 7126, where grits are again evident

The normal sandstones occur over the greater portion of lease No. 8328, except on the western portion, where the coal-bearing Felspathic sandstones are found. The most productive leases are 6435M and 6436M. Felspathic sandstones occur over these leases, and most of the development work has so far been carried out in them.

Leases 6842M and 6843M are for the most part occupied by diabase, and will be unproductive as regards coal.

Of the 2000 acres held in these properties a maximum area of 550 acres can be considered productive of coal.

(*b*) *Extent and Method of Mining Operations.*—Preparations have been made in these works to produce coal on a fairly large scale. Though the mine has been opened up in such a way as to facilitate production, still further work would have to be carried out before a large output could be guaranteed. The track inside the mine would have to be duplicated, and other similar slight alterations made in the general arrangement of the works.

The tunnel is situated about 3 miles from the sea, and an aerial ropeway has been erected to transport the coal to the coast.

The main tunnel of the mine has been driven a distance of, approximately, 300 feet in a south-westerly direction. The work has been carried out on the Bord and Pillar system, and bords have been opened up to the north-west and south-east. The mine has ceased operations for the last four years, as the result of the jetty on the coast being destroyed by storm.

The position of the tunnel has not been chosen to the best advantage, as the dip of the seam is towards the south. The present tunnel is situated towards the northern boundary of the leases. To win coal from this position the tunnel will always be more or less of the nature of a dip tunnel, and drainage problems will become more complicated as work proceeds.

The better system would be to attack the coal from the southwards, working to the rise.

(*c*) *Quality of Coal.*—A series of five analyses were carried out on samples of coal from the Dalmayne leases. These analyses are tabulated on page 29, and are represented by the registered numbers 411, 412, 413, 414, 415.

Reference to these analyses will show that the quality of this coal is in a general way similar to those of Mt. Nicholas and Fingal Ranges.

The Dalmayne coal does not decrepitate.

(*d*) *Production.*—The amount of coal produced from the Dalmayne colliery up to the present time is insignificant. Operations ceased after little development work had been performed because of the destruction of the jetty at Picanini Point.

(*e*) *Quantity of Coal Available.*—Although prospecting work has not been carried on to such an extent that all the seams have been exposed to their full thickness, the fact that all the main seams of contiguous areas have been located on these leases indicates that the possibilities of this area as a coalfield are equal to those in which the same seams occur. The Delta seam here shows a greater thickness than in any area, and at least 8 feet of coal can be won from this seam alone. It is the only seam on which work has so far been carried out.

The Theta seam has not yet been opened up to show coal of constant quality, so that the reserve from this source can only be assumed. It will, therefore, be assumed that a thickness of 4 feet of coal will be available from this seam.

It was also noted in this area that the Iota seam showed a thickness approximating 6 feet. In the Silkstone area this seam in one position showed a thickness of 4 feet of comparatively good coal. Though the seam has not yet been proven, it is reasonable to assume from data collected in other areas that a thickness of at least 4 feet of coal will be available from this seam also. The reserve has, however, been calculated on a 3 feet basis. There is nothing to indicate that the continuity of the seams over the greater portion of the area will be interrupted.

The total coal reserve at present calculable which can be drawn from this property is based on four seams having a total thickness of 20 feet over an area of 500 acres. This gives a total reserve of 12,000,000 tons. This may be added to from the remaining seams.

G.—*Unleased Coal-Bearing Area.*

(1)—Total Area.

The extent of unleased coal-bearing land in the Dalmayne area is 200 acres, situated to the southward of the leased land.

(2)—Number of Seams.

It is reasonable to assume that the seams at present known to exist on the leased land will also be located on the unleased land, and will, therefore, be at least seven in number.

(3)—Quality of Coal.

The quality of the coal should not in any way vary from that of the seams already exposed, and should be similar to all the coals previously discussed.

(4)—Quantity of Coal Available.

Assuming constant thicknesses for the seams, the reserves of coal on the unleased land will be 3,600,000 tons.

Chapter II.

THE SEYMOUR - DOUGLAS RIVER - DENISON RIVER - MT. PAUL COALFIELD.

(1).—Seymour Area.

A.—*Location and Extent.*

The area discussed here comprises 6 square miles of country situated on the sea-coast, and extending from Seymour on the north to Bicheno on the south. The average width of the area is, approximately, 1½ mile. No marked ridges or hills exist in the area, which extends along the coast in the form of a plain.

B.—*Access.*

This area has the same disabilities as regards accessibility as the Dalmayne area, the only means of access at present being the main St. Marys to Swansea road. In former years coal was shipped from the township of Seymour or from Bicheno, but as these ports are not at all times safe they cannot be regarded as means of access.

The proposed East Coast railway, if constructed, would pass through this area, and would provide a ready means of access.

C.—*Previous Reports.*

No complete reports of this area are at the present time available. When the late W. H. Twelvetrees visited the area in 1901 the mines were, even then, not open to inspection, but the original reports were available, and extracts from these were published by him. In these extracts Twelvetrees refers to the workings which were opened up by the Douglas River Coal Company between 1850 and 1860. The positions of these workings were again located and examined during the course of these investigations. Only fragments of coal were seen, and these had been exposed since operations ceased. No examination of the underground workings was possible.

Twelvetrees states, on the authority of the company's reports, that, in the inner mines, seams were struck at depths of 92 feet and 165 feet. At 92 feet the seam was 4 feet thick, consisting of two parts—2 feet 7 inches of tops and 1 foot 5 inches of bottoms. The seam at 165-feet level was 5 feet thick. The bottom seam is reported as yielding good-quality coal. Some 800 tons were won, when, owing to excessive costs of transport to Bicheno, the owners removed to the Lagoon Country.

At the Lagoon, shafts were sunk, and at 90 feet and 192 feet seams were struck. A bore put down from the 192-feet level failed to reveal coal in an additional 164 feet. The seam at the 92-feet level was small, but at the 192-feet level the thickness is reported as from 5 feet to 7 feet.

Selwyn, in his report on "Some of the Coalfields of Van Dieman's Land," gives the section of the seam as under:—

	ft.	in.
Black shale	2	0
Coal	0	6
Parting	0	3
Coal (worked)	1	8
Parting	0	3
Coal	0	6
Black shale	2	0

Charles Gould, in 1861, gave the following section for the same seam:—

	ft.	in.
Black shale	2	0
Coal	0	6
Parting	0	3
Coal	0	6
Black shale	2	0

The above are the only reports available as regards this area.

D.—*Topography.*

(1)—General Description.

The topography of the Seymour area is one of very low relief. The area extends as a plain for from 5 to 6 miles along the coast, and with an altitude of only a few feet above sea-level.

(2)—Relation to Mining.

The fact that the area is in the form of a plain makes it impossible for the adit system of mining to be applied in this area. The coal seams are known to dip towards the south, and it is possible that mining by dip tunnels could be applied. It is more probable, however, that shaft mining would be applied in this area.

E.—*Geology.*

(1)—Geological Map.

The geological map of this area is included in the north-eastern corner of the general geological sketch-map of the Seymour-Douglas River-Denison River-Mt. Paul coalfield. On this map have been marked the approximate positions of all the old bores and shafts.

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

The stratigraphical succession in this area cannot be observed, but the records of old bores put down in 1888 are available, and are included to indicate the strata likely to be met in shaft-sinking. The records of the coal seams cut by the shafts, as also do the observed outcrops, differ from the sections of the seams as shown by the bore records. The positions of the seams, however, agree fairly well. The variations in sections may be due to variations in thicknesses of the seams.

The records of strata passed through by the various bores put down in the area are as follow:—

Seymour No. 1 Bore (1888).

Total depth, 169 feet 5½ inches.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface soil and clay	5	2	5	2
Yellow sandstone	3	0	8	2
Green sandstone	3	0	11	2
Iron stone	0	2	11	4
Grey and yellow sandstone	8	4	19	8
Dark shale, hard and brittle	3	1	22	9
Bastard fireclay	1	10	24	7
Coal and black clod	0	4	24	11
Light bastard fireclay	1	1½	26	0½
Coal	1	1½	27	2
Band	0	1	27	3
Coal	0	1	27	4
Band	0	2½	27	6½
Coal	0	1½	27	8
Band	0	0½	27	8½
Coal	0	3	27	11½
Band	0	1	28	0½
Coal	0	0¾	28	1¼
Band	0	0¾	28	2
Coal	0	4	28	6
Band, very dark	0	1½	28	7½
Coal, very brittle	1	11½	30	7
Band	0	3	30	10
White fireclay	2	2	33	0
Bastard fireclay	5	6	38	6
Coal	0	2	38	8
Bastard fireclay	5	2	43	10
Sandy seam	0	3	44	1
Bastard fireclay	2	2	46	3
Hard blue shale	0	11	47	2
Coal	0	2	47	4
Bastard fireclay	3	1½	50	5½
Black clod	5	2	55	7½
Sandstones and thin blue shales	24	11	80	6½
Hard sandstone	2	0	82	6½
Blue shale	1	1	83	7½
Coal and shale	1	4½	85	0
Soft greasy shale	1	2½	86	2½
Blue shale	2	6	88	8½
Sandstone	3	4	92	0½
Hard sandstone	1	0	93	0½
Blue shale	3	4	96	4½
Coal	0	2	96	6½
Band	0	1	96	7½
Coal and clod	0	3½	96	11
Black clod	5	1	102	0
Dark shale	2	11	104	11
Light shale	0	10	105	9
Dark sandstone	1	8	107	5
Sandstone	31	0	138	5
Coal	0	2	138	7
Firm sandstone	5	6½	144	1½
Dark hard stone	0	2	144	3½
Coal	1	5	145	8½
Band	0	1½	145	10
Coal	1	6½	147	4½
Dark grey shale	1	6½	148	11
Sandstone showing coal stains	3	7	152	6
Sandstone	1	6	154	0
Firm blue shale	6	9	160	9
Coal	0	3	161	0

Seymour No. 1 Bore (1888).—continued.

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Brown shale	0	5	161	5
Light firm shale	3	4	164	9
Coal	0	2½	164	11½
Black clod and dark stone	0	7½	165	7
Black shale	1	5½	167	0½
Light shale	0	6	167	6½
Dark shale	0	5½	168	0
Coal	1	0½	169	0½
Hard floor	0	5	169	5½

Seymour No. 2 Bore (1888).

Total depth, 308 feet 3½ inches.

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Surface soil and boulders	4	6	4	6
Sandstone	31	5	35	11
Hard shale	1	0	36	11
Fine-grained sandstone	3	5	40	4
Hard shale, full of coal marks	0	6	40	10
Fine-grained sandstone	11	1	51	11
Sandstone and conglomerate of hard shale and sandstone	19	8	71	7
Free-boring sandstone	25	10	97	5
Dark shale	3	7	101	0
Coal	0	6	101	6
Band	0	1¾	101	7¾
Coal	0	10	102	5¾
Band	0	1	102	6¾
Coal	0	1½	102	8¼
White parting	0	0⅛	102	8⅜
Coal	0	4⅛	103	0½
Band	0	2½	103	3
Coal	0	2½	103	5½
Coal, with white parting	0	1	103	6½
Coal, with a few thin bands	0	10½	104	5
White band	0	1¼	104	6¼
Black band	0	2½	104	8¾
Coal, with thin bands	0	9½	105	6¼
Coal	1	5	106	11¼
Light band	0	0½	106	11¾
Coal	0	1	107	0¾
Band	0	1	107	1¾
Coal	0	1	107	2¾
Floor	2	8	109	10¾
Firm shale	2	11	112	9¾
Coal	0	2	112	11¾
Brown sandy shale	3	8	116	7¾
Firm, light, sandy shale	4	1¾	120	9½
Sandy shale, full of coal-stains	1	6	122	3½
Coal	0	1	122	4½
Firm light shale	3	8	126	0½
Dark hard shale	1	0	127	0½
Light and dark shale, alternate layers	4	2½	131	3
Sandstone, full of coal-stains	4	5	135	8
Thin blue shale and sandstone	20	0	155	8
Sandstone	6	2¼	161	10¼

Seymour No. 2 Bore (1888).—continued.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Thin blue shales	0	8½	162	7
Firm dark sandy shale	1	6	164	1
Coal	0	4	164	5
Sandstone, full of coal-stains	2	5	166	10
Black shale, showing fern impressions	1	0	167	10
Dark sandstone	1	2	169	0
Black shale	3	0	172	0
Firm sandstone	2	5½	174	5½
Coal	0	1	174	6½
Brown band	0	2	174	8½
Coal	0	1½	174	10
Black shale, with two thin seams of coal	5	6	180	4
Sandstone, full of coal-stains	1	4	181	8
Very firm grey sandstone	2	0	183	8
Clean sandstone	23	11	207	7
White hard sandstone (showing carboniferous matter)	4	5	212	0
Very hard dark shale	8	6	220	6
Hard dark sandstone, with coal seams	1	6	222	0
Conglomerate, coal, shale, and sandstone	1	11	223	11
Conglomerate	1	2	225	1
Black shale	2	10	227	11
Dark sandstone	2	0	229	11
Conglomerate	0	4	230	3
Coal	0	1	230	4
Dark sandstone	1	1½	231	5½
Coal	3	0	234	5½
Band of grey parting	0	0¼	234	5¾
Coal	0	9	235	2¾
Soft dark greasy band	0	0¼	235	3
Coal	0	4	235	7
Very firm sandstone	0	10½	236	5½
Dark shale	1	0	237	5½
Dark sandstone	2	7½	240	1
Light sandstone, with coal-stains	2	0	242	1
Blue shale	3	3	245	4
Bastard fireclay	8	1	253	5
Dark shale	2	0	255	5
Coal	0	0½	255	5½
Black shale	0	8	256	1½
Coal, with three bands	1	3	257	4½
Black shale	1	6	258	10½
Light sandy shale	2	6	261	4½
Black shale	0	10	262	2½
Sandstone	1	0	263	2½
Grey sandstone	5	7	268	9½
Dark sandstone	1	9	270	6½
Dark shale	0	10	271	4½
Bastard fireclay	0	11	272	3½
Dark sandstone	2	4	274	7½
Coal	0	2	274	9½
Sandstone	2	10	277	7½
Coal	0	2	277	9½
Sandstone	0	8	278	5½
Firm blue sandy shale	5	6	283	11½
Dark shale	1	0	284	11½
Sandstone	0	10	285	9½
Dark shale	1	7	287	4½
Hard coarse sandstone	0	4	287	8½
Blue shale	2	4	290	0½
Dark shale	1	2½	291	3
Conglomerate	1	4	292	7
Very hard light shale	2	10½	295	5½
Mud shale, with pebbles	12	10	308	3½

Seymour No. 3 Bore.

Total depth, 247 feet 1¾ inch.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface soil and loam	1	6	1	6
Clay	10	6	12	0
Decomposed sandstone	1	0	13	0
Sandstone	53	3	66	3
Blue shale	4	0	70	3
Sandstone	1	6	71	9
Dark shale	3	1	74	10
Dark and light shales	4	4	79	2
Coal	0	0½	79	2½
Band	0	2¼	79	4¾
Coal	0	5½	79	10¼
Coal and bands	0	3¼	80	1½
Coal	0	4	80	5½
White parting	0	0¼	80	5¾
Coal	0	4¼	80	10
Coal and bands	0	6¼	81	4¼
Coal	0	5¼	81	9½
White band	0	1	81	10½
Coal	0	0½	81	11
White band	0	0½	81	11½
Black band	0	1¼	82	0¾
Coal	0	1	82	1¾
Dark band	0	4¾	82	6½
Coal and white parting	0	1¼	82	7¾
Coal and white parting	0	0½	82	8¼
Coal and white parting	1	8	84	4¼
Band	0	2½	84	6¾
Coal	0	0½	84	7¼
Band	0	0½	84	7¾
Fireclay	0	8	85	3¾
Sandy fireclay	2	10	88	1¾
Bastard fireclay	1	4	89	5¾
Coal	0	2	89	7¾
Fireclay	4	6	94	1¾
Light sandy shale	4	4	98	5¾
Dark sandy shale	0	4	98	9¾
Blue shale	6	9	105	6¾
Dark shale	1	10	107	4¾
Dark stained sandstone	4	1	111	5¾
Clean sandstone	8	2	119	7¾
Sandstone and thin shales	13	4½	133	0¼
Shale	2	11	135	11¼
Light sandstone, full of coal seams	0	9	136	8¼
Blue shale	5	4	142	0¼
Black hard shale	1	1	143	1¼
Dark stained sandstone	4	7	147	8¼
Dark and blue shales	3	1	150	9¼
Hard dark brittle shale	3	1	153	10¼
Dark sandstone	1	5	155	3¼
Clean sandstone	3	5	158	8¼
Clean firm sandstone	10	8	169	4¼
Firm grey sandstone	14	4½	183	8¾
Dark shale	5	0	188	8¾
Sandstone	0	4½	189	1¼
Coal	0	2	189	3¼
Shale	0	8½	189	11¾
Coal	0	0½	190	0¼
Blue shale	0	6	190	6¼
Sandstone	0	6	191	0¼
Shale	1	1	192	1¼
Sandstone	1	6	193	7¼
Shale	0	10	194	5¼

Seymour No. 3 Bore—continued.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Coal	0	6½	194	11¾
Sandstone	1	5	196	4¾
Dark shale	0	10½	197	3¼
Mottled shale	0	7	197	10¼
Coal	0	1	197	11¼
Band	0	1	198	0¼
Coal and shale	0	2	198	2¼
Dark shale	0	3	198	5¼
Coal	2	6½	200	11¾
Band	0	3	201	2¾
Carbonaceous shale	0	2½	201	5¼
Coal	0	3½	201	8¾
Shales, mottled and dark	4	2	205	10¾
Fine-grained sandstone, very hard	3	6	209	4¾
Light blue shale, very firm	2	11	212	3¾
Very hard white shale	0	7	212	10¾
Coal, poor quality	0	11	213	9¾
Very hard black shale	0	10	214	7¾
Light shale	0	2	215	9¾
Coal	0	5½	216	3¼
Shale	1	4	217	7¼
Coal	0	1	217	8¼
Very hard black shale	0	4	218	0¼
Coal	0	1	218	1¼
Sandy shale	4	0	222	1¼
Firm sandstone	3	11	226	0¼
Shale	0	7	226	7¼
Black shale and coal	0	9	227	4¼
Light sandy shale	3	3½	230	7¾
Black shale and coal	0	6	231	1¾
Sandy shale	1	4	232	5¾
Dark mottled shale	0	6	232	11¾
Dark shale	0	2	233	1¾
Hard grey sandstone	8	4	241	5¾
Greenstone	5	8	247	1¾

Seymour No. 4 Bore (1888).

Total depth, 892 feet 3 inches.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface clay and drift	5	0	5	0
Yellow and grey sandstone	3	4	8	4
Hard black shale	0	4	8	8
Grey sandstone, with coal-stains	33	1	41	9
Hard dark curly shale	1	3	43	0
Conglomerate	3	8	36	8
Hard dark brittle conglomerate	4	0	50	8
Hard curly shale	0	8	51	4
Sandstone with coal-stains	2	10	54	2
Conglomerate	1	7	55	9
Clean sandstone	40	9	96	6
Conglomerate, shale, and sandstone	2	3	98	9
Sandstone	11	3	110	0
Blue shale	5	3½	115	3½
Black shale	2	7	117	10½
Blue greasy shale	1	4	119	2½
Sandy shale and bastard fireclay	14	7½	133	10
Sandstone	1	0	134	10

Seymour No. 4 Bore (1888)—continued.

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Black shale and coal	1	5½	136	3½
Coal and bands	0	9½	137	1
Fine-grained sandstone	1	2	138	3
Shale and bastard fireclay	4	8	142	11
Coal	0	2	143	1
Brown sandy shale	1	5	144	6
Sandy shale	7	5½	151	11½
Black shale	0	3	152	2½
Coal	0	1	152	3½
Blue shale	5	3	157	6½
Dark shale	1	1	158	7½
Sandstone, coal-stained	7	8	166	3½
Sandstone and thin shale	6	9	173	0½
Sandstone	2	1	175	1½
Thin grey shale	12	8	187	9½
Blue shale	6	1½	193	11
Black clod	0	1	194	0
Coal	0	6	194	6
Black shale	3	8	198	2
Sandstone, coal-stained	0	11	199	1
Blue shale	0	9	199	10
Sandstone	0	11	200	9
Blue shale	2	7	203	4
Sandstone, coal-stained	4	3	207	7
Black shale	2	4	209	11
Dark sandstone	9	0	218	11
Clean sandstone	18	6	237	5
Firm sandy shale	1	6	238	11
Blue shale	1	6	240	5
Shale, with ½-inch of coal	9	6	249	11
Mottled shale and coal seams	1	2	251	1
Brown shale	2	3	253	4
Hard blue shale	1	6	254	10
Conglomerate	5	4½	260	2½
Dark shale	0	5	260	7½
Coal	0	2	260	9½
Conglomerate	2	6	263	3½
Coal	1	5	264	8½
Brown shale	1	8	266	4½
Conglomerate	3	5	269	9½
Black shale and coal	0	3½	270	1
Blue sandy shale	1	9	271	10
Fine-grained sandstone	3	7	275	5
Blue shale	1	4	276	9
Coal	0	0½	276	9½
Dark blue shale	2	8	279	5½
Coal	1	8	281	1½
Coal, showing grey matter	0	1½	281	3
Coal	0	8	281	11
Soft black stone	0	1½	282	0½
White band	0	0½	282	1
Coal, bright	0	2	282	3
Band ½-in., coal ½-in.	0	1	282	4
Dark and blue shale	8	0	290	4
Bastard fireclay	2	0	292	4
Coal	0	0½	292	4½
Dark and blue shale	10	6	302	10½
Grey sandstone, very jointy	5	0	307	10½
White sandstone	3	0	310	10½
Conglomerate, spotted with pyrites	3	6	314	4½
Green sandstone	9	0	323	4½
Pebbles and veins of carbonate of lime	2	3½	325	8
Conglomerate, with pebbles	5	2	330	10
Grey sandstone	5	3	336	1
Shale, coal-stained	0	10	336	11

Seymour No. 4 Bore (1888)—continued.

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Sandstone, coal-stained	4	0	340	11
Conglomerate	1	0	341	11
Firm mud shale, with pebbles, some quartz	12	4½	354	3½
Fireclay	0	5	354	8½
Mud shale, traces of coal	10	4½	365	1
Mud shale, no traces of coal	20	1½	385	2½
Mud shale, minute fossils	77	6½	462	9
Green sandstone, with pebbles	22	10	485	7
Limestone, fossils	9	9	495	4
Rock, like granite	0	10	496	2
Hard limestone, fossils	123	3	619	5
Blue limestone	125	10	745	3
Fine-grained sandstone	42	8½	787	11½
Sandstone shale and conglomerate	16	8½	804	8
Shale and conglomerate	2	3	806	11
Coarse-grained sandstone, few coal-markings	9	6	816	5
Very coarse sandstone, patches conglomerate, no coal-marks	20	10½	837	3½
Conglomerate and rotten granite boulders	54	11½	892	3

Seymour No. 5 Bore (1888), Douglas River.

Total depth, 645 feet 1¼ inch.

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Surface shaft	44	0	44	0
Sandstone and clay	11	6	55	6
Sandstone and black clod	7	6	63	0
Clod and hard brittle shale	12	0	75	0
Light sandy shale	17	0	92	0
Fine-grained sandstone	4	9	96	9
Coal, inferior quality	0	5	97	2
Light shale	20	7	117	9
Fine-grained sandstone	14	3	132	0
Shale	6	7	138	7
Free-boring sandstone, showing thin coal pipes	33	1	171	8
Dark shale and clod, with coal veins	4	0	175	8
Fireclay	3	6	179	2
Sandy shale	6	5	185	7
Sandstone	1	0	186	7
Shale	2	3	188	10
Sandstone, some showing coal-stains	49	0	238	4
Coal	0	1½	238	5½
Sandstone, with coal pipes and stains	225	4	463	9½
Sandstone, much cleaner	90	8	554	5½
Coal seam, only 8 inches clean coal	1	6	555	11½
Fine-grained sandstone and sandy shale	57	2	613	1½
Coal	0	4	613	5½
Brown band	0	2	613	7½
Coal	1	1	614	8½
Band	0	2	614	10½
Coal	0	1	614	11½
Parting	0	0¼	614	11¾
Coal	0	2½	615	2¼
White band	0	1	615	3¼
Coal	0	10	616	1¼
White band	0	3	616	4¼
Coal	1	0	617	4¼
Hard sandy shale, showing fern impressions	27	9	645	1¼

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

No diabase has been shown to exist on this area as outcrops, but in the records of bore No. 3 it is found that diabase (greenstone) occurred at the bottom of the bore.

(4)—Structure.

(*a*) *Faults.*—The eastern and western limits of the Seymour area are denoted by the presence of major faults. The Cornwall Fault is easily located crossing the township of Seymour and passing into Maclean's Bay. It is again easily distinguishable at the township of Bicheno. The western fault is not easily located by surface observations. The mine workings at Seymour were reported to the writer as having encountered a fault as the workings proceeded westward. At Denison River inner mines two shafts were sunk a few chains apart, and the levels at which the coal was met in each shaft differed by upwards of 100 feet, proving the presence of a fault. This fault in direction would, therefore, pass along the foothills of the range from Seymour to Bicheno. No minor faults were located, but it is to be expected that this area, like all others, will have its complement of them.

(*b*) *Dip of Coal Seams.*—From the reports of the old workings of the previous companies it would appear that the coal seams of this area are dipping at a small angle in a direction a little west of south. In two places only were outcrops observed, and these also were dipping west of south at a small angle.

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

The only means available to determine the number of seams present in this field is reference to the records of bores put down in 1888. These bores (pages 63-69) indicate the presence of three seams. The shafts sunk at the inner mines of the lagoon area have also cut three seams, whilst the workings at Seymour have been reported as having cut only two seams. The disappearance of the third seam at Seymour may be accounted for by dip of strata, as the top seam of the Denison mine was met at a very shallow depth.

From information received at Seymour the old workings in this locality revealed the presence of two seams of thicknesses of 2 feet 6 inches and 4 feet 3 inches respectively. These seams were met at depths of 30 feet and 100 feet. As the top of the Seymour shaft is 70 feet above the sea, and the fall of the country is towards the sea, the extent of this seam would naturally be limited.

A shaft was reported to have been sunk practically on the sea-coast to a depth of 230 feet. No particulars as to depth at which seams were met could be ascertained.

Two outcrops were seen during the course of these investigations. Both are situated on the sea-coast, about one half to a mile south of Seymour. The two outcrops are representative of the one seam, and both are practically at sea-level.

One of these outcrops was partly opened up in the presence of the writer, and an incomplete section was obtained. The seam was later opened up to its full extent, and was then reported to be 5 feet 6 inches in thickness. The section, so far as it was taken, is as follows:—

13 inches	coal.
$1\frac{1}{4}$ inch	white band.
7 inches	coal.
$2\frac{1}{2}$ inches	black band.
2 inches	coal.
1 inch	white band.
10 inches	coal.
$1\frac{1}{2}$ inch	white band.
7 inches	coal.

Section incomplete.

It is probable that this seam is identical with the 4 ft. 3 in. seam mentioned previously as occurring at the 100-feet level in the original shaft.

It is, therefore, reasonable to assume that at least two seams of fair thickness occur in this area, one of which would appear to be of such quality as to warrant further attention.

F.—*The Mining Properties.*

All leases that were at one time held in the Seymour area have long since been abandoned, and no records of the workings can at present be found. The fact that in one case a mine operated for 17 years would indicate that the seam is of such quality and thickness as to warrant further work being done.

G.—*Unleased Coal-bearing Area.*

(1)—Total Area.

The extent of coal-bearing land in this area has been estimated to be, approximately, 1500 acres.

(2)—Number of Seams.

It would appear that three seams occur, but only one will be considered as providing a coal reserve for the area.

(3)—Quality of Coal.

Three samples were taken, and the analyses of these are indicated in the table (page 30) by the registered numbers 624, 625, 626. The lower 2 ft. 6 in. of this seam show a tendency towards caking, and the quality of this portion, as indicated by the analyses, is slightly better than the average East Coast coal.

(4)—Quantity of Coal Available.

Of the three seams occurring in this area only one is regarded as of sufficient importance to justify inclusion in the coal reserve. The average thickness of this seam over an area of 1500 acres is 2 feet 6 inches, giving a coal reserve of 4,000,000 tons.

(2)—THE DOUGLAS RIVER COAL AREA.

A.—*Location and Extent.*

The Douglas River Area comprises the land on either bank of the Douglas River, and extends from the river mouth, a distance of 7 to 8 miles, towards its source. It comprises in all 10 to 12 square miles of country, of which a comparatively small area is actually coal-bearing.

B.—*Access.*

At the present time the Douglas River area is, perhaps, the least accessible coalfield of the East Coast of Tasmania. No means of transport to and from the field are available, except the utilisation of pack-horses. Seymour, the nearest port, is distant about 7½ miles along the most practicable route for a tramway, whilst Bicheno, a slightly better port, is even more distant. Should the proposed East Coast railway be constructed, a branch line of at least 4 miles would be necessary to connect with the present workings.

C.—*Previous Reports.*

Reference is made in "The Geology of Tasmania," by R. M. Johnston (p. 169), to the Douglas River and Seymour Coalfields. Johnston makes reference to previous reports, now unobtainable, and gives the sections of a number of outcrops observed by previous writers. Three seams of varying thicknesses are discussed.

In 1901 the late W. H. Twelvetrees published an account of his investigations. This is included in his report on the Coalfields of Llandaff and the Denison and Douglas Rivers. Measurements of seams, together with analyses of the coals, are quoted, but no reference to the quantity of coal available as a reserve has been made. Twelvetrees, in his report, drew attention to the comparative inaccessibility of the area.

D.—*Topography.*

(1)—General Description.

With its source in Thompson's Marshes the Douglas River flows for a considerable distance over massive diabase before the Trias-Jura sedimentary rocks are met. These strata are first met at a distance of about 4 miles above the present workings, and the stream has worn a deep channel with more or less precipitous banks through these softer rocks. From an altitude of 1750 feet above the sea, the river, in a distance of 4 to 4½ miles, falls 1400 feet. Numerous small waterfalls are met, and in places cliff faces of 60 to 80 feet rise from the water's edge to form the river banks.

(2)—Relation to Mining.

The youthful topography of the area, coupled with the low angle of dip of the strata, has made it possible to locate the many outcrops, either in the steep banks or in the bed of the river, or in its many tributaries. From the greater number of the outcrops exposed, coal could be most advantageously won by the adit system. The river is subject to floods, and during the wet season only those workings well removed from the river bed would be able to continue operations. The seam on which the present tunnel has been driven is outcropping in the river bed at an altitude of 310 feet above the sea.

Faulting has occurred, which has placed the continuation of this seam, towards the coast, at a lower level than the general level of the country. Over the more accessible portion of the area, therefore, shaft-sinking would have to be carried out to win the coal from this seam. Up stream from the present workings a distance of, approximately, 1½ miles, the seam is found to again outcrop under conditions favourable to the adit system. This upper site is, however, situated at an altitude of 580 feet above the sea, and the intervening country is characterised by precipitous banks and small cliffs, over which it would be difficult to provide means of transport.

Should all the seams of this area be opened up both the adit system and shaft-mining will be employed.

E.—*Geology.*

(1)—Geological Map.

The geological map of this area is included in the general geological sketch map of the Seymour-Douglas River-Denison River-Mt. Paul Coalfield.

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

The Permo-Carboniferous strata are not in evidence at any place in the Douglas River area. From the comparatively level country at the mouth of the river the Felspathic sandstones of the Trias-Jura system rise to heights varying up to 2000 feet above the sea. The apparent excessive thickness of these strata is due to the presence of faulting which has taken place.

The lower sandstones were not in any place in evidence.

At least three diabase dykes have intruded these strata, and are to be seen crossing the river above the present 100-acre block of the Mt. John Company. The first of these dykes, with a width of 15 feet 9 inches, is exposed within 1 chain of the boundary of the lease. The second dyke, with a width of 16 ft. 4 in., is situated about ¾-mile above the lease, whilst the third dyke is, approximately, 1½ mile up stream from the leases, and is not far removed from the junction of the Mayson and Douglas Rivers.

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

There is no doubt that the diabase of the Douglas River is a transgressive mass intruding the strata, and is not in the form of a sill. The altitude at which the diabase is found *in situ* varies considerably within short distances. In the upper part of the main Douglas River diabase occurs, and to the north and west stretches as an unbroken mass to Harefield and Fingal respectively. The courses of the Apsley and Denison Rivers, two large streams to the west and south of the Douglas River, pass over the diabase for considerable distances. In the case of the Apsley River the diabase continues to an altitude of less than 400 feet above the sea. In the Denison River the diabase is found as low as 300 feet above the sea. Along the bank of the Douglas River the diabase is found at altitudes varying from 600 to 1200 feet. The presence of dykes crossing the river would also tend to support the belief that the diabase is transgressive. In the vicinity of St. Nicholas Cap it is possible that sill structure has developed, but even for this small area it is doubtful. The general mass of diabase is certainly transgressive, and the small area over which the sill structure may have developed would have little bearing on the coalfield.

(4)—Structure.

(*a*) *Faults.*—The difficulty experienced in correlating the many outcrops of the Douglas River area was due to the presence of innumerable faults of varying size. In practically no case could definite measurements of the faults be made. The minor faulting has not occurred with any regularity of direction, and faults have been observed having directions all round the compass. The presence of the diabase dykes has also complicated the correlation of the outcrops, and it is possible that a great amount of the minor faulting has been due directly to the intrusion of these dykes.

Only one major fault has been located in the area. It is axial in direction, and is more or less coincident with the direction of the upper portion of the Douglas River.

Minor faulting is more evident in this than in any area previously examined along the East Coast coalfields.

In the vicinity of the main tunnel a series of small faults are to be seen. In a tunnel on the right bank of the river opposite the main tunnel the seam has been faulted by a series of step faults, the throw of each being approximately 5 feet. They are axial faults, and the downthrow is towards the east. A transverse fault was reported as occurring in a prospecting shaft put down on the south bank of the river. The magnitude of this fault was not known, but the throw was stated as being towards the south.

At the main tunnel there is a large outcrop of coal, due to an 8-feet seam crossing the river. It is in this outcrop that the main tunnel has been driven. Towards the mouth of the river, a distance of about 8 chains, another outcrop of the same seam is met. The seam cannot be traced continuously from the one point to the other, so that it is evident that faulting equivalent to, approximately, 30 feet has occurred. This faulting would be axial in direction, and would have a throw towards the east.

At the Mayson River another outcrop of the main seam is seen. Here the altitude is 200 feet greater than it is at the main tunnel. The difference in altitude in this case is due to a combination of faulting and the dip of the coal seams.

(*b*) *Dip of Coal Seams.*—The dip of the coal seams of the Douglas River area is variable, the variation being for the most part due to proximity to faulting or diabase dykes. The maximum dip recorded in the area was 15°, in a southerly direction, at a position north-west of the corner peg of lease No. 6205. A dip of

10° was recorded in the same gully as that in which the 5-ft. seam has been opened up. The major fault of the area crosses the range in close proximity to this point, and it may be due to this fact that the high angle of dip is ruling here.

The general dip for the portions of the area which are removed from disturbing factors is, however, very small, and does not exceed 5°. The direction of dip is governed by the geological structure.

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

It is difficult to say with certainty how many seams of coal will ultimately be shown to exist in the Douglas River area, although from the thickness of Felspathic sandstones occurring here it is to be expected that the full eight seams will be shown to exist. Correlation of the various outcrops noted has not resulted in any definite conclusions being arrived at as to the number. Only two seams have up to the present time been sufficiently well opened up to enable sections to be given, and one or other of these seams can be traced over nearly the whole coal-bearing area. The exact relation existing between these two seams is not known, but there is no doubt that the main seam is identical with that on which the Dalmayne tunnel has been driven. This has been shown already to be the Delta seam of the series. From work done in areas to the south it would appear that the second, locally called the 5-feet seam, is the Gamma seam of the series. Five outcrops at lower altitudes than this seam were found on the western portion of St. Albans. The Gamma seam in the northern areas has, however, very different characteristics, and may not be identical, although geographical variation may account for the discrepancy.

Outcrops found at lower altitudes than the Gamma seam cannot be compared with that at the main tunnel, as should be the case if the relative positions of the seams are as stated. Faulting may have occurred to bring outcrops of higher seams to a lower level than the Gamma seam, but these faults, if present, have not been located. It will, therefore, be necessary for additional prospecting and development work to be carried out before the relative positions of these two seams will be ultimately decided.

The Delta seam in this area shows a cross-section as follows:—

Sandstone roof.

10½ inches	coal.
½-inch	white band.
7 inches	dull coal.
10 inches	bright coal.
8 inches	medium coal.
2 inches	white band.
3½ inches	coal.
12 inches	shale.
4 inches	bright flaky coal.
14 inches	dull coal.
½-inch	hard blackstone band.
10½ inches	bright coal.
13¾ inches	dull coal.
½-inch	blackstone band.
6 inches	coal.

Sandstone floor.

It is in this seam that the greater amount of work has been done, but even here there has only been 320 feet of tunnelling.

The second main seam of the area—the Gamma seam—shows the following cross-section :—

Sandstone roof.	
4 inches	bright coal.
2 inches	white band.
9 inches	dull coal.
$3\frac{1}{2}$ inches	poor coal.
3 inches	white band.
$\frac{1}{2}$-inch	coal.
$\frac{1}{2}$-inch	white band.
11 inches	coal.
2 inches	hard blackstone band.
6 inches	coal.
9 inches	hard blackstone band.
12 inches	medium coal.
Shale bottom.	

Very little work has been done on this seam. The presence of the two hard blackstone bands in the lower portion has made it a fairly easy matter to correlate its various outcrops, but it is due to these bands that it is problematical if any appreciable quantity of coal could be won from the seam. Improved methods will have to be adopted to work this seam, for the bands are not capable of being mined by picks.

Of the remaining coal seams little can be said. Their outcrops have been noted, but correlation has not been successful in this area. Outcrops of the one seam have been noted at various altitudes between 405 and 600 feet above the sea, whilst, again, outcrops of a second seam have been noted at 310 feet, 580 feet, and 1110 feet above the sea. Faulting has taken place to a great extent, and as a result of this faulting correlation of seams will not be successful without a great amount of additional work.

F.—*The Mining Properties.*

(1)—Mount John Coal Company.

(*a*) *Number and Area of Leases.*—This company is at the present time the holder of one lease of 100 acres situated on the south bank of the river. This lease (No. 6205M) was taken up by the company in January, 1913. Two other leases were at one time held by the company, but these have since been forfeited.

(*b*) *Extent and Method of Mining Operations.*—With the exception of a few prospecting tunnels and shafts of shallow depth, the only development work carried out in the area has been the driving of a tunnel 163 feet in length, and a crosscut of 156 feet.

The tunnel has been driven on the main or Delta seam, in a southerly direction. At the 95-feet mark a crosscut has been driven in an easterly direction. It was hoped that from this tunnel coal would be produced in quantity, but work has been temporarily stopped at the positions indicated above, as the result of meeting an old stream bed. This difficulty should prove to be only temporary, and the seam should regain its normal thickness in a short distance. No system has so far been decided on to win the coal, but it is likely that when operations are resumed the longwall system will be adopted.

(*c*) *Quality of Coal.*—The quality of the coal from the Douglas River area agrees very closely with that in neighbouring areas. Samples from the two main seams were taken and analysed. The analyses of these samples are represented in the table (page 29) by the registered numbers 417, 418, the former being that of the main tunnel seam, whilst the latter represents the Gamma seam.

The ash content of the coal from the main tunnel seam is higher than is usual with East Coast coals. This may be due to the fact that the tunnels have not yet reached solid coal. The whole of the coal from this tunnel and crosscut must be regarded as outcrop coal, as the result of meeting the old stream bed.

From the appearance of this seam it does not appear possible to improve the quality of the lower portion by washing treatment, but the upper portion of the seam is such as would lend itself easily to washing treatment, the bands being chiefly of the nature of shale.

In the case of the Gamma seam the presence of the two blackstone bands in the bottom portion renders the coal valueless until improved mining methods are adopted. These bands are 9 inches and 2 inches thick, separated by 6 inches of good coal. These 17 inches would at present be discarded as one band, and it would not then be possible to win more than 2 feet of coal from this seam.

The quality is similar to the general run of Trias-Jura coal.

(*d*) *Production.*—The amount of coal produced from the Douglas River area up to the present time is insignificant. A few bulk samples have been taken away, but with this exception no coal has been extracted.

(*e*) *Quantity of Coal Available.*—Of the coal seams present, only two are taken as justifying inclusion in the calculation of reserves. The Delta seam, with an average thickness of 4 feet over an area of 60 acres, gives a reserve of 288,000 tons.

The Gamma seam averages 2 feet over the same area, giving a reserve of 144,000 tons.

The total coal reserve of the Douglas River area would, therefore, be 432,000 tons.

G.—*Unleased Coal-bearing Area.*

(1)—Total Area.

The area of coal-bearing land in the Douglas River at the present time unleased is, approximately, 400 acres. This area is all included in the 2500-acre block held by W. J. McWilliams as an extended prospecting area.

The actual coal-bearing land is a comparatively narrow strip between the Douglas River and the range. It extends roughly from about ¼-mile above the Mayson River towards the mouth of the Douglas River as far as Coal Creek.

As the result of faulting, and the intrusion of diabase dykes, it is not to be expected that more than 400 acres of coal will be won from this area.

(2)—Number of Seams.

The same seams exist on the unleased land as were found on the Mount John Company's lease. The two seams already discussed will be the means of providing the reserve for the unleased land.

(3)—Quality of Coal.

There is no reason to expect any variation in the quality of the coal on the unleased land, and the analyses of the coal from leased land may be taken as representative of this.

(4)—Quantity of Coal Available.

The area of coal-bearing land is 400 acres, and the reserve thickness will be 6 feet, as in the previous case. The quantity of coal available, therefore, on the unleased land will be 2,880,000 tons, being 1,920,000 tons from the Delta seam, and 960,000 tons from the Gamma seam.

(3)—The Denison River Area.

A.—*Location and Extent.*

Situated about midway between the townships of Seymour and Bicheno, and about 3 miles from the mouth of the Denison River, this area covers about 3 square miles, of which a maximum of 500 acres may be regarded as coal-bearing.

B.—*Access*

As in other areas, the only means of gaining access at the present time is by way of the main road from St. Marys to Swansea. There are no suitable ports for shipping within easy distance of the field, although small shipments have from time to time been made from the ports of Seymour and Bicheno. The proposed East Coast railway would make this field easily accessible from Coles Bay, but with the facilities at present available there is little possibility of the area becoming productive.

C.—*Previous Reports.*

The only report at present available which deals with this area is that published in 1901, by the late W. H. Twelvetrees, on the "Coalfields of Llandaff and the Denison and Douglas Rivers."

Twelvetrees notes that previous mention was made by Gould of the seams of this area. Prominence is given by Twelvetrees to the shafts sunk on the flat country, included in this report under the heading of the Seymour Area, and only casual mention is made of the outcrops occurring in the river bed.

Analyses and sections of seams were published, but the area was then, as it is now, in an undeveloped state, and it is doubtful whether reliance can be placed on the analyses published previously.

In his report, also, Twelvetrees gives (pages 25, 26, 27) the report of the manager of the Gas Company in 1898, on the coking properties of the coal from this area.

Attention is also drawn to the fact that the seams are, for the most part, small in size.

D.—*Topography.*

(1)—General Description.

For a considerable distance the Denison River flows in a southerly direction. It then turns abruptly towards the east and empties into the southern portion of MacLean's Bay. Over the greater part of its course the river flows through a fairly narrow gorge, worn into the massive diabase which occurs over practically the whole of the country. At the western end of the eastern arm of the river Trias-Jura sedimentaries are met, and these are continuous to the mouth, except for the occurrence of a mass of diabase crossing the stream at the eastern extremity of the range. The river has worn a deep and narrow channel through the sedimentaries, and it is in these precipitous banks, or in the river bed itself, that the various seams are found to outcrop. The coal-bearing strata occur in a basin-like mass of diabase, through which a gap occurs to the north-eastward. At this point the Trias-Jura are continuous to the eastern flanks of the range.

On the southern bank of the river the stream has undermined the sandstones. Huge masses have collapsed, and cliff faces are the prominent features. Only a comparatively narrow belt of sandstones now remains on the southern bank, and as a coalfield, is practically negligible.

The main belt of Trias-Jura strata occurs on the northern bank of the river, but even here the area is limited, and diabase is met within $\frac{3}{4}$-mile of the stream.

The altitude at which the various seams occur varies from 150 feet to 400 feet above the sea.

(2)—Relation to Mining.

The proximity of the diabase to both the banks of the Denison River eliminates the possibility of proving the existence of any extensive area of coal below the general level of the river bed. Diabase would be encountered before any very great depth had been reached.

For those seams which have already been located, the adit system could be most advantageously adopted, except for one seam, which, outcropping at a low altitude on the eastern portion of the area, would be more amenable to shaft-mining.

E.—*Geology*.

(1)—Geological Map.

The geological sketch-map of this area is included in the general sketch-map of the Seymour-Douglas River-Denison River-Mt. Paul Coalfield.

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

The Permo-Carboniferous strata are not in evidence at all in this area.

Neither the lower nor the upper Trias-Jura sandstones are in evidence, the only sedimentaries present being the middle or felspathic sandstones. These sandstones are visible to an extent of, approximately, 600 feet, but the complete thickness is not in any place exposed. From the upper limit of the sandstones the diabase extends an additional 300 to 400 feet in thickness.

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

There is no better area than the one at present under discussion to illustrate the transgressive nature of the diabase mass occurring in the area. In every case the summits of the hills in the vicinity of the Denison River are composed of diabase. On the eastern boundary of the Mt. John lease of 320 acres a mass of diabase 5 to 6 chains wide is seen to cross the river and rise again into the hills on the north of the river. To the north of the river the Trias-Jura strata conceal this mass for a short distance, but a little further north the diabase is again met. Southward this mass can be traced until it junctions with the main body, and is seen to extend laterally and vertically till the main hills are reached. There can be no doubt, therefore, that this mass is transgressive with respect to the Trias-Jura strata.

The varying altitude at which the contact, between the Trias-Jura strata and the diabase, is met also tends to show that the main mass of diabase is transgressive.

(4)—Structure.

(*a*) *Faults.*—In this area little can be said of the various structures which may be present. The workings, as far as could be learnt in the field, have not yet revealed the presence of any faulting, but, as work proceeds, it is to be expected that the minor faulting, common to the coalfields of the East Coast, will be encountered.

To the westward the continuation of the Douglas River Fault is encountered, whilst to the eastward a major fault has been proved by the workings of the inner Denison River mines. Both these major faults are axial in direction, but as their position is outside the present area the lateral extension of the coal seams will in no way be affected by them.

(*b*) *Dip of Coal Seams.*—The general dip of the coal seams in the areas discussed previously is about 3° in a southerly direction. In the Denison River area a change in direction of dip is noted, and this change may be attributed to the intrusion of the diabase. At the tunnel driven on the Gamma seam the coal is seen to lie horizontally, and at this position the coal is at the maximum distance from the diabase mass. To the south of this position the dip of the seam is towards the north. That the dip is in this case in the opposite direction, and also that it is away from the diabase mass, would tend to show that a slight lateral displacement had taken place as a result of the intrusion of the diabase.

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

Of the eight seams shown to exist in other areas, only four have been definitely proved in the Denison River area, and correlation with the seams of other areas has not been successful.

The following seams have been noted and sections measured.

At an altitude of 430 feet above the sea, about 5 chains from the river on its northern bank, a tunnel has been driven a distance of, approximately, 50 feet on a seam, with a section as follows:—

Sandstone.
Shale roof.

3 inches	coal.
3 inches	blackstone band.
4 inches	coal.
6 inches	blackstone band.
17 inches	coal, free of bands.

Shale floor.
Sandstone.

The presence of the two hard blackstone bands makes it problematical whether this coal could be economically mined. The lower 17 inches of coal shows a slight improvement in quality, above the average, but the thickness is such as to entail increased expense in working.

In the river bed at an altitude of 310 feet the following section is seen:—

Sandstone.

3 feet	weathered coal or smudge.
18 inches to 24 inches	coal, with variable bands.
12 inches	carbonaceous shale.
9 inches	blackstone band.
3 feet	sandstone (fossiliferous).
12 inches	dirty coal.
6 inches	poor coal.
4 inches	white band.
3 inches	blackstone band.
1½ inch	white band.
8 inches	stony coal.
4 inches	white band.
3 inches	shaly coal.
8 inches	coal.
1½ inch	white band.
3 inches	coal.
¼-inch	white band.
6 inches	coal.
6 inches	carbonaceous shale.

Sandstone floor.

In the upper portion of the above strata a tunnel has been driven for some distance to test the quality of the coal from the 18-inch layer near the roof. It does not appear that the uppermost section, represented by the 3 feet of smudge, has yet been opened. The tunnel has now collapsed, and an examination is not possible.

A second seam is found to outcrop in the river itself at an altitude of 270 feet above the sea. The section is as follows:—

Sandstone roof.

15 inches	bright coal.
3 inches	stony coal.
15 inches	poor coal.

Shale floor.

A tunnel has been driven on this seam for some distance, but the entrance is at present below the level of the water in the river. About 18 inches of the shale floor have been taken up to give sufficient height to drive the tunnel. The tunnel has been driven in the direction of the dip of the seam, and an examination of the coal at the face was impossible. It is reported that samples have from time to time been taken from this tunnel for testing purposes. No records of these tests were, however, available.

At an altitude of 110 feet above the sea, on the left bank of the river, an outcrop was observed. At the present time there are no indications of work having been done on this outcrop, but one T. Rigby stated that he had sunk a hole through the seam, and quoted the following as being the section revealed:—

17 inches	bright coal.
1 inch	white band.
18 inches	bright coal.
2 inches	white soft band.
2 inches	coal.
Hard, smooth, brown floor.	

The top only of this seam is visible above the level of the stream bed. A shaft has been sunk a few chains to the north-west of this position, and coal was cut. The shaft has now fallen in, and it is not certain whether this seam was cut.

Other indefinite outcrops have been noted, but these can, in practically every case, be traced to one or other of the seams mentioned above.

Between the positions of the last two seams mentioned, a thickness of from 12 to 15 feet of mudstones occurs, and small bands of coal appear at intervals in this stratum. At the top of the mudstones a thickness of about 12 inches of coal is visible. In no place, however, is the thickness such as to warrant attention.

Of the above seams only one can definitely be correlated with seams found to the north. The seam occurring at an altitude of 430 feet is definitely a continuation of the Gamma seam of the Douglas River area. Geographic variations in the various seams have evidently taken place, for of the remaining seams the characteristics are not such as to warrant definite correlation with previous outcrops.

F.—*The Mining Properties.*

(1)—The Mount John Coal Mining Company.

(*a*) *Number and Area of Leases.*—The Mount John Coal Mining Company is the only holder of leased land in the Denison River area. Their lease, No. 6242M, of 320 acres, is situated for the most part to the north of the Denison River, and the eastern boundary is about 2 miles from the coast. The southern boundary is parallel to, and only a few chains from, the south bank of the river.

(*b*) *Method and Extent of Mining Operations.*—The mining operations in this area have not advanced past the prospecting stage. The only work done up to the present time has been the driving of the various tunnels mentioned previously, together with the exposure by small holes of a few outcrops of the seams. No attempts have yet been made to produce coal in quantity.

(*c*) *Quality of Coal.*—Reference to the analysis of the coal from this area reveals a slight improvement in quality as compared with other East Coast coals. The sample analysed (No. 419, page 29) was taken from the face of the tunnel, situated at an altitude of 430 feet on the northern bank of the stream. The sample represents 21 inches of coal from the two lower bands in the seam, but it is doubtful if, under working conditions, a greater thickness than 17 inches could be won from this seam. The presence of the blackstone bands presents a difficult factor to overcome in working.

Of the quality of the coal from other seams little can be said, as representative samples could not be obtained, due to collapse of the various tunnels. In general appearance, however, it is little different from the coals found in adjacent areas, and it is not expected that great variation in quality will occur. The small thickness of most of the seams makes their working a difficult matter, but with further prospecting and development work a greater thickness of coal may yet be proved to exist in the seam occurring at an altitude of 310 feet.

(*d*) *Production.*—Except for a few tons of coal taken from time to time as samples for testing purposes, no coal at all has yet been produced from the Denison River area.

(*e*) *Quantity of Coal Available.*—There are three seams definitely known on this property, extending over a total area of 300 acres, with an aggregate thickness of 6 feet of coal. This gives a coal reserve of 1,500,000 tons.

G.—*Unleased Coal-Bearing Area.*

(1)—Total Area.

The total area of unleased land in the Denison River Area is 150 acres.

(2)—Number of Seams.

The number of seams occurring on the unleased land is the same as that of the leased land, and their thicknesses will be found to be, approximately, the same.

(3)—Quality of Coal.

It is assumed that the quality of the coal on the unleased land is similar to that for the leased land. No prospecting work has so far been carried out on the unleased land, and opportunities to obtain samples have not yet been presented.

(4)—Quantity of Coal Available.

Taking into account the three seams, with a thickness of 6 feet as the average over 150 acres, which is the extent of the unleased coal-bearing area in this district, the coal reserve is given at 1,000,000 tons.

(4)—The St. Albans Area.

A.—*Location and Extent.*

Situated about midway between the source and mouth of the Apsley River, and about 7 miles due west of the township of Bicheno, the St. Albans area occupies about 6 square miles of country. The main portion of the field is situated on the western extremity of the St. Albans Plain, but outcrops have been noted as far east as Marshall's residence. The Trias-Jura strata are found to occur at altitudes up to 800 feet above the plain, and outcrops have also been noted on the narrow ledge of sedimentaries abutting against the diabase.

B.—*Access.*

From a little to the north of Bicheno a fairly good road branches from the main East Coast road, and follows a general westerly course along the northern bank of the Apsley River till the St. Albans area is reached. From this a branch road, from a point about 1 mile from the main road, crosses the Apsley River, and follows a more or less westerly course along the south bank. Except for these two roads there are at present no means of communication between this area and the main centres. The proposed East Coast railway would pass along the eastern margin of the St. Albans Plain. A branch line of about 2 miles would be necessary to establish communication with this area.

C.—*Previous Reports.*

The only previous reference to the St. Albans area is found on page 19 of the late W. H. Twelvetrees' report of 1901 on " The Coalfields of Llandaff and the

Douglas and Denison Rivers." Twelvetrees refers to an outcrop on R. Marshall's farm. This outcrop is situated to the south of the Apsley River, in an eastern branch of the main creek flowing through Lot 894. No other official reports on this area have so far been made.

D.—*Topography.*

(1)—General Description.

From a position about 1½ mile west of the town of Bicheno the St. Albans Plains extend in a westerly direction for a further distance of 3 miles. To the north and south of the Apsley River the plain extends for one-half to three-quarters of a mile, giving in all an area of 5 square miles of plain country. From the boundaries of this plain the ranges rise more or less abruptly to the north, west, and south, to a height of 1200 feet. To the east of the plain the hills reach an altitude of about 600 feet, whilst to the north-east and south-east low saddles occur in the ranges, through which easy access is gained. The whole area has the general appearance of an amphitheatre, the sides of which are formed of Trias-Jura sedimentaries, abutting against the massive diabase of the main range. It is in the Trias-Jura strata that the various coal seams outcrop at varying altitudes.

(2)—Relation to Mining.

The greater number of outcrops located in the St. Albans area are so situated as to readily lend themselves to mining by the adit system. It was reported that a seam of coal was at one time exposed on the plain country at Blindburn Estate. If this is so, and the seam is proved to be of economic value, a shaft would have to be sunk to enable the coal to be won.

E.—*Geology.*

(1)—Geological Map.

The geological sketch map of this area is included in the general geological sketch map of the Seymour-Douglas River-Denison River-Mt. Paul Coalfield.

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

The Permo-Carboniferous and the Lower or Ross sandstones of the Trias-Jura system are not in evidence in this area at all. The felspathic sandstones rise from the level of the plain country to an altitude of 800 feet above the plain. In a few places only are the upper sandstones in evidence. At altitudes varying from that of the plain to a maximum of 1200 feet the diabase is found to occur in the many creek beds and on the upper portions of the mountain slopes. In all cases the diabase forms the summit of the range.

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

The diabase of this area, like that in most of the areas immediately to the north, occurs as a transgressive mass with respect to the Trias-Jura sedimentaries. In the Apsley River, about half a mile from A. T. Gillies' residence, the diabase is found, *in situ*, at an altitude of about 150 feet above the sea. From this point the contact can be traced almost continuously along the face of the range till an altitude of about 600 feet above the sea is reached. In the Apsley River the metamorphic action of the diabase on the sedimentaries is seen.

In Lot 894 an outcrop of coal occurs at an altitude of about 280 feet above the sea. The coal in this outcrop has been baked by the diabase, and it now has the appearance of anthracite coal.

Very little displacement of the sandstones has taken place, and the tilting of the sedimentaries is of a few degrees only.

(4)—Structure.

(*a*) *Faults.*—No faults have been definitely located; but the occurrence of outcrops would indicate that there is a major axial fault crossing the area centrally.

On the western part of the area six outcrops of the full series of eight seams have been located. The lowest of these outcrops is found at an altitude of about 150 feet above the plain. Towards the east of the area a seam has been reported as occurring at the level of the plain. This would tend to show the presence of a fault between the positions of the two outcrops.

On the western portion of the area the Douglas River 5-ft. seam—the Gamma seam—occurs at an altitude of 780 feet above the sea. This seam is in other areas 175 feet above the main seam of the series. On the eastern portion of the area the main seam is found to occur at an altitude of 450 feet above the sea. This confirms the presence of an axial major fault.

Further support is given to the belief that this fault exists by the fact that if the general direction of the Douglas River fault be continued it would pass across the St. Albans area at the position indicated.

No other faults have benn proved to exist in this area.

(*b*) *Dip of Coal Seams.*—Where the coal seams occur to the north of the Apsley River they are found to dip in a general southerly direction. The amount of dip is small, being at the most about 3 degrees. To the south of the river a northerly dip is observed. In general the dip of the seam is away from the diabase, and has resulted from its intrusion into the surrounding strata.

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

In the western portion of this area, in a creek running through A. T. Gillies' orchard, six outcrops were located. These outcrops occur at the following altitudes above the sea:—325 feet, 540 feet, 570 feet, 630 feet, 670 feet, and 780 feet.

The outcrop at the 780 feet altitude has, since the writer's visit, been opened up sufficiently to show the two hard blackstone bands characteristic of the Douglas River 5-ft. (Gamma) seam. No other outcrop of this series has been opened up, so that correlation cannot be definitely undertaken. It is more than likely, however, that these outcrops are representative of the Gamma, Delta, Eta, Theta, Iota, and Kappa seams.

At an altitude of 870 feet, a little to the east of the former position, a seam was located to the north of Wm. Cornish's residence.

To the north of Lot 896, and about $1\frac{1}{2}$ mile to the east of Orchard Creek, a seam has been exposed by a short cut.

This seam has the following section:—

Roof indefinite.

12 inches	smudge.
6 inches	stony coal.
6 inches	poor coal.
$\frac{3}{4}$-inch	white band.
3 inches	coal.
$1\frac{1}{2}$ inches	white band.
$5\frac{1}{2}$ inches	coal.
1 inch	white band.
10 inches	coal.
$2\frac{1}{2}$ inches	white band.
$2\frac{1}{2}$ inches	coal.
12 inches	shale.
$18\frac{1}{2}$ inches	coal.
2 inches	band.
9 inches	coal.
6 inches	fireclay.

Shale floor.

This seam occurs at an altitude of 450 feet above the sea, and is comparable with the Dalmayne Main Tunnel seam or Delta seam.

On the south side of the Apsley River, in a creek mentioned previously as having been visited by Twelvetrees, there are to be seen four poor outcrops of coal seams. Measurements of only one of these outcrops could be made, and these are as follows:—

Sandstone.	
8 inches	clay (baked).
27 inches	hard, stony coal, poor quality.
3 inches	blackstone.
4 inches	clay, baked.
6 inches	hard, stony coal.
21 inches	very hard sandstone.
3 inches	clay.
3 inches	coal.
2 inches	clay.
36 inches	very hard sandstone.
12-14 inches	stony coal (anthracitic locally).
Shale bottom.	

The metamorphic action of the diabase is evident on practically the whole of the above section. Both the coal and the intermediate layers have been baked and hardened, with the result that the coal of the seam is practically valueless.

F.—*The Mining Properties.*

Two small areas are at the present time held as prospecting areas in the St. Albans district. The remainder is at present unleased, and in an undeveloped state.

As none of the seams has been opened sufficiently to enable an examination to be made no attempt can be made to discuss the quality or probable quantity of coal available in this area.

An approximate estimate of tonnage, however, can be made on the basis of the 1200 acres containing the six seams on the western edge of the area, together with 1200 acres below the eastern half of St. Albans Plain and 500 acres on the extreme eastern portion of the area.

(5)—Steep Creek Area.

A.—*Location and Extent.*

The Steep Creek area is situated immediately to the north of the township of Llandaff, and extends in a northerly direction a distance of from 2 to 2½ miles. The western boundary of the area is denoted by the main range, whilst the main road to Swansea passes along the eastern boundary. Approximately, 10 square miles are included in the area, of which 500 acres may be regarded as productive of coal.

B.—*Access.*

The main portion of this area is situated within 1 mile of the East Coast road, but up to the present time no transport facilities have been made available. With the construction of the East Coast Railway the area will be made readily accessible by the construction of a short branch line.

C.—*Previous Reports.*

A report on the Steep Creek area appears on pages 11 to 18 of W. H. Twelvetrees' report of 1901 on "The Coalfields of Llandaff and Douglas and Denison Rivers." In this report the outcrops of eight seams are mentioned, and sections and analyses of the various outcrops are quoted.

D.—*Topography.*

(1)—General Description.

From an altitude of little over 100 feet above the sea, at the main-road at Llandaff, the country rises, gently at first, but soon becomes steeper and more rugged, until within 2 miles to the west of Llandaff the mountain range has an altitude approaching 1200 feet above the sea. The area is characterised by a number of fairly steep and narrow ridges running in a general south-easterly direction from the mountain range to the plain country around Llandaff. Coal seams have been found outcropping on the mountain slopes, and have also been shown to exist by shafts and bores put down in positions indicated on the geological sketch map.

(2)—Relation to Mining.

The seams of this area are so situated that both the adit system and shaft mining will have to be adopted to win the coal. On the mountain slopes seams are found to outcrop, and dipping at a low angle, lend themselves readily to the adit system of mining. On the plain country, bores and shafts have been put down to reveal the presence of seams at lower altitudes. The coal from these seams will be won by shaft-mining.

E.—*Geology.*

(1)—Geological Map.

The geological map of this area is included in the general geological sketch map of the Seymour-Douglas River-Denison River-Mt. Paul Coalfield. The approximate positions of bores and tunnels have been indicated thereon.

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

At the point where Pike's Creek crosses the main-road at Llandaff a small area of Permo-Carboniferous shales have been exposed in the creek bed. These shales are seen to underlie the Trias-Jura grits, which cover the surface over an extensive area at Llandaff. The Permo-Carboniferous exposure is only a few square yards in extent, and is the only one located in the whole of the Steep Creek area. The shales and grits are found to dip in a direction south-south-east at 10°. The Trias-Jura sediments extend from the plain country to the mountain slopes, until an altitude of about 800 feet above the sea is reached. The Ross sandstones are not in evidence, although the basal grits are found over a fairly large area. This occurrence would indicate the presence of a fault, 200 feet or more in magnitude, passing through Llandaff in a direction parallel to the main-road. It is due to tilting at this fault that the Permo-Carboniferous shales are found to dip at 10°.

Llandaff Bore No. 1.

No. 1 bore, 90 chains west from the Llandaff-road to Bicheno. in the northern part of Lot 369, was 120 feet above the road and 150 feet above sea-level.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Stiff clay and hard broken sandstone	7	0	7	0
Soft sandstone	3	0	10	0
Broken sandstone	6	0	16	0
Solid sandstone	9	0	25	0
Broken sandstone	30	0	55	0
Sandstone, intermixed with decomposed vegetable matter	27	0	82	0
Solid sandstone	30	0	112	0
Sandstone	10	0	122	0
Blue shale	1	4	123	4
Sandstone	2	2	125	6
Sandstone, intermixed with decomposed vegetable matter	54	6	180	0
Solid sandstone	28	0	208	0
Sandstone, intermixed with decomposed vegetable matter	12	0	220	0
Broken sandstone	13	0	233	0
Sandstone	3	8	236	8
Coal	0	9	237	5
Blue shale	3	7	241	0
Blue shale, intermixed with decomposed vegetable matter	10	2	251	2
Coal, friable	3	10	255	0
Shale and sandstone	5	0	260	0
Blue shale and sandstone	8	6	268	6
Broken shale and sandstone	6	3	274	9
Clayey blue shale	12	3	287	0
Clayey shale and sandstone	7	0	294	0
Clayey shale	5	0	299	0
Limestone	1	6	300	6
Clayey shale	6	6	307	0
Shale and sandstone	4	0	311	0
Sandstone and decomposed vegetable matter	7	6	318	6
Coal	0	6	319	0
Shale and sandstone	5	0	324	0
Dark clayey shale	11	0	335	0
Coal	1	0	336	0
Clayey blue shale	5	0	341	0
Sandstone	25	10	366	10
Coal	0	5	367	3
Dark clayey shale	5	3	372	6
Coal	0	9	373	3
Dark clayey shale	7	3	380	6
Clayey shale	5	6	386	0
Dark clayey shale	6	5	392	5
Sandstone	0	7	393	0
Sandstone and decomposed vegetable matter	12	0	405	0
Sandstone	0	9	405	9
Clayey shale	15	3	421	0
Clayey shale and limestone	4	0	425	0
Sandstone	2	7	427	7
Clayey shale	1	5	429	0
Dark clayey shale	6	6	435	6
Sandy shale	10	6	446	0
Hard cemented white sandstone	0	6	446	6
Broken sandstone and shale	9	0	455	6
Broken sandstone and shale, giving place to granite	8	3	463	9
Granite, enclosing fragments of shale	1	3	465	0
Granite	6	0	471	0
Granite	4	0	475	0

Llandaff Bore No. 2.

No. 2 bore was situate 105 chains a little west of south from No. 1, on **Hume's** boundary, 20 feet above the road and 50 feet above sea-level.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface clay	2	6	2	6
Sandstone	13	6	16	0
Blue shale	2	0	18	0
Sandstone	3	6	21	6
Dark shale and coal	1	3	22	9
Blue shale	1	0	23	9
Coal	0	3	24	0
Blue and dark shale	4	0	28	0
Blue shale	5	0	33	0
Dark shale	1	0	34	0
Coal	0	2	34	2
Dark shale	0	10	35	0
Coal	0	4	35	4
Dark shale	0	8	36	0
Coal	0	6	36	6
Blue shale	2	6	39	0
Dark shale (small veins of coal)	3	0	42	0
Shale and sandstone	14	0	56	0
Sandstone, intermixed with small veins of coal	33	0	89	0
Sandstone	19	0	108	0
Broken sandstone	13	0	121	0
Sandstone	10	0	131	0
Sandstone and shale	1	0	132	0
Sandstone	18	0	150	0
Sandstone, intermixed with decomposed vegetable matter	15	6	165	6
Sandstone	46	6	212	0
Sandstone, with small veins of coal	42	0	254	0
Sandstone	21	0	275	0
Sandstone	9	8	284	8
Blue shale, with coaly matter	5	7	290	3
Sandstone	1	3	291	6
Black shale, with veins of coal	1	2	292	8
Sandstone	0	2	292	10
Black shale	1	0	293	10
Sandstone	12	8	306	6
Sandstone	34	6	341	0
Sandstone and shale	5	0	346	0
Coal	1	8	347	8
Sandstone and shale	0	2	347	10
Coal	0	7	348	5
Blue and dark-coloured shale	3	7	352	0
Coal	0	6	352	6
Blue and dark clayey shale	10	0	362	6
Clayey shale	10	6	373	0
Dark and blue clayey shale	6	6	379	6
Shale and sandstone	9	6	389	0
Black shale and coal	0	10	389	10
Blue clayey shale	1	2	391	0
Sandstone, with layers of shale	13	0	404	0
Solid sandstone	13	0	417	0
Limestone	0	10	417	10
Dark-coloured shale	1	2	419	0
Sandstone	11	9	430	9
Clayey shale	10	5	441	2
Black clayey shale	2	4	443	6
Sandstone, intermixed with decomposed vegetable matter	27	6	471	0
Sandstone and shale	6	4	477	4
Shale and coal	0	8	478	0
Sandy shale	4	0	482	0
Sandstone and shale	21	0	503	0

Llandaff Bore No. 2—continued.

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Sandstone	17	0	520	0
Clayey shale	6	0	526	0
Shale	1	0	527	0
Limestone, with carbonate of iron	0	10	527	10
Blue and dark-coloured shale	6	2	534	0
Dark-coloured shale	8	6	542	6
Shale and sandstone	1	0	543	6
Coarse grey sandstone	5	0	548	6
Sandstone and shale	11	0	559	6
Clayey and sandy shale	11	6	571	0
Clayey shale	3	3	574	3
Shale and sandstone	5	2	579	5
Sandstone	12	7	592	0
Sandstone	8	0	600	0
White cement and quartzite	5	0	605	0
Sandstone and shale	4	0	609	0
Sandstone	5	0	614	0
Broken sandstone and shale	9	5	623	5
Blue clayey shale	6	7	630	0
Shale and limestone	1	9	631	9
Broken conglomerate	11	6	643	3
Conglomerate and sandy shale	6	6	649	9
Granitic conglomerate	3	8	653	5
Fine-grained granitic conglomerate	1	10	655	3
Coarse sandstone and granitic cement	29	11	685	2
Granitic cement	32	10	718	0

Llandaff Bore No. 3.

No. 3 bore is 70 chains north-west from No. 2, on the boundary between Lot 410B and Lot 369, about 1 mile north of the north boundary of Llandaff township, and 380 feet above sea-level (350 feet above the road).

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Surface soil	12	0	12	0
Boulders of diabase (greenstone)	13	0	25	0
Loose ironstone detritus	15	6	40	6
Shale detritus and loose stones	15	6	56	0
Dark and blue shale, with veins of coal	6	0	62	0
Broken blue shale	4	6	66	6
Blue and dark clayey shale	5	6	72	0
Shale, with small veins of coal	9	0	81	0
Coal and bands.	0	8	81	8
Blue and dark shale	16	6	98	2
Sandstone	2	6	100	8
Dark-brown and blue shale	14	6	115	2
Blue clayey shale	11	10	127	0
Sandstone	2	10	129	10
Clayey shale	20	2	150	0
Grey sandstone	3	0	153	0
Dark shale	0	4	153	4
Coal	0	8	154	0
Dark and blue clayey shale	9	6	163	6

Llandaff Bore No. 3—continued.

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Dark and blue broken shale, with small veins of coal	34	6	198	0
Sandstone	2	0	200	0
Sandstone, with coal-markings	27	0	227	0
Dark and blue shale, with small veins of coal	4	0	231	0
Blue and dark shale	4	2	235	2
Coal and bands.	1	3	236	5
Sandstone, with coal-markings	48	1	284	6
Shale and sandstone	2	6	287	0
Sandstone, with coal-markings	37	8	324	8
Limestone and shale	0	4	325	0
Sandstone, with coal-markings	24	0	349	0
Dark shale, with coal veins	0	9	349	9
Sandstone	8	3	358	0
Sandstone, with coal-markings	81	0	439	0
Sandstone and shale, with coal-markings	11	0	450	0
Sandstone, with coal-markings	82	6	532	6
Blue and dark shale	7	0	539	6
Coal	0	8	540	2
Shale, with seams of coal	3	6	543	8
Coal	0	6	544	2
Band	0	4	544	6
Coal	1	0	545	6
Band	0	6	546	0
Coal	0	9	546	9
Shale and sandstone	3	3	550	0
Dark and blue broken shale	13	0	563	0
Dark shale	1	6	564	6
Rotten shale	8	0	572	6
Broken shale and sandstone	16	6	589	0
Dark and blue broken shale	12	0	601	0
Broken shale and sandstone	10	0	611	0
Broken sandstone	11	0	622	0
Green sandstone	29	0	651	0
Sandstone and shale, with coal-markings	27	6	678	6
Broken sandstone and shale, with coal-markings	9	6	688	0
Shale and sandstone	25	0	713	0
Hard white sandstone	11	0	724	0
Sandstone	2	0	726	0
Fine-grained granite	11	0	737	0
Granite	14	0	751	0

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

In the Steep Creek area are to be found two separate occurrences of diabase.

Diabase is found to occur as the summit of the whole of the mountain range flanking the area on the north and west, and there can be little doubt as to the transgressive nature of this mass. The varying altitude at which the diabase-Trias-Jura contact is observed, coupled with the presence, over extensive areas, of baked sedimentaries, indicates the transgressive nature of the diabase. There is a possibility that a small area of diabase situated immediately to the north of the Mt. John section will be shown to be a sill, but the extent is so small that it can have no bearing on the area as a whole. A saddle occurs between this mass and the main range through which the Trias-Jura can be traced continuously. The altitude at which the contact of this mass with the surrounding sandstones is observed is more variable than would be expected for a sill. It is probable, therefore, that this body is an extension of the main mass of diabase forming the range.

In the plain country, particularly to the east of the main-road, a second occurrence of diabase was observed. The outcrops of this mass are in places surrounded by the Trias-Jura grits, whilst in other places a thin layer of grits still covers the diabase. It was at first thought that this mass occurred as a sill between the Permo-Carboniferous and Trias-Jura formations. The occurrence of a continuous succession from Permo-Carboniferous shales to Trias-Jura sandstones in Pike's Creek disproves this belief. That this second mass of diabase is also transgressive is evidenced by the fact that the outcrops can be traced almost continuously to their junction with the diabase ranges further to the east.

The diabase of the Steep Creek area is, therefore, in all cases transgressive with respect to the sedimentary rocks of the area.

(4)—Structure.

(*a*) *Faults.*—The Douglas River and Foster's Faults intersect at the northern boundary of the Steep Creek area. From this point two faults, roughly parallel to each other, pass in a general south-westerly direction through the township of Llandaff. They have been called the Llandaff East Fault and the Llandaff West Fault.

The Llandaff East Fault was located from surface observations and confirmed by bore records. Towards the western boundary of Llandaff a bore (No. 2) was put down to a depth of 718 feet, and bottomed on the basal grits of the Trias-Jura system. These grits are also found to outcrop at the Main road in Llandaff, so that between the two positions a fault, with a throw of at least 650 feet to the west, must occur.

From the bottom of bore No. 2 the Trias-Jura measures are apparently continuous to the mountain slopes, where they are found at an altitude of 800 feet above the sea. This would indicate a thickness greater than 1500 feet for the Trias-Jura sedimentaries. This thickness is much in excess of that ruling generally throughout the area.

The number of coal seams located and proven by this bore are together greater than is generally found. A second fault has therefore been assumed to account for these irregularities. This has been called the Llandaff West Fault.

From the south of the area a fault passes in a south-easterly direction to cross Moulting Lagoon, and to pass to the south of Mt. Paul. This has been called the Mt. Paul Fault.

There is no further evidence of faulting in the area.

(*b*) *Dip of Coal Seams.*—The dip of the coal seams throughout the Steep Creek area is at a low angle, not exceeding 4°, in a general southerly direction. One or two observations of dips approaching 10° were noted, but in each case the position was in close proximity to a fault to which the greater dip could be attributed.

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

Reference to W. H. Twelvetrees' report of 1901 (page 14) shows that eight seams were located by him in the Steep Creek area. Outcrops at a much lower altitude have also been located, but repetition of seams has occurred as the result of faulting.

Though the upper outcrops have not been located over all the area, their presence in at least part of the area has been assumed, as the result of correlation. In the central portion of the area the Trias-Jura strata have been weathered to a greater extent than has been the case in the north. In the latter locality, therefore, some of the upper seams most probably exist, but to the south they probably have been denuded.

Of the various seams present only one has been opened sufficiently to give any idea of its quality.

This seam has been opened up by two short tunnels, and coal has been taken as bulk samples for testing. It occurs in Steep Creek, at an altitude of 530 feet above the sea, and has the following cross section from top to bottom:—

11 inches	smudge.
13 inches	shale.
8 inches	coal.
1 inch	white band.
$5\frac{1}{2}$ inches	coal.
2 inches	black band.
$4\frac{1}{2}$ inches	coal.
12 inches	shale.
Sandstone.	

This seam, though thin, shows a fair agreement in section with the upper portion of the main Douglas River seam, and has therefore been assumed to be the Delta seam.

A continuation of this seam into Pike's Creek was located at an altitude of 350 feet, a few chains to the south-east of bore No. 3. The section of the seam at this locality is as follows:—

Sandstone roof.	
12 inches	coal.
2 inches	white band.
9 inches	coal.
1 inch	white band.
1 inch	coal.
3 inches	blackstone band.
9 to 12 inches	coal.
Shale floor.	

A short tunnel has been driven on the seam at this point. A small fault was met after driving only a few feet. The difference in altitude is accounted for chiefly by the dip of the seam, but small faults will probably also be found to occur.

In Steep Creek a second seam has been opened sufficiently to enable the section to be measured. The seam occurs at an altitude of 170 feet, and the section is as follows:—

$8\frac{1}{2}$ inches	coal.
1 inch	white band.
$7\frac{1}{2}$ inches	coal.
1 inch	white band.
12 inches	coal.
2 inches	white band.
5 inches	coal.

The tunnel has not been driven sufficiently to warrant sampling, the coal still being soft and friable due to weathering.

At an altitude of 590 feet in Steep Creek there is a big outcrop of sandstones, shale, and coal. The layers of coal are in no part thick enough to warrant development work being done.

At an altitude of 450 feet in a gully to the south of Steep Creek a seam of poor-quality coal 2 ft. 6 in. thick was observed.

At an altitude of 400 feet above the sea, in Pike's Creek, a 3-ft. smudge was observed. No development work has so far been done, and a section of the seam is not available.

Other outcrops have been observed, but for the most part these can be accounted for by repetition, due to faulting.

F.—*The Mining Properties.*

Mt. John Coal Mining Company.

(*a*) *Number and Area of Leases.*—Only one lease of 100 acres is at present held in the Steep Creek area. This lease, No. 7165, is in the name of J. H. Edwards, and is situated about 2 miles north of Llandaff.

(*b*) *Extent and Method of Mining Operations.*—The mining operations in this area have not so far advanced past the prospecting stage. A few short prospecting tunnels have been driven.

(*c*) *The Quality of Coal.*—The quality of the coal from this area is indicated in the table of analyses (page 29) by the registered number 416. This analysis reveals a higher percentage of ash than is usual for the East Coast coals, but in a general manner the quality does not differ from that of the coals of other areas.

(*d*) *Production.*—The only coal produced from this area has been a few samples reported to have been used on the railway and steamers for testing purposes. No records of the tests are, however, available.

(*e*) *Quantity of Coal Available.*—In calculating the coal reserves in this area two seams only can be taken into consideration at present. These show a total thickness of 4 feet 6 inches, and in the 100-acre area of the property give a coal reserve of 500,000 tons.

G.—*Unleased Coal-Bearing Land.*

(1)—The Total Area.

The total area of unleased coal-bearing land in the Steep Creek area is, approximately, 400 acres, in which the Mt. John lease is more or less centrally situated.

(2)—Number of Seams.

The same seams have been shown to exist on the unleased land as have already been discussed for the leased land.

(3)—Quality of Coal.

The quality of the coal on the unleased land must be assumed to be the same as for the coal on the leased land.

(4)—Quantity of Coal Available.

Taking into consideration the two seams definitely known in the district, having a thickness of 4 ft. 6 in., a coal reserve of 2,000,000 tons will be available in the 400 acres of unleased land.

(6)—Mt. Paul Area.

A.—*Location and Extent.*

Situated at the northern end of Freycinet Peninsula, about 1½ miles to the east of Moulting Lagoon, the peak of Mt. Paul occurs rising to a height of 1800 feet above the sea.

On the flanks of this mountain peak, Trias-Jura sandstones occur, and it is in this belt that the coal seams of the area are found. The limits of the area have not yet been definitely proved, but it is certain that for at least 1 mile the various seams extend in a north and south direction. That the area may extend as far northwards as Mt. Peter is probable, although up to the present time only one very poor outcrop has been located there.

The Mt. Paul area comprises the land between Moulting Lagoon on the west, and the sea-coast on the east, and extends in a north to south direction from the northern slopes of Mt. Peter to the southern slopes of Mt. Paul. The actual coal-bearing portion is a comparatively narrow strip situated centrally in the area.

B.—*Access.*

At the present time this area is inaccessible to all except foot traffic. No roads have been constucted, nor have any other means of transit been made available. About 3 miles south of this area an ideal port is available at Coles Bay, but as no railway has yet been constructed to the port, nor shipping facilities provided, the port, so far, has not been available to the holders of the mining properties in the district. The Mt. Paul area could, however, be made readily accessible by the construction of a short line to Coles Bay, but the proposed East Coast railway, if built, would pass close by the western boundary, and would serve all the requirements of the Mt. Paul properties. It may be found necessary to construct a short line into the Mt. Paul workings, but its length would not be greater than 1 mile.

C.—*Previous Reports.*

A short report on the tin ore at Schouten Main, by the late W. H. Twelvetrees, accompanies his report on the Llandaff and Denison coalfields, published in 1901. No previous reports have, however, been placed on record regarding the coal-bearing area in the vicinity of Mt. Paul.

D.—*Topography.*

(1)—General Description.

The western portion of the area is comparatively flat. The strata outcropping on the flats are for the most part Permo-Carboniferous limestones or Trias-Jura grits. On the western extremity of the area the diabase is met on the banks of Moulting Lagoon. To the south-west granite is found to outcrop to the east of the diabase, whilst still further east Cambro-Ordovician slates are found as a narrow belt between the granites and the Trias-Jura strata.

On this flat country practically the whole of the Trias-Jura strata have been denuded. A comparatively small thickness of the basal grits are found to occur on the many small ridges of the area, whilst in the intervening gullies the Permo-Carboniferous limestones are found to outcrop.

About a mile to the east of Moulting Lagoon the foothills of Mts. Paul and Peter are met. These mountains form a comparatively short and narrow ridge, rising quickly to a height of 1600 feet above the sea, the last 400 feet at least being composed of a diabase capping. The eastern slope of the mountain falls abruptly through Trias-Jura sandstones till the Permo-Carboniferous limestones are met, but further to the east the limestones are again found to outcrop at an altitude much above the base of the Trias-Jura grits. A fault is present, and along its course a stream has worn a deep and narrow valley in a general axial direction.

Between the two mountain peaks a saddle occurs, comparable with the saddles occurring in the Mt. Nicholas Range. No diabase is to be seen in this saddle, and its absence tends to show that it occurs on the mountain peaks as the remnants of a sill, and not as a transgresive mass. There is a possibility of a fault crossing the range through this saddle, but up to the present it has not been located.

The whole area is characterised by the absence of notable drainage channels. The comparatively few creeks that do occur are small, and for the most part are continually dry.

(2)—Relation to Mining.

As in the greater number of the previous areas the coal in the Mt. Paul area is so situated as to be won by mining on the adit system. The chief outcrops of the area are situated at an altitude of about 300 feet above the general level of the country, and a tunnel has already been driven on the main seam.

The proximity of faulting has caused a local dip of 4° in a northerly direction.

E.—*Geology*.

(1)—Geological Map.

The geological sketch map of the Mt. Paul area is included on the general sketch map of the Seymour-Douglas-Denison-Mt. Paul Coalfield, and is represented on the south-eastern corner of the map. It has been compiled from the mineral charts of Llandaff and Coles Bay, together with the land chart, Glamorgan No. 2.

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

The western, southern, and eastern boundaries of the Mt. Paul area are characterised by the presence of granites, which form the coast-line of practically the whole of Freycinet Peninsula, and extend westward along almost the whole of the northern shore of Coles Bay. Centrally situated with regard to the granites, the Trias-Jura and Permo-Carboniferous strata occur as a roughly triangular mass, the apex of which is towards the south.

Over the eastern portion of the area, where Permo-Carboniferous strata are met, only the uppermost limestone horizon is to be seen. The Trias-Jura grits are prominent over a wide extent of country immediately to the north-west of Mt. Paul. These grits occur as cappings to a number of low ridges, in the hollows between which the Permo-Carboniferous limestones are found to outcrop. To the northward these grits are absent, and Permo-Carboniferous limestones are prominent, but further to the north the grits are again to be seen. There is probability of a fault existing here.

No measurement of the Permo-Carboniferous strata could be made on the western fall of the mountain, but on the eastern fall, where the Trias-Jura strata have been faulted below the Permo-Carboniferous, a creek has worn its channel along the fault-line to reveal the presence of at least 150 feet thickness of Permo-Carboniferous limestones. Conformably above the limestones the normal Trias-Jura section is met. The upper limits of this series were not examined, but the Lower or Ross sandstones and the Felspathic sandstones were both found to occur.

The summits of the two mountain peaks are each composed of diabase.

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

The importance of the Mt. Paul area as a coalfield is dependent directly on the mode of occurrence of the diabase

The area is bounded by the positions of two major faults, outside of which there is no possibility of the occurrence of coal. In the trough between the faults the Trias-Jura coal-bearing strata occur. The average distance between the faults throughout the area is from $1\frac{1}{2}$ to 2 miles, of which distance at least half a mile has no representatives of the Felspathic or coal-bearing sandstones. The diabase of Mt. Paul is situated centrally with respect to the probable coal-bearing area. It is therefore evident that were the diabase a transgressive mass the value of the field would be seriously affected, for the coal would then occur only as a narrow belt round the margin of the diabase. From the data at present available it would seem that the diabase at Mt. Paul and Mt. Peter is not transgressive, but has been intruded as a sill. The distance between the two mountain peaks is, approximately, 1½ miles. A saddle occurs between the two peaks in which diabase does not occur. This saddle in every respect is similar to the saddles found to occur at Mt. Nicholas, where the diabase has been shown to be a sill. The dip of the strata at Mt. Paul has not been affected by the diabase, the northerly dip being accounted for by the presence of faulting.

Though the evidence at hand is far from being conclusive, still there is no evidence to show that the diabase is transgressive. The evidence generally tends to show that the diabase is a sill capping the Trias-Jura, and under which the coal will be expected to occur.

(4)—Structure.

(*a*) *Faults.*—The limits of the Mt. Paul coalfield are defined by the presence of two axial faults, to which is due the roughly triangular shape of the Trias-Jura outcrop to the south of Mt. Paul. The continuation of the Douglas River Fault is found to cross Moulting Lagoon at a position westward of Mt Peter, and has a direction of about 10° east of south. This fault passes just outside the south-western corner of the coal lease at Mt. Paul, and has a throw to the east of, approximately, 250 feet.

The continuation of the Cornwall Fault is also to be found in the vicinity of Mt. Paul. This fault intersects the Douglas River Fault at a position a little east of south of Mt. Paul. Its direction, from the point of intersection, is, approximately, due north, and passes along the eastern foothills of Mts. Paul and Peter, and continues northward through the township of Bicheno. This fault has a throw of, approximately, 500 feet.

The altitudes at which the various seams have been located would indicate the possibility of a fault of some magnitude occurring between the mountain and the more western major faults. The four outcrops at present known can be correlated fairly well with the four upper seams (Alpha, Beta, Gamma, and Delta) of the series. The four lower seams are at present missing, and with the grits occurring at an altitude of, approximately, 200 feet below the main seam, it would appear that the four lower seams have been faulted below the level of these grits. This necessitates the assumption of a fault with a throw of 250 feet towards the east existing between the Douglas River Fault and the mountain.

The Trias-Jura strata have therefore reached their present position as the result of trough-faulting of, approximately, 500 feet magnitude.

No other major faults were located in this area during these investigations. One minor fault was seen close to the present tunnel at Mt. Paul. The throw of this fault is at least 15 feet.

No other minor faults were noticed, but it is to be expected that the small faults common to all East Coast coal mines will be met as work proceeds in this area.

(*b*) *Dip of Coal Seams.*—The dip of the coal seams of the Mt. Paul area is found to be in the opposite direction to that ruling in all previous areas. The Mt. Paul seam dips towards the north at an angle of 40°. This dip may be attributed to the proximity of major faults.

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

Only one seam has been opened sufficiently to enable definite conclusions to be drawn as regards the thickness and general nature of the seam.

This seam occurs at an altitude of 420 feet above the sea, and can be correlated definitely with the seam occurring at the Dalmayne main tunnel. The Mt. Paul tunnel has therefore been driven on the Delta seam, and it should be expected that four lower seams would be found to occur. No seams at lower altitudes could, however, be located, and it has therefore been assumed that additional faulting has occurred to the eastward of the main fault, and these lower seams may yet be proven by boring on the flanks of the mountain.

Other outcrops have been located at altitudes of 470 feet and 600 feet. These latter outcrops have not so far been opened up, and definite conclusions as regards thickness and quality of seam cannot be formed.

F.—*The Mining Properties.*

Mount Paul Coal Mining Syndicate.

(*a*) *Number and Area of Leases.*—The Mount Paul Coal Mining Syndicate is at present operating on one lease—a reward claim of 240 acres, situated on the southern and western flank of Mt. Paul. This lease is the only one at present held in the Mt. Paul area.

(*b*) *Extent and Method of Mining Operations.*—The syndicate has driven a dip tunnel on their main seam for a distance of, approximately, 460 feet. The tunnel is driven in a northerly direction, and is falling with an average grade of 1 in 15.

This tunnel is the only developmental work carried out so far in the area, and it has not yet been indicated which method of mining will ultimately be adopted. The nature of the seam is such, however, as to lend itself more advantageously to mining by the Bord and Pillar method of mining.

(*c*) *Quality of Coal.*—The seam, as revealed by the tunnel at Mt. Paul, shows the following section from roof to floor:—

Sandstone roof.	
6 inches	stony coal.
2½ inches	bright coal.
½-inch	blackstone band.
8 inches	bright coal.
4 inches	dull coal.
½-inch	blackstone band.
¼-inch	coal.
½-inch	blackstone band.
10 inches	coal, with one penny band.
¼-inch	blackstone band.
6½ inches	coal, with one penny band.
5½ inches	bright coal.
¼-inch	band.
20 inches	poor coal.
½-inch	band.
12¼ inches	coal.
6 inches	shale band.
32 inches	coal.
Shale floor.	

The above section shows a total thickness of 9 ft. 7¼ in. From the number of small bands occurring in the seam it is to be expected that the coal produced will, like the coal from previous areas, contain a high percentage of ash. The seam is identical with that already opened up by the workings of the Dalmayne Colliery, and the quality cannot be expected to differ to any great extent from that of the coal from those workings.

Analyses are represented by the registered numbers 745, 746, page 30.

(*d*) *Production.*—The only coal produced from these workings up to the present time has been a few bulk samples for testing purposes by the various people who from time to time have contemplated purchase.

(*e*) *Quantity of Coal Available.*—In calculating the coal reserves of this area it is only possible at present to include one seam, and of this seam, after bands have been excluded, only 6 feet can be taken as being available. The area over which this seam extends is, approximately, 1 square mile. This gives a reserve of 4,700,000 tons.

There are other coal seams which will add to this reserve as they are developed.

(7)—Fosbrook Area.

A.—*Location and Extent.*

To the south of, and adjoining, the Steep Creek area a belt of coal-bearing land extends as far south as Coombend. At the northern extremity of the area is situated the farmstead property of Mr. A. C. Fosbrook, close to which is situated the only mining lease of the area. The area is situated on the western side of the main-road from Bicheno to Swansea, and extends from the township of Llandaff in a south-westerly direction to Coombend, a distance of about 3 miles. The main range marks the western boundary of the area, which in all covers some 6 square miles.

B.—*Access.*

The main-road from Bicheno to Swansea passes along the eastern boundary of Fosbrook area, and is at the present time the only means of gaining access to the area. With the construction of the East Coast Railway the northern portion of Fosbrook area could be made accessible by the construction of a short branch line of about 1 mile in length. To connect the southern portion of the area with the railway would mean the construction of a much longer branch line, and it is doubtful whether this portion of the area would ever be sufficiently productive to warrant such expenditure.

C.—*Previous Reports.*

No previous reports on this area have been prepared.

D.—*Topography.*

(1)—General Description.

A narrow belt of flat country exists immediately to the west of the main-road, and from the margin of this plain the Main Range rises rapidly to a height in places reaching 1200 feet above the sea. The southern portion of the range has a lower altitude than the north, and reaches only an altitude of about 800 feet above the sea. The crown of the range is in every case composed of diabase, and the Trias-Jura sandstones form the mountain slopes. This area, like the Steep Creek area, is characterised by a number of fairly steep ridges, running from the Main Range towards the plain country. The drainage of the Fosbrook area is effected by a number of creeks flowing through the centre of the area into the Apsley River. The drainage of the mountainous country is effected by a stream flowing southerly through a steep and narrow gorge into the Swan River. A narrow divide exists between the sources of the creeks and the south-flowing stream.

The main outcrops of coal have been located at various altitudes on the mountain slopes, chiefly in the beds of the creeks.

(2)—Relation to Mining.

The chief difficulties to be overcome in the mining of the coal in this area will be the transportation of the coal from the mines to the plain country. The steep ridges common in the area will necessitate the construction of fairly long and expensive tramways.

The positions at which the seams have been located, coupled with the low angle of dip prevailing in the area will enable the adit system of mining to be adopted in every case.

E.—*Geology.*

(1)—Geological Map.

The geological sketch map of this area is included in the general geological sketch map of the Seymour-Douglas River-Denison River-Mt. Paul Coalfield.

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

The Permo-Carboniferous strata are not in evidence in this area at all. The Trias-Jura sandstones occurring on the plain country rise to form the mountain slopes, and have a maximum thickness of, approximately, 800 feet. Towards the south of the area a smaller thickness of sandstone is visible, but in no place is the basal stratum visible. An accurate measure of the thickness of the sandstones is therefore impossible. The Felspathic sandstones are the only ones in evidence, and it is probable that faulting has occurred to cause a repetition of strata. The diabase throughout the area forms the summit of the range.

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

At Coombend diabase is met *in situ* at an altitude of, approximately, 450 feet above the sea. To the south of this point the diabase extends as an almost unbroken mass for a distance of 10 miles. A small area of Trias-Jura sandstones was observed at Cranbrook.

To the westward of the area the diabase extends in an unbroken mass as far as these investigations were carried.

South-west of Fosbrook's farmhouse a narrow ridge is seen, which acts as a divide between streams flowing eastwards and streams flowing in a southerly direction. On the eastern flank of this ridge the Trias-Jura sediments are to be found at an altitude of 200 feet above the bed of the stream to the west of the ridge. This stream is a deep and narrow gorge over 250 feet in depth, and the channel has been worn in massive diabase. In the Mt. John section, at the head of the main creek, diabase was met *in situ* at an altitude of 570 feet. The banks of the creek at this point were composed of sandstone, which could be traced to an altitude of 740 feet. A coal seam was located at an altitude of 690 feet.

From the above data there can be no doubt of the transgressive nature of the diabase mass of this area.

(4)—Structure.

(*a*) *Faults.*—No faults have so far been definitely located in Fosbrook area. The major faults, located at Llandaff, will probably continue into the Fosbrook area, and account for the abnormal thicknesses of Felspathic sandstones found.

(*b*) *Dip of Coal Seams.*—Except where the variation may be accounted for by proximity of diabase, the various coal seams of Fosbrook area are found to dip in a southerly direction at a low angle.

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

Five outcrops have been located in Fosbrook area, and although the area is still in an undeveloped state, three of the outcrops have been opened up to enable measurements of the seams to be made.

At an altitude of 380 feet above the sea, in the main creek passing through the Mt. John section, a small seam was seen to occur at the foot of a small sandstone cliff. The section of this seam is as follows:—

15 inches	coal.
2 inches	white band.
5 inches	coal.
6 inches	blackstone band.
8 inches	coal.
12 inches	shale.
1 inch	coal.
Shale floor.	

This section agrees fairly well with the section of the upper portion of the main seam in the Douglas River area. It also agrees with the seam in Pike Creek, in the Steep Creek area, and is therefore the Delta seam.

At an altitude of 550 feet above the sea a second seam is exposed. The section from roof to floor is as follows:—

Sandstone roof.	
7 inches	bright coal.
3 inches	black shale.
2 inches	white band.
4 inches	coal.
14 inches	carbonaceous shale.
4 inches	hard blackstone band.

This seam is identical with the Douglas River 5-ft seam, and is therefore the Gamma seam. The above measurements were made on a weathered outcrop, and the true nature of the seam could not be determined from the appearance of this outcrop.

At an altitude of 690 feet above the sea another seam has been exposed as the result of a landslip. The outcrop is situated high in the left bank of the main creek passing through the lease, and is only a very short distance removed from the Trias-Jura-diabase contact. The diabase is found to outcrop also in the creek bed at an altitude of 580 feet above the sea.

The section of this seam from top to bottom is as follows:—

15 inches	coal (poor).
1 inch	white band.
2 inches	blackstone band.
6 inches	white band.
12 inches	poor coal.
4 inches	white band.
1 inch	blackstone band.
$\frac{1}{4}$-inch	white band.
6 inches	blackstone band.
3 inches	clay.
5 inches	blackstone band.
3 inches	clay.
11 inches	coal.
4 inches	white band.
3 inches	dark shale.
2 inches	white band.
12 inches	coal.
$1\frac{1}{2}$ inch	band.
Coal; thickness indefinite.	

This outcrop has a thickness over all of 7 feet 6 inches, but the number of bands is so great that the seam is more or less valueless.

Two other outcrops were located in this area at altitudes of 480 feet and 520 feet above the sea. These outcrops have not, so far, been opened up, and no measurements are available.

F.—*The Mining Properties.*

(1)—The Mount John Mining Company.

(*a*) *Number and Area of Leases.*—The Mt. John Company at the present time are the holders of one lease of 100 acres in the Fosbrook area. This lease (7180) is in the name of J. H. Edwards, and is situated about half a mile to the north-west of the township of Llandaff.

(*b*) *Extent and Method of Mining Operations.*—Mining operations in this area have so far only resulted in a few short open cuts and tunnels being driven to prove the seams in the various outcrops.

(*c*) *Quality of Coal.*—Work had not progressed sufficiently on any seam of the area to enable a representative sample to be taken. No analyses can therefore be given. The coal from the two upper seams measured is poor in appearance, and the number of bands visible in the seams would make these seams difficult to work.

The coal in the lower seam is better in quality than is the case with the top seams, but the seam is thin, and would be difficult to work.

(*d*) *Production.*—No coal has so far been produced from Fosbrook area.

(*e*) *Quantity of Coal Available.*—The only seam which it is justifiable to include in the calculation of the coal reserve is one which would yield 20 inches of coal. This is known to occur over an area of 60 acres belonging to this company, giving a coal reserve of 120,000 tons.

G.—*Unleased Coal-bearing Area.*

The unleased coal-bearing area extends as a narrow strip of land along the range from Fosbrook's to Coombend. It would be difficult to state the exact area which would be coal-bearing. With seams of thickness and quality, as indicated on the Mt. John lease, the amount of coal in reserve in the area would be small. With the data at present available no attempt has been made to calculate the quantity of coal available in the unleased area.

Chapter III.

SWANSEA - SCHOUTEN ISLAND COALFIELD.

(1)—Swansea Area.

The area included in the map of the Swansea-Schouten Island Coalfield, which occurs on the mainland, contains no coal whatever.

(2)—Schouten Island Area.

A.—*Location and Extent.*

Schouten Island comprises 16 square miles, situated at the southren extremity of Freycinet Peninsula, and about 13 miles in a south-easterly direction from the township of Swansea. The coal seams known to exist on the island occur at or near sea-level, and the chief outcrops at present visible are in close proximity to the anchorage.

B.—*Access.*

A comparatively safe anchorage exists on the northern end of the island, in which ships of shallow draft shelter from the weather. This is the only good anchorage on the island, and by its means access to the island is gained. In practically all weathers, except from the north-west, the anchorage is comparatively calm. A jetty was at one time built in conjunction with the coal-mining industry of the island. This jetty has since been destroyed, but it was reported that small boats could load at it in all weathers. No regular service exists to the island, the only means of making a landing being by means of boats hired from Swansea or Triabunna.

C.—*Previous Reports.*

In 1848 Joseph Milligan reported on the island and its possibilities as a coal-field. In his report (13) Milligan gives a description of the workings that existed at that time. Two seams are reported, one of which has a thickness of over 6 feet.

D.—*Topography.*

(1)—General Description.

The eastern portion of Schouten Island is characterised by fairly high hills of granite. The granite area extends as far west as the anchorage, where it gives way to diabase; whilst on the extreme north the granite gives way to sandstones. There can be no doubt of the existence of an axial fault crossing the island. The western portion of the island is not so rugged as the eastern, the country for the most part being more heavily timbered, and rising to the hills in a series of fairly gentle undulations. On the northern shore the sandstones are found to extend, from the position of the granite, westward along the whole of the coast, except for a short distance, where a northern extension of the diabase has intruded the sandstones, and is now forming the coastline.

The whole of the eastern and south-eastern coastline of the island is composed of sandstones rising gently towards the south, the coast in all cases being bounded by cliff faces, increasing in height as the southern extremity of the island is reached.

(13) Papers and Proceedings of Royal Society, Van Dieman's Land. Vol. I., Part I, 1849.

(2)—Relation to Mining.

The chief outcrops located on the island have all been found at or near sea-level, on the northern extremity of the island. As the general dip appears to be towards the north, the easiest method of winning the coal from this area would be by tunnels driven into the seam from the positions where they have at present been located.

E.—*Geology*.

(1)—Geological Map.

The geological map of the Schouten Island Area is included on the general sketch map of the Swansea-Schouten Island Coalfield. The approximate positions of the various workings have been marked.

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

The Permo-Carboniferous strata are not in evidence on Schouten Island. On the east of the island the granites are found from the coastline to the summits of the hills. The central portion of the island is composed of diabase, whilst the western, southern, and northern shores are composed of sandstones of Trias-Jura age.

The sandstones of the west coast are the Lower or Ross sandstones, and those of the north coast are the Felspathic sandstones, in which the coal seams are found to occur. The sandstones for the most part are dipping towards the north, and on the northern end of the island the dip is fairly great, indicating the probability of a fault of some magnitude.

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

There can be no doubt of the dyke-like nature of the diabase on Schouten Island. On the northern shore there is an intrusion of diabase which can be seen to have definitely passed upwards through the sandstones. Though an examination of the whole island was not undertaken, and no definite evidence regarding the diabase has been gathered, still, the northern portion of diabase is of such magnitude as to be regarded more as an extension of a huge transgressive mass than as a dyke. The main mass has therefore been assumed to be similar to its northern extension

(4)—Structure.

(*a*) *Faults.*—At least one axial major fault exists on Schouten Island. This fault is indicated by the contact between granite on the one hand and diabase and Trias-Jura sandstones on the other. This fault line roughly divides the island into two equal portions.

A second fault exists on the northern end of the island. In direction this fault would be approximately from N.E. to S.W.

Minor faults have not been located in number. One small fault was seen at an outcrop of coal on the beach, in the vicinity of the shaft put down by Bernacchi, at the north-western extremity of the island

(*b*) *Dip of Coal Seams.*—The dip of the various outcrops found on Schouten Island is by no means constant. Dips ranging up to 30° towards the north were recorded. These high angles of dip lead to the assumption of a fault being present, though in one or two places the intrusive diabase is responsible for the high angle at which the beds are lying.

On the western shore, towards the central portion of the island, and further south, the beds appear to be dipping gently towards the north.

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

Three outcrops only were observed during these investigations, none of which show coal of quality worthy of exploitation. These outcrops appeared to the west of the diabase intrusion at the coast, and occur under such conditions of dip that the continuation of the seam from the coast inland would reappear at the surface in a very short distance. The area, therefore, over which these seams extend is too small to be worthy of consideration.

Most of the work done on Schouten Island was carried out previous to the examination in 1848, by Joseph Milligan. This work has been done in the Trias-Jura strata, close to the anchorage. Two short tunnels and two shafts have been sunk on this land all of which at the present time have collapsed, and entrance is impossible. Mr. Milligan, on his visit, was able to enter the tunnels, and states:

> "The lower seam . . . . measures 6 to $6\frac{1}{2}$ feet throughout.(14) The old workings are of the following nature:—
>
> One main drift a little above high-water mark, and nearly 6 feet by 6 feet, has been carried in the direction (S.S.W. and W.S.W.) or range of the seam more than 100 yards.
>
> From this two branch galleries have been worked towards the crop so as to communicate round a massive square pillar.
>
> A narrow air course had been carried thence to the surface of the bank.
>
> The drift ended abruptly, and apparently in massive clay." (15)

The original drive put in evidently finished up at a fault, the magnitude of which is not known. No records are to be found as to the quantity or quality of the coal produced from these old workings. A tramway was constructed along the coast, a distance of about 3 miles, to a jetty, where coal was loaded. It was reported that this jetty was in water sufficiently deep for a boat of 12 feet draught to berth alongside.

F.—*The Mining Properties.*

(1)—Number and Area of Leases.

Two leases—one of 320 acres, the other of 420 acres—have been applied for by A. L. Luttrell, on the north-western portion of Schouten Island. No leases are, however, in actual existence at the present time.

(2)—Extent and Method of Mining Operations.

Except for the old workings mentioned previously there are no works other than one prospecting shaft put down by Bernacchi.

(3)—Quality of Coal.

None of the seams are sufficently exposed to give an opportunity to sample properly. The outcrops, however, appear of very poor quality, and it cannot be expected that the quality of the seams here will approach in quality the average of the East Coast coals.

(4)—Production.

No coal is being produced at the present time from Schouten Island. The old workings have all fallen in, whilst only prospecting shafts are at present being sunk.

(14) Proc. of Royal Society, Van Dieman's Land, 1849. Vol. I., Part I., page 5.

(15) Proc. of Royal Society, Van Dieman's Land, 1849. Vol. I., Part I., pages 8 and 9.

(5)—Quantity of Coal Available.

The quantity of coal available on the eastern shore of the island will be very small. No attempt has been made to calculate the amount which, at a maximum, would not exceed 10,000 tons. A narrow belt of Felspathic sandstones exists along the shore-line. These are tilted at the high angle of about 23° towards the coast. This high angle of dip is indicative of either a fault or the intrusion of the diabase. The evidence in this case is in favour of the presence of a fault which has a downthrow to the north-west. The sandstones on the lower part of the island are, as far as were examined, the Lower or Ross sandstones, which are not coal-bearing. The possibility of mining coal on a commercial basis from the east coast of the island is remote, for the quantity available would not be sufficient to maintain the working for any great period of time.

A second area exists, adjoining the anchorage, where coal has already been mined. The quantity here is also limited, and as work has already been carried out over an extended period, the quantity now available would be too small to warrant extensive workings.

The area over which coal would be found would, in this place, be, approximately 10 acres.

The seam mined was reported as being 6 feet thick, of which 2 feet 6 inches at the bottom was of good grade. Assuming this thickness to prevail over the whole area, the total quantity of coal available would be 30,000 tons, approximately. From this quantity must be deducted the quantity of coal already mined, of which there is at present no record.

(3)—Other Areas.

The foregoing are the descriptions of the various coalfields where coal has been shown to extend over appreciable areas. Any two other points along the east coast coal outcrops were noted, but in each case the area likely to carry coal is too small to be economically worked, and it is doubtful whether the seams would develop to sufficient thickness to warrant exploitation.

Cranbrook.

At Cranbrook, on the Swan River, a small seam 6 inches thick is seen to outcrop in two places. A dyke of diabase passes between the two positions of outcrop, and the strata have been tilted at a high angle as a result. This dyke is, approximately. 8 feet wide, and runs in a general north-east direction. It cannot be traced past the banks of the river.

Old Man's Rivulet.

The second area where a small showing of coal was seen was at Old Man's Rivulet, about 8 miles south of Swansea. This area would not comprise more than 400 square yards. The seam outcrops on the main-road from Swansea to Hobart, and has the appearance of being about 3 feet thick. The area, however, is too limited in extent to be of any commercial value.

Maria Island.

Coal was also reported to occur on Maria Island, but search failed to reveal its presence. A fault exists running the length of the island. To the east of this fault the Permo-Carboniferous strata exist, while to the west of the fault the main rock in evidence is the diabase, or a small thickness of metamorphosed sandstones. Along the western shore there are a few isolated small areas of Trias-Jura strata, but these all show the intrusive nature of the diabase, and are found tilted at varying angles according to the proximity of the diabase.

Little possibility exists of finding coal on the west coast of Maria Island. No outcrops are visible, and the proximity of diabase would in any case render the quality of the coal too poor to be of use.

Chapter IV.

TRIABUNNA - BUCKLAND COALFIELD.

(1)—Triabunna Area.

A.—*Location and Extent.*

The Triabunna Area is situated at the head of Spring Bay, at a distance of 33 miles south of the township of Swansea, and 56 miles in a north-easterly direction from Hobart. Though the Trias-Jura sandstones are found to occur over a fairly extensive area, it is only in a very limited area immediately round the head of Spring Bay that the possibility exists of finding coal in quantity.

B.—*Access.*

Situated, as it is, on the upper portion of Spring Bay, the Triabunna Area is easily accessible to boats of shallow draught. Boats of lesser draught than 12 feet can at the present time proceed to within 1 mile of the Triabunna township, where facilities for shipping have already been provided by the construction of a small jetty.

The main-road from Swansea to Hobart passes through the township of Triabunna, and it is by this means that access to the area is at the present time gained.

The probable importance of this area as a coalfield is due to its easy accessibility by water, and its proximity to the capital and to Maria Island, where the erection of cement works would give a ready market for the coal which may be won.

C.—*Previous Reports.*

A report on the Spring Bay area appears in the Secretary for Mines report for the year 1890. In this report, A. Montgomery (then Government Geologist), gives a fairly detailed account of the workings as reported to him at that time. At least two seams were reported as having been cut by both bores and shafts.

R. M. Johnston, in his "Geology of Tasmania," refers also to the Triabunna area, and, like Montgomery, gives extracts from a previous report by Selwyn.

D.—*Topography.*

(1)—General Description.

The township of Triabunna is situated on relatively flat land at the head of Spring Bay. On the shores of the bay itself Trias-Jura sandstones are found to outcrop, but for the most part the plain country is composed of recent alluvium covering the Trias-Jura strata to a depth of, approximately, 20 feet. To the north-east, north, and west of the township the country rises gently to form a low range the summit of which is in all cases composed of diabase. These hills rise to an altitude of from 600 to 700 feet above the sea. The sandstones in contact with the diabase are for the most part the Upper sandstones, and are found to occur at practically all altitudes lower than that of the summit of the hills. The Felspathic sandstones occur on the lower slopes of the hills, and are found to outcrop along the shores of the Bay.

To the south of the bay the Lower or Ross sandstones are found to occur over a fairly extensive area, and the metamorphic action of the diabase is evident in many places.

(2)—Relation to Mining.

As the coal seams occur below the general level of the plain it will in all cases be found necessary to mine the coal by shaft mining.

The various seams so far proven, exist at depths of about 200 feet below the plain, and the coal should be easily won from shallow shafts sunk from the plain country.

E.—*Geology*.

(1)—Geological Map.

The geological map of the Triabunna Area is included in the general sketch map of the Triabunna-Buckland Coalfield.

On this map have been marked the approximate positions of the various shafts and bores of the area

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

The Permo-Carboniferous strata are not exposed at any point in the Triabunna area. The Felspathic sandstones of the Trias-Jura series are found outcropping on the shores of Spring Bay, and extending to the foothills of the range surrounding the township. A small thickness of the upper sandstones are found above the Felspathic sandstones and flanking the range. The Lower or Ross sandstones occur to the south and east of the Bay, and extend almost to Orford on the south and to Oakhampton Bay on the east.

The summit of the range surrounding the township is in all cases composed of massive diabase.

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

At Oakhampton Bay definite evidence as to the nature of the diabase mass is to be seen. The overlying Trias-Jura strata have been metamorphosed by the diabase, resulting in places in the formation of quartzite, as the result of the metamorphic action on the basal grits. In places tilting of the sandstones has occurred, and dips as great as 20° have been recorded as a result. From sea-level at Oakhampton Bay the massive diabase is found outcropping at practically all altitudes as great as that of the summit of the range, and the Trias-Jura strata are found to abut against this mass at altitudes as great as 450 feet above the sea.

South of Triabunna the metamorphic action of the diabase is again seen, and at Orford the transgressive nature of the diabase is to be seen in the extension of the range to the sea-coast.

There can be no doubt that the diabase of this area is a transgressive mass, which forms the boundaries of the coalfield at Triabunna.

(4)—Structure.

(*a*) *Faults*.—The nature of the country in the Triabunna area makes it difficult to determine the presence of faulting. Over practically the whole area recent alluvium has been deposited, and the outcrops observed have been insufficient to enable definite conclusions to be formed.

In a previous report by A. Montgomery a fault has been suggested as passing along the estuary at the head of Spring Bay. Montgomery has based his conclusions on the evidence obtained from reports of work that had previously been carried out in the area. No details of this work have been given by Montgomery, and at the present time no details of the workings to the west of the bay are available. This fault has therefore been assumed to exist, and the probability of its existence must be considered should further work in the area be contemplated.

(*b*) *Dip of Coal Seams.*—No definite observations of angles of dip were made in this area. Only a small number of indefinite outcrops were located, and from these it was evident that the seams are dipping in a general northerly direction.

From extracts from Selwyn's report, published by A. Montgomery in 1890, it would appear that a north-westerly dip was recorded in the various shafts sunk in the area.

The angle of dip is in no case great, and varies only slightly from the horizontal.

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

The information concerning the number of seams of coal occurring in the Triabunna area has for the most part been gathered from previous publications. Four outcrops have been noted on the shores of Spring Bay, but these outcrops are representative of only two seams, the outcrops having been observed on both sides of the estuary. The outcrops have been subjected to the agencies of weather to such an extent that no definite conclusions could be drawn as regards quality. The largest outcrop observed in the township of Triabunna appeared to be of very poor-quality coal.

From sections of strata revealed by shafts and bores put down in the area, and described by Montgomery in his report of 1890, it would appear that only one seam of workable thickness occurs in this area.

Montgomery was unable to make an examination of the old workings, and based his conclusions on information gathered from residents of the district, and also on a report published in 1855 by Selwyn. From Montgomery's report the following data, which have been taken from Selwyn's report of 1855, are obtained.

Seven shafts in all have been sunk in the Triabunna area. The positions of these shafts have been marked on the geological sketch map of the area, and the particulars pertaining to them are as follows:—

Shaft A.—Sunk to a depth of 95 feet, and passed through 1 foot of coal at a depth of 80 feet.

Shaft B.—Sunk to a depth of 70 feet, and cut 8 inches of coal at a depth of 53 feet. A bore was then put down from the bottom of the shaft an additional 73 feet, and cut a 5-ft. seam of coal.

Shaft C (Gurney's Shaft).—Sunk to a total depth of 111 feet. At a depth of 32 feet, 8 inches of coal were met. The shaft bottomed on the 5-ft. seam, as cut by the bore at B.

Shaft D.—Sunk to a depth of 100 feet. From the bottom of this shaft a bore was put down an additional 100 feet. No coal was met in either the shaft or the bore.

Shafts F, G, H.—These shafts are all situated on the plain country. Fragments of coal are still to be observed at the surface, but no particulars are available as regards depth of shaft or positions of coal seams. From Montgomery's report it would appear that the coal in these shafts was met at a depth greater than would be normally expected. Montgomery assumed a fault to pass along the estuary to account for the differences in levels.

The following bores have also been put down in the area:—

No. 1 *Bore.*

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Surface soil	1	0	1	0
Dark sandy clay	9	0	10	0
White running sand	1	0	11	0
Sandy clay merging into sandstone	3	0	14	0
Soft sandstone	2	0	16	0
Very firm grey thin shales	3	0	19	0
Sandstone, some of it mottled	15	0	34	0
Firm grey thin shales	1	0	35	0
White, sharp, quartzose sandstone	11	0	46	0
Sandstone, getting firmer	25	8	71	8
Coarse-grained, sharp, quartzose sandstone, varying in colour, hard and soft bars	23	4	95	0
Dark brown sandstone, brittle and firm	5	0	100	0
Light grey sandstone	5	0	105	0
Soft coarse-grained decomposed felspathic sandstone, charged with iron pyrites	8	9	113	9
Yellowish green to greyish greasy soapstone, changing in going downwards to dark greenish rather hard soapstone, and finally into diabase greenstone, of which the soapstone is a decomposition product. Joints at 117′ full of concretionary spherules of carbonate of iron	3	6	117	3
Diabase greenstone, fine-grained and decomposed towards the top, but rapidly getting firmer and also of coarser grain. Zeolites in joints and cavity at 162′ 6″	57	6	174	9
TOTAL	174	9	174	9

Bore commenced 25th February, 1891; finished 20th March, 1891.

No. 2 *Bore.*

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Surface shaft, clay and drift	13	0	13	0
Soft brown sandstone	1	0	14	0
Hard brown sandstone with vertical iron veins	13	0	27	0
Very hard dark shale	1	0	28	0
White shale	0	6	28	6
White brittle sandstone	2	6	31	0
Very hard white shale	1	5	32	5
Hard white sandstone	1	0	33	5
Green sandstone	6	6	39	11
White sandstone	0	4	40	3
Very brittle grey quartzose sandstone with vertical fracture	1	2	41	5
Hard quartzose white sandstone	4	7½	46	0½
Hard bluish-grey compact flinty sandstone or quartzite, with conchoidal fracture	0	8	46	8½
Compact grey sandstone or quartzite with almost vertical joints	1	8½	48	5
Hard greenish sandstone with vertical joints much like diabase greenstone in appearance. Altered felspathic sandstone	27	8½	76	1½
TOTAL	76	1½	76	1½

Bore commenced 1st April, 1891; finished 15th April, 1891.

No. 3 *Bore.*

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Surface shaft, heavy boulder wash	23	6	23	6
Sandstone, with coal stains and fern prints	1	6	25	0
Dark greasy shales	7	6	32	6
Dark and light shales	2	8	35	2
Coarse-grained friable quartzose sandstone, somewhat micaceous, much stained with carbonaceous matter	10	11½	46	1½
Soft grey thin shales	8	4	54	5½
Black carbonaceous mudstone or clod	0	8½	55	2
Hard white flinty quartzose sandstone, approaching to quartzite	0	5	55	7
Coarse grained very friable dark coloured quartzose sandstone	0	2½	55	9½
Black shale or clod	0	6	56	3½
Soft sandstone with minute fossils	1	1	57	4½
Dark sandstone with calcite	1	3	58	7½
Light and dark sandstones	3	6	62	1½
Black carbonaceous mudstone or clod, with a little coal	0	4	62	5½
Light grey soft shale or claystone	3	1½	65	7
Sandstone with coal stains	4	10	70	5
Light blue shale	1	1	71	6
Light grey argillaceous fine-grained sandstone and grey shale	5	0	76	6
Pink shale, iron stained	7	0	83	6
Light sandy shale	5	3½	88	9½
Sandstone	1	3	90	0½
Light blue shale	5	1	95	1½
Light grey shale or fine-grained felspathic sandstone, with calcite interlaminations	6	0	101	1½
Dark firm shale, with calcite veins	4	11	106	0½
Dark blue shale	1	6	107	6½
Very dark shale	0	9	108	3½
Light blue shale	11	0	119	3½
Blue shale or fine-grained felspathic sandstone, with fern impressions	2	0	121	3½
Shale varying in character, partly coal-stained grey thin shales or hard fireclay	1	6	122	9½
Pink shale	6	11	129	8½
Firm sandstone	1	6	131	2½
Pink shale	2	0	133	2½
Sandstone	6	2½	139	5
Brownish felspathic sandstone and shale	3	0	142	5
Conglomerate of sandstone and pink shale	0	10	143	3
Brown shale and grey grit	4	1	147	4
Light bluish grey and pinkish and dark bluish grey arenaceous shale. Impression of *Phyllotheca sp.* at 154 feet	16	8	164	0
Soft sandstone	2	6	166	6
Shales, pink, blue, and sandy	5	0	171	6
Micaceous light grey felspathic sandstone, with coal stains; a few inches of conglomerate in last foot	33	9	205	3
Hard white flinty quartzose sandstone	4	0	209	3
Fine-grained quartzose sandstone, light grey and pinkish, passing into siliceous mudstone, with carbonaceous matter	11	4	220	7
Slightly micaceous fine-grained sandstone and arenaceous shale. Fine print of *Thinnfeldia sp.* at 230 feet, fragmentary prints of *Thinnfeldia* and *Phyllotheca* at 227 feet and 225 feet	14	0	234	7
Arenaceous shales and quartzose sandstones with prints of *Phyllotheca* and *Zeugophyllites*	13	0	247	7
Pink and light blue fine-grained quartzose sandstone and arenaceous shale	34	4	281	11
Pink shales	5	1	287	0
Green quartzose sandstone, light coloured in places	51	10	338	10
Red sandstone, quartzose, and sharp to touch	1	9	340	7
Green sharp quartzose sandstone, with included lumps of mudstone, forming a conglomerate for a few inches at 394′ 6″, getting hard at 419 feet	82	1	422	8
Solid, very dense, aphanite diabase greenstone, with conchoidal fracture	1	4	424	0
TOTAL	424	0	424	0

Bore commenced 25th April, 1891; finished 12th June, 1891.

No. 4 Bore.

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Surface shaft	8	0	8	0
Yellow sandstone, with coal markings	22	0	30	0
Blue sandstone, with coal markings	38	0	68	0
Dark shale	1	8½	69	8½
Coarse-grained sandstone	1	4	71	0½
Coal and shale	0	2	71	2½
Brown shale	1	5	72	7½
Dark shale	1	0	73	7½
Blue shale	3	0	76	7½
Sandy shale	7	7½	84	3
Coal	0	1	84	4
Black clod and coaly matter	1	0	85	4
White shale, with thin coal pipes	0	10½	86	2½
Coal (did not form solid cores)	2	3¼	88	5¾
Brown band	1	0	89	5¾
Black clod	0	10	90	3¾
Coal	0	7	90	10¾
Clod	0	3	91	1¾
Coal	0	3	91	4¾
Black shale	0	3	91	7¾
Sandy shale	1	7½	93	3¼
Soft sandstone	6	3	99	6¼
Dark shale	2	9½	102	3¾
Clod and coal	0	2¼	102	6
Sandy shales, with patches of clod	27	6	130	0
Hard white coarse-grained quartzose sandstone, approaching to quartzite	27	0	157	0
Greasy black clod, with thin seam of coal	1	0	158	0
Sandy shale	3	0	161	0
Hard white quartzose micaceous sandstone, with coal stains and thin pipes	3	6	164	6
Sandy shale and sandstones, with patches of clod, full of coal stains	6	6	171	0
Sandstone (quartzose) and shale, variable	7	4	178	4
Dark shale	2	0	180	4
Light band	0	8	181	0
Dark shale	1	0	182	0
Light band	0	3	182	3
Dark shale, with a trace of coal	1	3	183	6
Black clod	4	1	187	7
White shale	3	3	190	10
Coal	0	1½	190	11½
Sandstone, light and dark	5	9½	196	9
Very impure coal and black clod	0	4	197	1
Dark shale	3	8	200	9
Sandstone	2	11	203	8
Sandstone and shales, the latter getting lighter in colour	20	4	224	0
Sandstone and shales, two very thin seams of coal	15	0	239	0
Light grey fine-grained argillaceous sandstones, with pinkish tinge	22	10	261	10
TOTAL	261	10	261	10

Bore abandoned at 261′ 10″ as having passed into strata already tested by No. 3 bore. Bore commenced 23rd June, 1891; finished, 18th July, 1891.

From the above data it would appear that only one seam of workable thickness has been shown to exist in the Triabunna area. This seam has been proved to be 5 feet in thickness, but the quality of the coal has not been indicated in any way.

The bores and shafts mentioned above constitute the whole of the work carried out in the field, and these at the present time have collapsed, and are inaccessible.

F.—*The Mining Properties.*

(1)—Number and Area of Leases.

No mining operations are at present being carried out in the area, and those leases which at one time may have been taken up have now been abandoned.

(2)—Quality of the Coal.

The data at present available is insufficient to enable conclusions to be drawn as regards the quality of the coal in the Triabunna area. As all the shafts in which the coal had been exposed had collapsed, sampling was impossible, and analyses from this area are not available.

(3)—Quantity of Coal Available.

In the present undeveloped state of the field no attempt has been made to calculate the quantity of coal available. The area over which coal occurs will be found nct greater than 300 acres, but until the thickness of the seams has been proven no estimates can be made.

(2)—Buckland Area.

A.—*Location and Extent.*

Five miles due north of Buckland, on the highlands between Bluff and Sand Rivers, several seams of coal have been discovered on land owned by P. E. French.

Exploratory works have proved the continuation of the seams a distance of 60 chains in a north-westerly direction, but their length on the dip has not been determined. Probably the extent of coal-bearing strata uninterrupted by diabase does not exceed 120 acres.

B.—*Access.*

The difficulty of access tells greatly against the development and exploitation of the coal seams in this area at the present time. A branch road leading past the mine connects at Buckland (1000 feet lower) with the main highway between Hobart and the eastern districts. This branch road is quite unsuitable for heavy traffic, and as a possible line of transportation is too impracticable to be worth discussion. The only practicable route for a tramway is that following the Sand River gorge to the valley of Prosser River, then turning along the course of that stream to Orford, the nearest shipping port. The cost of the construction of a 2-ft. gauge tramway from the mine to this port, a distance of 15 miles, would not be less than £50,000. The question at issue is whether or not the coalfield is of sufficient importance to justify the expenditure of such a large sum of money in providing these transportation facilities.

C.—*Previous Reports.*

Reference is made by A. R. Selwyn [16] to the occurrence of coal at Prosser's Plains, in the Back River country, in a report communicated to the Royal Society of Tasmania in 1855.

In 1890 A. Montgomery [17] paid a hurried visit of inspection to Prosser Plains, and reported the results of his investigations to the Secretary for Mines.

(16) Papers and Proceedings of the Royal Society of Van Dieman's Land. Vol. III., Part I., 1855.

(17) Montgomery, A.: Report on Prosser Plains Coal Area. Report of the Secretary for Mines, 1890-1891.

D.—*Topography.*

(1)—General Description.

The topography of Buckland district is extremely irregular. From the flat flood-plains of Prosser and Back Rivers, in the neighbourhood of Buckland, the land surface rises rapidly to the north and south, reaching altitudes between 2000 and 3000 feet above sea-level in a few miles. Prosser River, flowing in a general easterly direction, and Bluff, Sand, and Back Rivers, flowing from the north, have carved deep broad valleys in the softer rocks. These streams, following the lines of least resistance, have their channels in sandstones, along lines of faulting or else along contact lines between the sedimentaries and the hard, resistant diabase. Evidences of widespread erosion are very pronounced. The soft felspathic sandstones containing the coal measures have been almost entirely removed, the only remnants left being found on French's property and on Prosser Plain. The strata that remain still covering the subjacent diabase consist of the lowest sandstone and shale members of the Trias-Jura and the Permo-Carboniferous. Over a very large part, however, the sedimentary rocks have been completely eroded, and the denuded diabase projects above the general level in the form of residual mountains. Prosser River, surrounded on all sides by diabase, has cut a deep precipitous gorge through a great mass of this rock (4 miles wide) in its course to the sea.

A peculiar feature is the occurrence of swamps and marshes in the high lands. In some cases the bottoms of these marshes consist of diabase, in which event they are formed by the removal of the soft strata in places where the surface of the intrusive is slightly concave.

The southern part of this district is, in almost every respect, similar to that just described.

(2)—Relation to Mining.

The topography of the district is not altogether favourable to mining. French's mine, perched on a hill about 1500 feet above sea-level, in very broken country, is difficult of access; and the Prosser Plain coal beds, even if the prospect warranted it, could be developed only by means of shafts. However, the facilities for mining the coal in French's prospect are better, and the conditions for exploitation are generally more favourable than at Prosser Plain.

E.—*Geology.*

(1)—Geological Map.

Information required to illustrate the rugged nature of the surface was not obtained on this journey owing to the length of time that would have been necessary to make a complete topographic survey, but all other features have been carefully mapped. It will be noticed that a distinction has been made between the Felspathic and the lowest or Ross sandstone members of the Trias-Jura by the use of symbols indicative of the names of these strata.

An interesting feature in connection with the Ross sandstone members of this formation is the presence, in very appreciable amounts, of common salt and epsomite. The stratum comparatively rich in common salt is about 15 feet thick, and consists of white, slightly felspathic, siliceous sandstone. Twenty feet below this is the epsomite stratum, 5 feet thick, consisting of similar fine-grained sandstone of a yellow to light pink-colour flecked with brown. In this rock the epsomite is evenly distributed, and immersed in water, the sandstone, following the dissolution of the salt, readily disintegrates into its constituent particles. The rapid disintegration of these strata on the weather side is well illustrated by numerous extensive caves formed along the cliff-faces overlooking Bluff River. In these caves the salts have been redeposited on the floors from solutions percolating through the sandstones.

These strata can be traced without interruption for many miles, but the salt content varies appreciably from point to point. Samples 515 and 515A represent the composition of the epsomite and salt sandstones respectively.

These common salt and epsomite beds have been observed by A. Montgomery in the valley of Kangaroo River, and by W. H. Twelvetrees and the writer in the neighbourhood of Ross and in other parts of the midlands. The removal of these salts from the sandstones by solution in water has resulted in the formation of the salt pans or sinks so commonly found in the neighbourhood of Ross and Tunbridge.[18]

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

The Trias-Jura formation occupies nearly 20,000 acres in this district. The uppermost member has been completely removed by erosion, and two or three isolated remnants of comparatively small extent constitute all that is left of the felspathic sandstone member in which the coal-beds are found. Underlying these are the Ross sandstones, over 450 feet thick, which are barren of coal, but contain potential deposits of epsomite and common salt. Sections of these strata are given in the log record of the bore holes. It will be noticed that near the bottom of the bores the uppermost member of the Permo-Carboniferous was entered. Rocks of this latter system are exposed at surface in several places. They consist of yellowish mudstones containing fenestella and spirifera, and white calcareous mudstones replete with the more common bryozoa and brachiopoda.

The following bore results give some details of the Trias-Jura sediments:—

Bore A (Prosser's Plains).

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface soil	6	0	6	0
Sandstone, soft brown	35	6	41	6
Sandstone, firm, white and grey	48	6	90	0
Shale, blue	1	0	91	0
Sandstone, white quartzose with mica	84	3	175	3
Sandy shale, light grey	19	9	195	0
Sandstone, greenish grey, quartzose	51	0	246	0
Shale, arenaceons	18	0	264	0
Sandstone, greenish grey, quartzose	67	10	331	10
Sandstone, hard quartzose	20	8	352	6
Shale, with minute marine fossils	29	0	381	6
Shale, hard greenish with veins of calcite	24	6	406	0
Shale, hard, dark, arenaceous	8	2	414	2

Bore B (Prosser's Plains).

Strata.	Thickness ft.	in.	Total Depth ft.	in.
Reddish sand and diabase gravel	31	0	31	3
Sandstone, white and brown quartzose	4	6	35	6
Shale, grey	0	8	36	2
Sandstone, brown quartzose	1	7	37	9
Shales, grey and dark	15	6	53	3
Sandstone, grey quartzose	0	6	53	9
Shale, dark grey	10	0	63	9
Sandstone, hard, grey quartzose	14	10	78	7
Shales, dark grey	14	5	93	0
Shale, greenish grey, arenaceous	5	6	98	6
Shale, bluish and reddish	13	11	112	5
Sandstone, grey quartzose	1	0	113	5
Shales, grey and red, with sandy bands	30	4	143	9

[18] See P. B. Nye, Geological Survey, Tas.: Underground Water Supply Paper No 1.

Bore B (Prosser's Plains)—continued.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Sandstone, grey quartzose	5	0	148	9
Shale, grey, with carbonaceous markings	1	10	150	7
Shale, grey arenaceous	30	8	181	3
Sandstone, white quartzose	37	2	218	5
Shale, grey	1	6	219	11
Sandstone, white quartzose	1	6	221	5
Shale, grey arenaceous	16	8	238	1
Sandstone, grey quartzose with pebbles	97	11	336	0
Shale, dark	0	6	336	6
Sandstone, white quartzose with pebbles	8	7	345	1
Shale, grey	2	6	347	7
Sandstone, grey quartzose	21	6	369	1
Mudstone, white	4	7	373	8
Sandstone, grey, green, and brown quartzose	63	1	436	9
Diabase, dense, fine-grained, with calcite	3	0	439	9

Bore A was sunk about a mile south-west from Brockley House, and nearly due south of the point of confluence of Back and Prosser Rivers.

Bore B was sunk at a point 10 chains south-west from Robinson's shaft and tunnel. The failure in cutting the coal beds, and the fact that the strata passed through consist of the lowest members of the Trias-Jura, clearly show that the felspathic sandstones containing the seams have been faulted, the displacement amounting to fully 450 feet. The course of this fault is a little west of north, being parallel to others observed in the valleys of Sand and Bluff Rivers.

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

A glance at the accompanying map (Plate XIV.) will show that outside the area occupied by the great mass of diabase numerous comparatively small protrusions of this rock occur in the sedimentaries. This fact proves that at no great depth diabase underlies the whole area, and is part of the great transgressive igneous mass referred to elsewhere. From this parent body sills traverse the strata, and dykes intersect them, protruding here and there in all quarters of the area.

(4)—Structure.

(*a*) *Faults.*—The various changes in direction and degree of dip of these unflexed formations indicate faulting and tilting. Perhaps the fault of greatest displacement and length is that coursing west of north, passing between Robinson's shaft and the bore hole on Cornish's land. This is a downthrow fault to the south-west, with a displacement of at least 450 feet. Parallel faults of lesser magnitude occur in the valleys of Sand and Bluff rivers. So far as can be seen, all the important faults here are the direct result of the diabase intrusion, and apparently no faulting of the diabase itself has occurred.

(*b*) *Dip of Coal Seams.*—At French's prospect the dip of the coal seams and the enclosing strata is to the south-west at angles varying from 5 to 10 degrees. Outside the immediate neighbourhood of this mine the dip changes. At Bluff River near the salt deposits it is a little east of south, and a mile north of Press' homestead the same beds of strata dip almost due east. Further northward, in the Wilderness country, it returns to the normal south-west direction, and at Cornish's prospect on Prosser Plains the angle of inclination is between 35 and 45 degrees.

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

A fairly complete section of the coal-bearing strata is shown in Robinson's shaft and tunnel on Prosser Plain. In 107 feet of rock four distinct coalbeds were intersected.

On French's land three seams have been exposed, and there are indications of several others, but not sufficient exploratory work has been done to make a definite pronouncement as to the number occurring there. Alpha and Beta seams, apparently, are absent; Gamma, Delta, and Eta are exposed.

In Robinson's shaft and drive, as stated above, four distinct beds of coal occur, the most important of which is the lowest, outcropping at surface in Back River. The following section of the strata is exposed in the shaft and tunnel:—

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Soil, brown	5	0	5	0
Diabase boulders	6	0	11	0
Sandstone, brown felspathic	5	6	16	6
Sandstones, blue with dark bands	6	3	22	9
Sandstones, blue with fern fossils	1	2	23	11
Sandstone, hard	0	9	24	8
Sandstone, blue with streaks of coal	1	0	25	8
Sandstone, hard and flinty	0	5	26	1
Coal, humic, good quality	0	6	26	7
Clod	1	9	28	4
Coal bright	0	3	28	7
Shale, carbonaceous	2	6	31	1
Sandstone, hard laminated	28	0	59	1
Sandstone, micaceous	0	3	59	4
Shale. indurated, light	2	3	61	7
Shale, dark, indurated	2	6	64	1
Clay, soft, yellow	0	6	64	7
Clod, black, hard	5	11	70	6
Coal, bright, with 3-inch band	1	10	72	4
Clod, black	0	6	72	10
Sands one, felspathic	2	0	74	10
Clod and shale, black	4	0	78	10
Coal, very bright	0	6	79	4
Clod, black	4	8	84	0
Shale and clod	14	6	98	6
Coal with clay partings	1	0	99	6
Clod and shale	3	0	102	6
Coal, bright	3	3	105	9
Sandstone, hard and flinty	1	0	106	9

F.—*The Mining Properties.*

(1)—French's Prospect.

(*a*) *Number and Area of Leases.*—Two areas have been pegged under licence to prospect for coal, but no leases of Crown lands have been secured yet by the discoverers.

(*b*) *Extent and Method of Mining Operations.*—Until recently no attempt had been made to test the coal outcrops by underground workings. A few holes had been sunk here and there, but these were not productive of important results. The owners realised that, under the circumstances, exploration by tunnelling would prove the best means for the purpose in view, and works of this nature were laid out accordingly.

The coal beds are exposed in an extensive land-slip on the south-west side of Sand River Valley. In order to test the seams under cover of solid rock an adit was driven in the direction of dip underneath an outcrop of high-grade coal, from a point 30 feet below the Buckland-Woodsdale road. This tunnel has been advanced 120 feet in broken ground without meeting the main seam. At 100 feet from the entrance an attempt was made to explore the seams overhead by rising, but after penetrating the first seam operations were suspended on account of a large outflow of water and inefficient ventilation.

The following section was measured in the tunnel, 60 ft. from the entrance:—

Sandstone roof.
2 ft. coal, bright, laminated.
6 in. fireclay, soft, white.
6 in. coaly clod.
2 ft. fireclay and shale, hard.
6 in. coaly clod.
2 ft. shaly clay.
3 ft. coaly clod.

Sample 494 was obtained at the place where the measurement was taken, and represents the 2-ft. seam of bright coal. Occurring in the landslip the coal at this point was much broken, but between the cleats it is hard and compact.

Sample 495 represents the 3-ft. seam of coaly clod on the bottom of the tunnel. The quality had improved so much that it was considered worthy of further investigation. It is dull-black in colour, but contains thin bright layers occasionally.

Lower down the hill slope there are indications of other seams. Thin veins of high-grade coal occur in the landslip near the bottom of the valley, and water soakages at ledges in the slip indicate the near presence of coal seams.

Since the writer's visit another seam of coal, 2 feet thick, has been found on the hillside, about 80 feet above the level of the tunnel. Sample 512 gives an idea of the average grade of the coal of this seam. In appearance it is very similar to that of the rich coal exposed at the adit mouth.

In its present undeveloped condition it is impossible to form an idea of its extent, thickness, and value.

(c) *Quality of the Coal.*—This is a firm, hard coal, of humic (bituminous) character, consisting of alternate dull and bright laminations of varying thicknesses. It is capable of withstanding severe shock without crumbling, and is not appreciably affected by exposure to the weather. It ignites readily at a comparatively low temperature, producing great heat in the process of combustion.

In every respect it is remarkably similar to that mined at Dalmayne and Cornwall.

(d) *Production.*—There has been no production to date.

(e) *Quantity of Coal Available.*—The exact limits of the coal-bearing strata have not been defined, nor have the several seams known to exist here been explored, therefore it is impossible to attempt an estimation of the quantity of coal available in this area. However, it is certain that the productive measures here are not extensive, being but a remnant of the great formation that contains the most important coal seams.

(2)—Prosser Plains Coal Area.

(a) *Number and Area of Leases.*—Prosser Plains is the name given to the broad flood-plain of Back River, and extends from Prosser River northward, a distance of 5 miles. Near the headwaters, where the coal seams outcrop, the valley is narrow and V-shaped, and is bounded on both sides by diabase.

The first exposure of coal is on land owned by Albert Cornish, and the second occurs about a mile further up-stream.

(*b*) *Extent and Method of Mining Operations.*—Coal was discovered here in 1854, and in the following year A. R. C. Selwyn visited and reported on the prospect. Since that time a little exploratory work has been performed, but with discouraging results.

The workings on these coal beds are only of an exploratory character. They consist of three shafts and two tunnel openings.

Robinson's shaft (50 feet deep) is situated 120 feet south-west from the outcrop in Back River, intersected two small seams of coal, and the drive, 80 feet long, leading north-eastward from it exposed five seams.

About 40 chains to the southward two prospecting shafts were sunk to 70 feet in white siliceous sandstones.

These openings, together with the bore-hole, comprise all the exploratory works.

At the places where the seams are exposed the direction of dip varies from S. 15° W. to W. 20° S., and the angle of inclination from 35 to 45 degrees.

The tilting of the strata at such a high angle indicates considerable disturbance by the intruding diabase. The full effects are shown by the failure to find the continuation of the seams southward in bore-hole B. The log records of this and A bore-hole[19] show that the productive measures consist of a faulted remnant only, and that the lower unproductive siliceous sandstones occupy the surface a few chains southward.

(*c*) *Quality of Coal.*—Unfortunately these workings were inaccessible at the time of the recent investigation, and no samples could be obtained there. However, samples were secured from the smaller seam of the lowest coal-bed and of loose pieces of coal from the larger seam. Sample 498 represents the quality of coal in the smaller seam exposed in the bed of the river. It is stained brown by iron oxide, and under constantly running water has deteriorated.

Sample 499 consists of loose pieces of bright coal picked up at random from the larger seam, which is covered with river gravels and diabase boulders.

Neither sample is truly representative of the quality of the coal.

The other seams are small and unimportant. A little over a mile further up-stream, coal outcrops again in faulted position in the bed of the river.

The coals are of humic character, though not of first-rate quality. The ignition point is low, combustion is free and complete, and the coal burns with a long, yellow flame. It is of rather slaty structure, and contains a large proportion of ash and shaly impurities. In places, however, it is hard and compact, and in its clean condition contains very little ash. Probably under cover the coal maintains this high-grade quality.

(*d*) *Production.*—There has been no production to date.

(*e*) *Quantity of Coal Available.*—In small, detached areas, such as this, it is impossible to estimate with any degree of exactitude the tonnage of coal available. Attempts to explore the area have not been productive of good results, and no definite information has been obtained, except at the outcrops, upon which a safe calculation could be based. From the evidence in hand it appears that the extent of coal-bearing ground is very small, and not of any considerable economic importance. In fact, the prospects are so discouraging that there is little likelihood of another attempt being made to reopen the mine.

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[19] See above, pp. 113, 114.

Chapter V.

TASMAN PENINSULA COALFIELD.

(1)—Saltwater River Area.

A.—*Location and Extent.*

Saltwater River flows into Norfolk Bay through the north-western part of Tasman Peninsula. The settlement at the mouth of the river is 50 miles by the sea route from Hobart, and the old coal mines lie 3 miles north of Saltwater, where the peninsula is very narrow. The coal-bearing strata extend from the eastern to the western shores, a distance of 3 miles. The southern extension of this field is interrupted by a narrow dyke of diabase, which intersects the strata in a north-easterly direction, and after passing right across the Peninsula, crops up again on Slopen Island. Northward the seam rises to the surface in a horizontal distance of 20 chains. The coal-bearing area is not greater than 400 acres.

B.—*Access.*

This area is easily accessible by water. Norfolk Bay provides a safe anchorage for vessels of all sizes, and the existing jetties, with inexpensive additions, are capable of accommodating ships of 1000 tons displacement. Small trading vessels ply regularly between Saltwater and Hobart.

C.—*Previous Reports.*

So far as can be ascertained, descriptive reports only have been made on this coal area. There are no official records, nor are there references in the Proceedings of the Royal Society of Tasmania to these occurrences.

D.—*Topography.*

(1)—General Description.

This land surface consists of rounded diabase hills, rising upwards of 1000 feet rather steeply above the lowland littoral, which is occupied chiefly by sedimentary rocks. In some places the strata, protected on the flanks by buttresses of diabase, attain considerable altitudes, but as a rule erosion has so reduced these less-resistant rocks that they usually present a more subdued outline than the harder igneous material. The differential effect of erosion on these dissimilar formations is perfectly illustrated by the irregularly indented coastline. These indentations, resulting from the inroads of the sea into the soft strata, provide safe harbours for vessels even in the roughest weather. During Recent time there has been an elevation of the land surface, as exemplified by the lagoons and marshes near the coast.

(2)—Relation to Mining.

The principal mine is situated in flat country, and operation is in consequence performed by means of shafts. Two other outcrops occur also in the lowland country near the sea-coast, with no especial advantage in either case, but on Price's, McKay's, and Barnett's the outcrops are in the highlands, and the conditions for exploitation are decidedly better. It is necessary, however, to cart the coal long distances from the highlands to the sheltered ports on Norfolk Bay, as there are no safe harbours on the west coast.

E.—*Geology.*

(1)—Geological Map.

The geological map, besides showing the relationship between the several sedimentary and igneous formations, illustrates the effects of faulting on the productive measures. It shows also the positions of the known coal outcrops and the southern limitation of the old coal mine area by a narrow dyke of diabase.

It will be noticed that there are several small areas of basalt near Saltwater River, and again larger masses in the neighbourhood of Copping. At Ironstone Point the basalt contains an excess of iron, and leachings of limonite and hematite from the rock have stained the sands and sandstones a brown to brick-red colour. Remnants of the basaltic lava flow are scattered here and there in a more or less direct line as far as Sorell.

Remnants of Teritary sands and clays are found on the peninsula, but these are so small and unimportant that they have not been shown on the map. Later Quaternary and Recent sand dunes and alluvial deposits are indicated.

The greater part of this district is occupied by Lower Marine strata of the Permo-Carboniferous and by diabase, and remnants only of the upper coal measures remain.

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

At Eaglehawk Neck and at Tasman's Arch some of the Lower Marine members of the Permo-Carboniferous are well represented and exposed to view in the high cliffs overlooking the sea The lowest member is a coarse gritty mudstone conglomerate of undetermined thickness showing cross-jointing of remarkable regularity, and forming what is known as the "Tesselated Pavement." Pebbles and boulders of quartz, quartzite, granite, and of other waste rock form the coarser, though minor, constituents of the mudstone, which is unusually hard and compact. The plane of axial jointing is almost invariably parallel to the strike of the strata, and that of the transverse is at right angles thereto. The major cracks are persistent through all strata, but the minor cracks peter out in the shaly members. In some places the cracks end abruptly, and others commence a few inches away, and continue on the same course. The axial direction of the major planes is not universal, and transverse jointing is in places obliquely inclined to them. It is noteworthy that the lines of jointing are not deflected from their true courses by hard pebbles. These pebbles are cleaved as sharply as the cementing material of the mudstone conglomerate.

This jointed structure is an after effect of the intrusion of diabase, and represents the lines of contraction following the cooling of the super-heated rock. Iron-laden hot solutions circulating through the cracks deposited parts of their contents as limonite, and so hardened the walls of the cracks that the rims between the beds of strata stand out in relief from the softer central portions in contorniate fashion.

At the Blow Hole the section of strata is represented as follows, in ascending order:—

(1) Intercalated fossiliferous mudstones and calcareous sandstones, 60 feet thick, containing Fenestella, Productus, Spirifera, Pachydomus, Platyschisma, Pleurotomaria, Aviculopecten, &c.
(2) Grits of undetermined thickness.
(3) Yellowish white, calcareous mudstones, 135 feet thick, containing Sanguinolites and Terebratula.

Along the coast-line leading southward from the Saltwater River Coal Mine for half a mile beyond Turner Point, and again in the vicinity of Lime Bay, calcareous mudstones and sandstones are exposed, and evidently are part of the same beds of strata that outcrop near Copping.

Reposing on these are the sandstone members of the Trias-Jura formation, containing the coal beds.

The lowest member of this formation consists of grits, yellow and white, micaceous sandstones, and blue and grey shales. These sandstones, in places showing false bedding, are found, with diabase interruptions, forming ragged cliffs along the coast between Cascades and Saltwater River. The felspathic sandstone member overlying the preceding has been completely removed from a large portion of the area occupied by the sedimentaries, as well as the diabase, and even at the coal mines it has been greatly reduced in thickness by erosion.

On Nichol's, McKay's, and Barnett's land the sandstones project above the general level in the form of perpendicular cliffs over 100 feet high.

(4)—Structure.

(*a*) *Faults.*—Besides numerous minor faults there are two major dislocations that completely separate the coalfield into three groups of mines. The fault of most importance is one following the course of a narrow diabase dyke at the Saltwater River coal mines. This is one of very considerable displacement, the amount of which, from the data available, could not be accurately determined. Coursing in a north-westerly direction almost parallel to that fault is another of similar dimensions, following the north-eastern foothills of Mt. Communication and Mt. Wilmot.

With the exception of the aforementioned, none of the faults has any serious effect on the exploitation of the workable seam of coal.

(*b*) *Dip of Coal Seams.*—The general direction of dip of the strata and coal seams is south-westerly, and the angle of inclination is from 5 to 11 degrees. Although the prevailing dip is south-westerly there are marked changes in direction in different quarters of the area, due to the complicated nature of the diabase intrusion.

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

Only two seams, probably identical with Eta and Theta seams, are known here. Outcrops of seams found outside the main colliery area, because of lack of data, cannot be correlated with other seams.

F.—*The Mining Properties.*

(1)—Number and Area of Leases.

No mining leases or rights are at present held in this area.

(2)—Extent and Method of Mining Operations.

These coal mines were worked for many years by the Imperial Government to provide fuel for the various establishments in the neighbourhood, and also for the penal settlement at Port Arthur. The coal was also sent largely to Hobart for household use.

All the workings are inaccesible at the present time, and as the records are meagre and disconnected it is impossible to give a detailed account of the nature and extent of the mining operations. It is understood that active exploitation of the coal seams ceased about 40 years ago.

The following extracts from a letter written by the Governor, Sir W. Denison, in 1847 are illuminative:

> " I believe there is a quantity of very good coal in different parts of the country, but the cost of transport is so great as to prevent it being worked: as it is, the demand is sufficient to bring up the price of coal at Hobart Town to about ten or eleven shillings per ton. The works on the shore where the coal is raised are badly managed. Fifty tons are got out per diem by the labour of 150 men, and a steam-engine, whereas three times the quantity would be raised by private enterprise, with the labour

of free men. Besides the opening of the mine at the top of a hill, and all the water has to be pumped out and the coal raised to the hill-top: instead of which the whole mine might have been drained, and the coal run out at once on to the wharf, had an adit or gallery been driven into the hillside.

"The coal is a species of anthracite, like some of the Welsh coal. It answers very well for the kitchen, but is dirty and flies about too much to be used in the sitting-rooms, where we have either wood or English coal."

The convict settlement at Saltwater River was probationary and penal, and the mine was worked by convicts under punishment. In the early stages of development the hauling and pumping were done by man labour, later machinery was installed for these purposes.

As seen to-day, the ruins of extensive buildings and the several mine openings are all that is left to indicate the importance of the operations.

The mine openings consist of masonry-lined circular shafts (12 to 15 feet in diameter), situated at irregular intervals along the strike of the coal over a distance of 60 chains. Main shaft (156 feet deep), and the next south-west of it, were sunk in diabase near the point of contact with the sedimentary rocks.

One half-mile north-eastward from main shaft is another shaft of similar construction, and still in a perfect state of repair, which was originally intended for ventilation purposes. This, probably, represents the limit of the workings to the westward. A large tonnage of coal is available in this part of the mine, but 20 chains further to the south-east it has been excavated nearly to the surface.

(3)—Quality of the Coal.

Sample 481 was taken from one of the large dumps of slack at pithead. The coal had been exposed to the action of the weather for at least 40 years, and, doubtless, had been greatly affected thereby. In appearance it is steel-grey to black in colour, and possesses a slaty structure and coarse-grained cross-fracture. The analysis shows a high carbon content, low volatile matter, and a high proportion of ash.

The coal burns with difficulty, and slowly, unless kindled with wood, and emits little or no smoke. It decrepitates badly, owing to the presence of pyrites films between the laminæ, thus necessitating the use of fire screens. Its flame is blue and short, and it does not agglutinate nor cake. Originally of humic character it has been metamorphosed by the effect of the intrusive diabase, and now appears anthracitic.

(4)—Production.

The coal bed was discovered in 1834, and production commenced in the following year. Before the end of 1835 the mine was producing at the rate of 500 tons per month, and was still in active operation in 1847, when the rate had increased to 50 tons per diem.

A large quantity of coal has been mined, and shipped to market from this area. There are no records of the total production, but the quantity is indicated by the large stacks of slack coal still remaining in the vicinity of the pits. These dumps have been afire for many years, and are still burning. From these indications it is probable that not less than 60,000 tons has been produced altogether.

(5)—Quantity of Coal Available.

It is not possible to give precise information relating to the available coal in this area. The seams do not show at outcrop; few sections are available for examination, and the workings are inaccessible. There is no basis upon which an attempt could be made to estimate the coal resources with any degree of accuracy. It is considered that only as the result of an extraordinary demand would it be expedient to reopen this mine.

(2)—Premaydena.

On lot 7575, south of Saltwater River, is an old dip-tunnel, and an air shaft. The tunnel has caved in, and the coal seam is not exposed. A few pieces of coal found at the mouth of the pit show it to be of similar character to that occurring in the main mine. The seam is enclosed in 12 feet of shale, and is overlain by felspathic sandstone, and the dip is south-eastward, contrary to the general trend. These workings are only 10 feet above sea-level.

About 20 chains along the coast northward of Price Flats jetty is an outcrop of coal 2 to 6 inches thick. Here, again, the roof is felspathic sandstone and the floor carbonaceous shale, which in turn overlies shaly sandstone. The country hereabouts is greatly disturbed by intrusive diabase. The dip varies considerably in the neighbourhood of the igneous rock, but returns to its normal south-west trend 200 yards further on. In one place the strata are on edge; in another the dip is south-eastward at a high angle.

Sample 446 was taken from the narrow seam at the cliff, and is neither indicative of the character nor the true composition of the coal.

Splendid sections of the carbonaceous shaly members occur along the coast on the western side of Impression Bay, where several shallow shafts have been sunk in search of the coal seam, but without success.

On Geo. Nichol's farm, east of Mt. Communication, is an outcrop of shale and coal, contained in greenish felspathic sandstone. The coal in place was not seen, owing to the deep soil-cover and the accumulation of debris, but large blocks were brought to surface in ploughing the fields.

Further westward, 230 feet higher up the mountain side, the shale outcrops again, indicating a fault of 300 feet displacement. On the other side of Mt. Communication, foward the western sea coast, it is reported that large blocks of good coal have been picked up in a small creek, but no trace of coal was found in that locality on this journey.

At McKay's, cliffs of massive Ross sandstone stand out above a shale floor. Important seams are not likely to be found in them.

On Barnett's property the same uninterrupted series of sandstones occur. Below them are springs, from which hydrous oxide of iron is being precipitated. Such springs are found issuing from coal seams, but here these indications are unfavourable.

(3)—Dunalley.

About a mile and a half southward from Dunalley a thin seam of coal outcrops on the roadside. Into this seam an adit has been driven 100 feet. From the end of the adit a rise connects the underground workings with the surface.

The seam of coal, 3 to 8 inches thick, is enclosed in carbonaceous shale, which is overlain by felspathic sandstone. Underneath the seam the shale is fully 8 feet in thickness. From the information in hand it is evident that this seam is identical with the Saltwater River seam on the other side of Norfolk Bay. This area of coal-bearing strata is only 40 acres in extent, and, except on the sea front, it is surrounded by diabase. The occurrence is of no economic importance.

(4)—Copping.

Twenty chains east of the post-office a bed of carbonaceous shale similar to that at Dunalley is exposed in the road-cutting. No coal was found, but a complete section of the shale was not seen. This shale bed outcrops again on Wooley's land at a much higher elevation. The extent of coal-bearing strata is difficult to determine, as diabase intrusions are common, and basaltic lava occupies a large portion of the surface. In this direction the coal is thinning, and the occurrence is not likely to prove important.

(5)—Kellevie.

On Cobb's land at Kellevie carbonaceous shale containing a thin seam of coal is exposed. These coal-bearing strata formed part of the Dunalley-Copping formation, which has been cut into small areas by the intruding diabase.

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 Cygnet 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 11 degrees. Three hundred feet to the south-west the angle of dip amounts to 10 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 complications 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. ft.	in.	Total Depth. 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	2½	102	11½
Dark shale	0	7½	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	5½	269	10½

Bore A—continued.

Strata.		Thickness. ft.	in.	Total Depth ft.	in.
Gamma Seam, 5 ft.:		6	3	276	1½
Dull coal	1 ft.				
Band	9 in.				
Dull coal	10 in.				
Clay parting	1 in.				
Dull coal	3 in.				
Dark band	2 in.				
Bright coal	1 ft. 2½ in.				
Clay band	2 in.				
Dull coal	4 in.				
Band and coal	1½ in.				
Bright coal	1 ft. 4½ in.				
Fireclay		2	10	278	11½
Fine-grained sandstone		5	3	284	2½
Blue shale		3	5	287	7½
Delta Seam, 3 ft. 5½ in.:		3	7	291	2½
Coal	3 ft. 2½ in.				
Clay band	1½ in.				
Coal	3 in.				
Fireclay		3	9½	295	0
Sandstone, dark 3 ft. 6in., grey 33 ft. 6 in.		37	0	332	0
Dark sandy shale		3	2	335	2
Eta Seam, 1 ft. 3 in.:		1	5½	336	7½
Coal	3 in.				
Dark band	1 in.				
Bright coal	7 in.				
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
Iota Seam, 2 ft.:		2	3	350	4
Stony coal	2 in.				
Soft coal	1 in.				
Bright coal	1 ft. 1½ in.				
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	2½	523	5½
Shale		0	6	523	11½
Coal, dull		0	3	524	2½
Shale		0	4	524	6½
Red clay		0	1½	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	0½	343	5½
Coal } Iota Seam	0	5½	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.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Coal	0	9	308	3
Soft clay band	0	1	308	4
Coal	1	7½	309	11½
Fireclay	0	6	310	5½
Dark shale, with fern impressions	1	2	311	7½
Grey sandstone	2	10	314	5½
Dark shale, with fern impressions	2	8	317	1½
Grey shale	0	3½	317	5
Dull coal	0	5	317	10

Bore D.

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. 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	$2\frac{1}{2}$	
Coal, with bright laminæ	0	9	
Clay, hard	0	$2\frac{1}{2}$	
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	$4\frac{1}{2}$	
Coal, bright	0	4	
Clay, hard	0	6	Sampled 1 ft. 3 in.
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 ¾-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 7½ 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 torrential 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, 26 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 VII.

BRUNY - STRATHBLANE - CATAMARAN COALFIELD.

(1)—Bruny Island Coal Area.

A.—*Location and Extent.*

Bruny Island lies off the south-east coast, about 14 miles south of Hobart. It is separated from the mainland by D'Entrecasteaux Channel, a deep waterway from 1 to 3 miles wide. The northern part of the island is almost completely severed from the southern, and the parts are usually referred to as the North Island or the South Island, as the case may be, although there is no actual separation. Its greatest length from Denne Point, the northern extremity of the island, to Bruny Head, is 31 miles. The breadth of North Bruny varies from 2 to 7 miles, and that of South Bruny varies from 3 to 10½ miles. This extreme variation in breadth is due to the deep and wide indentations of its numerous bays. The coal-bearing areas of this island constitute a very small portion of the total area—probably not exceeding 500 acres. The chief coal area is at Adventure Bay, on the east coast; other occurrences are near Arched Rock, on the south-east coast, and at Lunawanna and near Sheepwash Bay, on the west coast.

B.—*Access.*

River steamers trade regularly to the ports on the west side of the island, and occasionally visit Quiet Corner, the chief shipping port on the east side. Quiet Corner is situated near the southern end of Adventure Bay, near the coal mine, and is partly protected from southerly gales by the promontory terminating at Penguin Island, but in rough weather it provides neither a safe anchorage nor adequate protection for ships. Zschachner's Mine is connected by tramway with the jetty at Quiet Corner. Two jetties directly below the mine were built in an exposed position, and were destroyed by heavy seas following severe gales.

C.—*Previous Reports.*

The only official record extant of the occurrence of coal on Bruny Island is contained in a report of the Survey Department made by Thos. Scott, R. A. Roberts, and J. Hobbs, on the 25th October, 1826.[25]

In 1915 Arthur Wade[26] was detailed to investigate the supposed oil-bearing strata on North Bruny and report on the prospects. His work, published as a Parliamentary paper, deals exhaustively with this subject.

D.—*Topography.*

(1)—General Description.

The minutely indented coast-line of Bruny Island is the result of the relative rates of erosion between the highly resistant diabase and the comparatively soft Permo-Carboniferous strata that occupy the rest of the surface. The south-eastern and southern shores, exposed to the heaviest weather, are bordered by bold cliffs of diabase with remnants of partly occluded sediments. On the eastern shores the

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(25) **Thos. Scott, R. A. Roberts, and J. Hobbs: Coal at South Cape Bay and Adventure Bay. Legislative Council Paper No. 16, 1861.**

(26) **Wade, Arthur, D.Sc., A.R.S.Sc.: Petroleum Prospects on Bruny Island. Parliamentary Paper No. 60.**

occasional deep bays mark the inroads of the sea into the soft unprotected strata, while the projections indicate again the more resistant diabase. On the calmer western shores the sedimentary rocks are much more extensive, and the indentations are not so pronounced. Probably the rate of weathering is influenced somewhat by the general south-westward dip of the strata.

The highlands are almost wholly occupied by diabase, and have a meridional trend. These great inland masses of igneous rock likewise owe their prominence to the erosion of contiguous strata. At Adventure Bay there are in the flat swampy shore-lands indications of an uplift that took place in Recent or in Quaternary time.

(2)—Relation to Mining.

The coal-bearing strata of Adventure Bay occupy lowlands near the seashore. The dip of the strata is south-westward toward the centre of the island, and the coal beds rise to the surface a few chains only along the coast-line. Owing to faulting the seam cannot be opened from dip; tunnels and shaft-sinking is necessary in every case. It is evident that the topography is of no advantage to mining.

E.—*Geology*.

(1)—Geological Map.

The geological map illustrates the relative positions of the igneous and sedimentary rocks. The chief sedimentary formation comprises a number of widely different members of the Permo-Carboniferous, but the limitation of the map precludes a separation being made. In the Adventure Bay littoral there are, in addition, unconsolidated sediments of Quaternary age, and on the foothills above them remnants of Tertiary deposits. These latter are quite unimportant.

Throughout the southern part of the island the texture and constitution of the diabase are remarkably uniform. The same may be said of this rock in general in the northern part of the island, but a remarkable variant from the normal type traverses the centre between the 9 and 1 mile pegs from Denne Point. This rock evidently represents a later phase in the differentiation of the diabase magma, and occurs in the form of a dyke. It is particularly striking that there is no mergence into the normal type, but a sharply-marked contact line divides the two. Macroscopically the rock appears to consist dominantly of plagioclase felspar, the augite being quite subordinate. Lacking facilities for microscopic examination, the discussion of this rock will be left for a later publication.

Along the line of contact of this rock with the sedimentaries between Adams Bay on the west and Trumpeter Bay on the east, a very large mass of limonite occurs. Toward the centre of this mass is a thermal spring, probably one of a number of others occurring along the line of outcrop. The igneous rock near the contact evidently contains a large amount of iron pyrites, which, oxidising to sulphate, is carried in solution to the surface, and is there decomposed into hydrous oxide of iron and sulphuric acid. From this it follows that the warmness of the spring solution is due to chemical activity. The limonite contains a little gold.

Near the north-west corner of the big lagoon on the north island a bore-hole was sunk 430 feet through Permo-Corboniferous strata on a supposed oil prospect.

The following particulars of the bore have been placed at the disposal of the Mines Department:—

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Sand and clay	43	0	43	0
Quartz sand	8	0	51	0
Coarse sand	11	0	62	0
Running drift wi h no water	39	0	101	0
Sand and water	11	0	112	0
Limestone conglomerate	27	0	139	0
Brown shale	8	0	147	0
Quartz sand	5	0	152	0
Limestone conglomerate	4	0	156	0
Fine sand with no water	14	0	170	0
Brown clay	6	0	176	0
Limestone conglomerate	3	0	179	0
Limestone	69	0	248	0
Hard carboniferous grit	1	6	249	6
Hard blue siliceous shale	3	0	252	6
Hard limestone	3	0	255	6
Very hard grit	3	0	258	6
Very hard limestone with alternate bands of shale	171	6	430	0

It has been repeatedly reported to the Geological Survey that oil seepages had been observed and that bitumen had been found issuing from the rocks, but residents were unable to show the writer any such occurrences. It is interesting to note that at Cloudy Bay loose blocks of Pre-Cambrian schist occur below water's edge.

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

The Permo-Carboniferous is usually hidden beneath Trias-Jura strata in the slightly disturbed areas, and is only exposed in the uplifted parts where intense erosion has removed the overlying formation, but on Bruny Island the Trias-Jura has been completely removed and splendid sections of the older formation are exposed for examination. At One Tree Point a cliff face nearly 300 feet high shows an interesting section of marine mudstones with intercalated layers of grits, conglomerates, and arenaceous limestones practically devoid of fossils. Farther southward at Variety Bay are strata crowded with fossils. The following section has been observed:—

	Feet.
Conglomerates and grits	5
Siliceous limestones and mudstones replete with casts of *Pleurotomaria morrisiana*	15
Siliceous limestones with casts of *Spirifera convoluta*, *Spirifera strzelecki*, *Terebratula sacculus*, *Aviculopecten limæformis*, and *Aviculopecten fittoni*	12
Mudstones containing abundant casts of the Bryozoa. *Fenestella fossula*, and *Protoretepora ampla*, together with other forms	85

These beds dip at angles varying from 10 to 16 degrees to the south of west.

Beds exposed near Ford Bay consist of buff-coloured arenaceous limestones containing fossil casts of Bryozoa, such as *Fenestella*, and of Brachiopoda, such as *Spirifera* and *Productus*. These beds dip to the south of west. They contain numerous boulders of igneous rocks, chiefly granites. One huge boulder of muscovite-biotite granite stands out prominently at the point, and schistose varieties of lesser size are abundant. About one-half mile north of Daniels Bay, on the sea-shore, another enormous boulder of muscovite granite projects through the beach sands, and schistose granites and porphyries are abundant under the siliceous limestone member in hills on both sides of the Alonnah-Adventure Bay Road.

From the sand-dunes along the shore of Adventure Bay an uninterrupted section of strata is exposed. The sequence, as observed by Johnston, is as follows:—

	Feet.
Grits, conglomerates, sandstones, and mudstones containing (sparingly) fossil casts of *Spirifera strzelecki*, *Spirifera darwinii*, *Pterinea macroptera*, and silicified conifer trunks	550
Similar beds devoid of fossils	230
Carbonaceous shale	12
Laminated sandstones with ripple marks	139
Sandstones with black and grey carbonaceous shales containing coal beds	143
Grey shales and laminated sandstones in thin beds	160
Brown, coarse sandstones with false bedding	245
White, evenly-bedded sandstones	150

Occurring in these strata there can be no doubt that the coal beds belong to the Permo-Carboniferous or Lower Coal Measures. They are further distinguished from the Trias-Jura by examples of Glossopteris and Gangamopteris, fruits and other plants characteristic of this formation that are found in the associated bands of carbonaceous shale.

In this formation nearly all members are represented, ranging through the Lower Marine beds without interruption to the terrestrial beds. There is a gradual transition from one group to the other, and Upper Marine beds are absent.

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

The diabase here, as in neighbouring fields, occurs in the form of a transgressive igneous mass from which have sprung forth numerous sill-like bodies at various horizons in the intruded strata. The sills dip to the south-west in conformity with that of the enclosing strata. The great mass of the diabase has cut through these strata and stands out boldly nearly 2000 feet above sea-level.

The striking feature of this intrusion is its extreme irregularity of form.

(4)—Structure.

(*a*) *Faults.*—At the Adventure Bay mine (Zschachner's) considerable faulting has taken place. Between the east and west shafts there are numerous minor dislocations. These faults cause an upthrow and downthrow alternately of 2 feet or more. The faults are noticeable in the cliff face overlooking the sea. The most northerly shaft is on the top side of a 32-feet upthrow fault trending north-westerly, with its underfoot to the east. Outside the mine workings there are indications of extensive faulting with displacement of strata sufficient to limit operations from any particular opening to very small areas. Complete dislocations of the strata have been observed at several points in the north part of the island.

(*b*) *Dip of Coal Seams.*—In the mine the general dip of the seam is a few degrees west of south, but at the outcrop on the sea-coast it is south-west in conformity with the general direction of the dip of strata throughout the field. The amount of dip varies from 7 to 12 degrees.

On the south-east coast near Arched Rock the seam dips west at 10 degrees, and near Lunawanna it is south-west, as it is also on Charlson's property north of Sheepwash Bay.

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

The widely separated outcrops on Bruny Island are parts of one coal-bearing bed disrupted by the intrusion of diabase. On stratigraphic and palaeontologic grounds it is considered that the Bruny and Cygnet coal beds occur on the one horizon and are probably identical. It is significant that the chemical and physical properties of the coals of these areas are strikingly similar. The lower or "Mu" bed occurring at Cygnet has not been found here; and apparently it has petered out in this direction.

The average thickness of coal at the Adventure Bay outcrop is only 12 inches, but, it is reported, the seam increases to 20 inches in the main workings. In other parts the seam is very small.

F.—*The Mining Properties.*

(1)—Number and Area of Leases.

At the time of this investigation two leases were pegged for coal. One of them includes the farming property of 160 acres owned by A. S. Zschachner, and the other encloses 47 acres of land charted in the name of A. Abraham.

(2)—Extent and Method of Mining Operations.

Mining operations commenced here in 1879, and continued without interruption until 1881. During the following decade operations were carried on intermittently for various reasons, and in the early nineties the mine was abandoned. Under the superintendence of M. Zschachner a very considerable amount of development work was performed, and thousands of tons of coal were mined and shipped to Hobart.

These workings consist of three shafts and two dip tunnels. The main or No. 1 shaft is 120 feet deep, and the No. 2, about 200 yards distant to the north-west, is 90 feet. From the main shaft headings were driven 400 feet south-east and 1000 feet north-west, and a large part of the coal was mined up the rise to the 32-feet fault. On the north side of the fault No. 3 shaft entered the coal bed at 24 feet, but very little coal was obtained from this mine opening. The section of the coal bed at the place where the sample was taken was:

No. 114, Lamba Coal Bed.	ft.	in.	
Sandstone	2	6	
Shale, hard (roof)	4	0	
Coal, laminated	0	6	
Shale	0	3	
Coal, bright	0	9	Sampled.
Shale	0	1	Sampled.
Coal, bright	0	6	Sampled.
Shale, hard (floor).			

Sample 114 was taken from the outcrop showing in the face of the cliff below A. S. Zschachner's residence. Exposed to the weather and the action of storm waters it had, doubtless, deteriorated considerably. Unfortunately, the workings were inaccessible at the time of this investigation, so that it was impossible to examine the coal under cover of thick strata. The uppermost 6-inch band is thinly laminated and rather too dirty for present economic uses, but the sampled portion is hard and clean.

Operations being on such a small scale, no effective system of handling nor adequate means of transport was provided. In order to reduce the cost of transport a jetty was constructed in the open roadstead directly below the mine openings, but heavy seas soon demolished the structure and a return to the safer anchorage at Quiet Corner was found necessary. The coal was conveyed to Quiet Corner by tramway, and lightered to the barges in which it was shipped to Hobart. The high costs of transport and mining, and the low price of coal at Hobart, combined to bring about the cessation of operations in this mine.

(3)—Quality of Coal.

In every essential this coal is remarkably similar to that of Mt. Cygnet. A change from its rather dull appearance is brought about by occasional bright laminations. It is hard and tough, and is capable of withstanding rough handling without being reduced to slack. For domestic uses it is very serviceable, and is a fair steaming coal. The ignition point is high, and combustion is slow and complete, leaving a friable white ash residue.

(4)—Production.

No records have been kept of the production of coal from this mine. Probably the total amount does not exceed 20,000 tons.

(5)—Quantity of Coal Available.

The actual area of coal-bearing strata has not been accurately determined. The upper measures of the Permo-Carboniferous occupy over 1000 acres, but only a small portion of this area has been explored and proved to be coal-bearing. It is impossible, therefore, to form even an approximate estimate of the quantity of coal available. On the 30-inch standard([27]) seam as a basis for calculation, the coal in this area cannot be taken into consideration in the estimation of available supplies.

G.—*Unleased Coal-Bearing Areas.*

On the south-east coast near Arched Rock remnants of the coal measures are exposed in the cliff face. The seam here is 6 inches to 14 inches thick, and is considerably disturbed.

On the eastern shore of Little Taylor's Bay, and 1 mile south of Lunawanna, is a small area of coal-bearing strata. A little work has been done here, but there is no prospect for mining.

Further north, on Charlson's property near Sheepwash Bay, several shallow shafts were sunk to test the seam, but the results were disappointing, and the continuance of exploratory work was not warranted by the prospects.

(2)—Strathblane Area.

A.—*Location and Extent.*

The Strathblane coal area lies 4½ miles south-west from Folkstone jetty on the southern bank of Port Esperance. The nearest considerable settlement is Dover, a township of 1000 people, situated on the north-west bank of the harbour; and Hobart, the chief centre of population, lies 52 miles northward.

The total extent of this field is not more than 1000 acres, but on the western side of the diabase hills dislocated masses of coal-bearing strata occur over a large area.

B.—*Access.*

The easy accessibility of these mines and their proximity to a deep-water port are decided advantages in their favour. Tramways connecting with Folkstone pier pass within a few chains of the main workings of the Strathblane, and within a half-

([27]) See below, p. 243.

mile of the Hastings, mine, and could be utilised in their present condition for the conveyance of coal to this port of shipment. Port Esperance is a large, almost landlocked, harbour, with a broad deep waterway on the south side free from obstructions of any sort. A glance at the plan (Plate XXII.) will show the depth of water in fathoms at every point of the harbour.

River steamers trade regularly between Port Esperance and Hobart, and overseas vessels of over 1000 tons capacity call here to load timber.

C.—*Previous Reports.*

This area was visited in 1914 by W. H. Twelvetrees [28], and an account of his investigations is given in Geological Survey Bulletin No. 20. In his report Mr. Twelvetrees describes the various workings and briefly refers to the igneous rock formations and their relation to the coal-bearing strata. At the time of his visit the workings were inaccessible, and he was unable to obtain reliable information as to their extent and condition. Since then no further developmental work has been performed, and not much information could be gathered to supplement his report.

D.—*Topography.*

(1)—General Description.

Port Esperance is bounded on the north and south sides by steep diabase hills fringed with Permo-Carboniferous strata, and on the west by similar formations at a much lower altitude. In this direction Creekton Rivulet flows through the broad, flat, buttonrush-covered valley separating the Strathblane and Hastings coal areas. The hills on both sides of the valleys rise gradually toward the west, then abruptly into the mountain range, of which Adamson Peak (4085 feet) is the culminating point. There are indications of recent uplifts in this area, for Esperance River, which once spread over a very broad valley, is now entrenched in its old bed and confined between narrow precipitous walls. In its confined channel erosion is still going on, and the river is gradually reducing its bed to base level. Numerous mountain torrents of no great size or length accentuate the topographic relief by their rapid dissection of the sedimentary formations. Port Esperance was formed by the inroads of the sea into the comparatively soft strata, and its shape was fashioned by the outline of the more resistent diabase.

(2)—Relation to Mining.

The most prominent feature of the area leased for coal-mining is a ridge, less than half a mile wide and 300 to 400 feet high. This ridge rises abruptly from the flat plain of Creekton Rivulet valley, and on the east and south-west sides the upper group of seams outcrop and can be traced without difficulty for a mile. The coal in this locality can be operated from dip-tunnels. Any seams occurring at a lower elevation can be attacked only by means of shafts.

E.—*Geology.*

(1)—Geological Map.

It will be noticed that the Permo-Carboniferous crop out along the shore-line and inland where erosion has removed the overlying younger sediments and reduced the surface within 200 feet of sea-level. The Trias-Jura north of Esperance River and Port Esperance consist of the Ross sandstones and yellow shales, while the members of this formation on the south side consist chiefly of the felspathic or coal-

[28] Twelvetrees, W. H.: The Catamaran and Strathblane Coalfields and Coal and Limestone at Ida Bay. Geol Surv. Bull., No. 20, 1915.

measure sandstones. The diabase intrusive has cut the sedimentaries into most extraordinary shapes. Isolated areas of vesicular basalt are found here and there.

In addition to the physical features of this area, the map shows the depth of water in fathoms at every point of the harbour of Port Esperance. This information was obtained from the soundings recorded on the Admiralty chart of this coast-line.

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

The upper mudstone and sandstone members only of the Permo-Carboniferous formation are exposed in this locality. They are found fringing the northern shore of Port Esperance, and are exposed by erosion in the valley of Dover Rivulet. These members are generally devoid of fossils. Succeeding them are the Ross sandstones of Trias-Jura age, outcropping to the north of Esperance River, from which the overlying felspathic and upper sandstones have been denuded. The felspathic member crops out a mile to the southward, and occupies a fairly large area, but in the valley of Creekton Rivulet it has been entirely removed by erosion. The thicknesses of the several members of these formations could not be determined with any degree of accuracy.

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

This igneous rock occupies a very large portion of the surface, and doubtless underlies the whole area of sedimentary rocks at no great depth. Sill forms of intrusion are not apparent, and the outline appears to be that of the irregular surface of a laccolith. The irregular degree and direction of inclination and the minor faulting of the strata are largely due to the uneven outline of this intrusive igneous rock.

(4)—Structure.

(*a*) *Faults.*—Everywhere the beds are upturned at a high angle, and at least two faults have been located.

(*b*) *Dip of the Coal Seams.*—Although the inclination of the strata varies locally, both in degree and direction, the beds have a general rise towards the south-west. At the main workings on the south-west side of the hill in which the coal is found the dip of the seam is at a high angle (18°) to the north-east, but on the east side the general inclination is reversed, and the dip is towards the north-west. It appears likely that this reversal of dip is due to a complete dislocation of the strata.

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

The evidence now in hand indicates that the Hastings and Strathblane seams are identical. Their continuity, however, has been interrupted by Creekton Rivulet, which has completely dissected the upper coal beds. Seams Gamma, Delta, and Eta have been opened up—no others have as yet been found.

F.—*The Mining Properties.*

(1)—The Strathblane Mine.

(*a*) *The Number and Area of Leases.*—The Strathblane Mine is held under leases from the Crown by H. J. Colbourn, and comprises Sections 8680M, of 200 acres, 8683M, of 200 acres, and 6708M, of 240 acres.

(*b*) *Extent and Method of Mining Operations.*—Coal was discovered here 13 years ago by William Anderson, under whose direction the subsequent exploratory works were carried out. Active mining has hitherto been confined to the dip and horizontal tunnels on Section 6708M, in which 400 feet of driving and sinking have been done.

One chain east of the tramway, near the northern boundary of Section 5132M, now vacant, a tunnel has been driven 30 feet on the dip of the seam on a bearing of 55 degrees. At the time of the investigation the tunnel was full of water, and it was impossible to obtain a representative sample of the coal, which, at the entrance, is nearly 2 feet thick. Probably this corresponds with the lower seam exposed in the Hastings Mine.

A section of the coal-bed exposed at the entrance to the tunnel is—

No. 429A, Delta Coal Bed.

	ft.	in.
Fireclay (roof).		
Coal	0	4
Clay band	0	2
Coal	1	6
Fireclay, hard (floor).		

Sample 429A was taken from the stack outside the tunnel, but it cannot be regarded as representative of the true quality of the coal-bed as a whole. The coal is dense and hard, and withstands weathering very well. It is dull-black in colour, relieved by a few shining streaks, and is of the sub-humic variety.

Main tunnel is just outside the south boundary of the 240-acre section and about 100 feet north of the preceding. It commences below the outcrop on a bearing of 38 degrees, intersecting the seam at 30 feet, and at 40 feet commences on the dip, and continues 150 feet farther. The seam has been driven on over 100 feet towards the south-east, starting from the point of intersection in the horizontal tunnel. In this heading the coal appears to be of very good quality. It is massive, fairly hard, black in colour, with bright laminations, and is of humic (bituminous) nature. Where the heading starts the coal-seam is nearly 4 feet thick, but it varies greatly farther in, and the average is about 2 feet·9 inches.

Sample 429 taken from this heading represents the composition of the clean coal. Examination shows the presence of pyrites, and a higher sulphur content is found than usual in coals of this age.

Ten feet lower and 100 feet to the north-eastward of the preceding a strike heading has been driven from the creek over 100 feet on a bearing of 160 degrees. At the entrance the coal-bed is nearly 5 feet thick, but near the end of the heading it is only 2 feet. The following section was measured where the sample was taken :—

No. 429, Gamma Coal Bed.

	ft.	in.	
Fireclay, grey (roof).			
Shale, carbonaceous	0	6	
Coal, bright laminated	3	0	Sampled.
Clay	0	3	
Coal, very bright	0	4	
Fireclay (floor).			

Sample 429 was taken 30 feet from the entrance. The 3-feet seam only of the coal-bed was sampled.

It is evident that this is identical with that exposed in the main workings, but in faulted position in relation thereto. No serious attempt has been made to trace the seam on the west side of the creek. Perhaps the chief reasons are that the coal-bearing strata are covered with detrital material shed from the igneous rock exposed higher up on the hill, and that the surface is clothed with a thick growth of vegetation.

These constitute the workings on the south-west side of the hill.

The workings in the flat country on the east side of the ridge are not so extensive.

About 2 chains from the southern boundary of Section 6708M a dip-tunnel has been driven 60 feet on a bearing of 190 degrees on a seam of coal 2 feet thick. The dip of the seam here is 19 degrees. Thirty feet above the end of the tunnel a shaft has been sunk to the seam, and connects with the tunnel. Twelve feet down an upper seam 15 inches thick was passed through—this probably corresponding with Delta seam at Hastings.

A little farther along the foot of the hill another tunnel has been driven into the seam 30 feet. All these workings are now full of water, and consequently samples of the coal could not be obtained.

On Section 8680M, about 12 chains from the southern boundary, a shaft was sunk to a depth of 25 feet in soft shaly sandstones containing impressions of Trias-Jura plant life.

The seams have been traced along the eastern flank of the hill a distance of 100 chains, but until recently no serious attempt had been made to explore them in order to ascertain their value.

(*c*) *Quality of Coal.*—The analyses show that the coal is of somewhat superior grade to that of Mt. Nicholas and Cornwall, but like that, contains a high percentage of ash. In general appearance the unaltered coals are very similar to those of the eastern districts. It is dense and hard, compact, laminated with alternate dull and bright bands. It has a cubical fracture, is rather brittle, but slacks very little and withstands weathering remarkably well. The bright variety ignites readily in the candle-flame, and on the hearth burns freely with a long yellow flame, giving out great heat in the process. As a domestic fuel it is far superior to most local coals, and for steaming purposes it is highly prized. The proximity of the mine to the deep-water port places this coal in a very favourable position in the Hobart market.

(*d*) *Production.*—The few hundred tons of coal shipped from this mine were obtained in the exploratory works carried on from time to time. The output was sufficient only to enable the operators to thoroughly test the qualities of the coal for steaming and domestic purposes.

(*e*) *Quantity of Coal Available.*—Sufficient data are not available from which to estimate even approximately the amount of coal contained in this area. That it is very considerable is quite evident, because of the long line of outcrop extending from Creekton Rivulet to Worsley's property, a distance of $1\frac{3}{4}$ mile. The lateral extent, however, has not been determined, and cannot be measured until much exploratory work has been done. The undisturbed rocks are not well exposed in this area, the surface being covered with boulders and soil derived from the masses of diabase and basalt capping the ridge to the west and north. Moreover, the heavy forest and thick undergrowth clothing the hills add greatly to the difficulties of examination. It is quite evident, therefore, that a considerable amount of exploratory work is necessary before an idea can be formed of the coal resources of this area.

(2)—The Hastings Mine.

(*a*) *Number and Area of Leases.*—A section of 250 acres, enclosing the workings of this mine, is held under Lease 8580M from the Crown by J. A. Crisp, of Hobart.

(*b*) *Extent and Method of Mining Operations.*—This mine was opened up many years ago, but its development has been slow, and little coal has been shipped from it. Three seams have been exposed by means of tunnels, the uppermost having been sunk on to a depth of at least 200 feet. Gamma seam is 37 feet above Delta, which, in turn, is 27 feet above Eta seam. On Gamma seam, which dips at a high angle (23 degrees) in a direction 72 degrees west of north, a dip-tunnel has been sunk over 200 feet. These workings are in fair order and accessible to a depth of 120 feet. The following section was measured at the place where the sample was taken:—

No. 427, *Gamma Coal Bed.*

	ft.	in.	
Felspathic sandstone (roof).			
Coal	1	$0\frac{1}{2}$	
Clod, coaly	0	3	Sampled.
Clay band	0	2	Sampled.
Coal	0	4	Sampled.
Clod, coaly	0	4	Sampled.
Coal	2	8	Sampled.
Fireclay (floor).			

Sample 427 was taken 50 feet down the incline from a fresh face of coal. As the whole bed, 4 feet 9 inches thick, is broken and shipped to market uncleaned, the bands of clay and coaly clod were included in the sample. By treating the coal in washing machines a great reduction in the ash content could be effected. The roof is very firm, and consists of sandstone of the usual felspathic variety; the floor is formed of hard fireclay. The upper $12\frac{1}{2}$ inches of coal is hard, flinty, and fairly brittle; the lower bands of coal are softer, but of better quality, and firm enough to carry without undue crumbling.

No. 2 tunnel was sent in horizontally to intersect all seams from a point 140 feet east of, and 18 feet lower than, No. 1 tunnel. Driven on a bearing of 254 degrees through felspathic sandstone, Eta seam was intersected at 40 feet, and Delta seam at 105 feet, but Gamma seam was not met with up to 160 feet from the entrance.

A section of the coal bed was measured at the point of intersection. It shows—

No. 428, *Delta Coal Bed.*

	ft.	in.	
Sandstone, felspathic (roof).			
Clod, black	0	7	
Coal	0	6	Sampled.
Clay band	0	1	Sampled.
Coal	1	9	Sampled.
Fireclay, grey (floor).			

Sample 428 represents the quality of the coal at the point of intersection. The coal is rather dull-black, with occasional bright laminations traversing it at short intervals.

At this point the direction of dip is about 50 degrees west of north, and the angle of inclination 23 degrees.

Eta seam, where exposed in the tunnel, is made up of—

No. 462, *Eta Coal Bed.*

	ft.	in.	
Fireclay, grey (roof).			
Coal	0	2	
Clay band	0	2	
Coal	1	7	Sampled.
Fireclay, grey (floor).			

Sample 462 consists of the 19-inch band of coal only. It was taken where the seam was measured in the tunnel.

It has been suggested that the Gamma and Delta seams are identical, but in faulted position, because the former has not been intersected in the lower tunnel. The dissimilarity shown between the sections of these seams in such a short distance discountenances this idea.

The seams have been exposed on many of the timber-haulage tracks traversing Crisp's section and the country adjoining it to the westward, but little or no exploratory work has been done in that direction.

(*c*) *Quality of Coal.*—In every respect the quality of the coal is essentially similar to that in the Strathblane Mine. The coal is a variety of humic (bituminous) that has not suffered greatly from the metamorphic effects of the intrusive diabase.

(*d*) *Production.*—As the work here has been of an exploratory character only, the production has been very small, and probably has not exceeded 500 tons, the little that has been produced having been used for testing purposes in steam-engines, and also for determining its suitability for domestic uses.

(*e*) *Quantity of Coal Available.*—Although the seams have been traced over a very considerable area, there are insufficient data relating to their thickness to enable an estimate of the quantity of coal in this area being made with any degree of accuracy.

(3)—Catamaran Area.

A.—*Location and Extent.*

The area about to be described is situated 2 miles westward from the shores of Recherche Bay and 64 miles southward from Hobart. The visible coal-bearing strata extends for several miles north and south of the chief mine, but the continuity of the seams has been interrupted by faulting and by igneous intrusives. In the aggregate the visible coal-bearing strata in these disconnected areas amount to 2200 acres. Farther westward these formations extend into the mountain region, but little is known of their importance in that direction.

B.—*Access.*

The main road from Hobart to Dover continues to Ramsgate, connecting all the settlements along the sea-coast with one another. It is in fairly good order to Leprena, but farther southward is in a general state of disrepair, and in places is almost impassable. This area is more easily accessible by sea through the smooth-water passage of D'Entrecasteaux Channel (with a depth of 40 to 100 feet of water) to Recherche Bay. This bay, from its position, is sheltered from westerly storms, but is fully exposed to heavy weather from the south-east. Small boats of 8 or 9 feet draught enter Catamaran River and anchor in safety nearly half a mile upstream, but no provision is made for large vessels in the bay. It is contemplated by the owner of the Catamaran mine to construct a jetty from the western shore opposite Bennett's Point, where, it is stated, ships can ride in safety. At the present time there is a weekly shipping service with Southport, but there is very little trading into Recherche Bay.

C.—*Previous Reports.*

The earliest record of the occurrence of coal in this district is embodied in a report by J. Hobbs [29] relating to a voyage of exploration by boat round Tasmania in 1824. In this report Hobbs mentions the occurrence of three seams of coal enclosed in sandstone exposed in the cliff-face overlooking the sea at South Cape Bay. In a later report [30], dated 25th October, 1826, he details the results of further investigation.

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(29) Hobbs, J.: Boat Expeditions round Tasmania, 1824. House of Assembly Paper No. 107, 1881.

(30) Hobbs, J.: Coal at South Cape Bay and Adventure Bay, 1826. Legislative Council Paper No. 16, 1861.

The next reference to this area is contained in a paper by Dr. J. Milligan, read before the Royal Society of Van Diemen's Land in 1849 ([31]). Milligan mentions the occurrence of carbonaceous shale in the standstone cliffs at Southport and the occurrence of coal on the east side of Recherche Bay and at South Cape Bay.

R. M. Johnston ([32]), in a paper published in the Proceedings of the Royal Society of Tasmania in 1893, describes the geology of Southport and Ida Bay, with special reference to the fossil plant remains which occur in the coal measures at those places.

In 1902 ([33]) two official reports by W. H. Twelvetrees were published by the Mines Department. These reports embrace decriptions of coal measures at Catamaran, Recherche Bay, Ida Bay, and Southport. This field was visited again by W. H. Twelvetrees ([34]) in 1914, and the results of his investigations were published in Bulletin No. 20 of the Geological Survey. In this work Twelvetrees presents a detailed account of the coal seams in these areas.

D.—*Topography.*

(1)—General Description.

The topography of Southern Tasmania is extremely rugged and mountainous. The outstanding feature of the region is the irregular mountain range formed by a succession of lofty peaks trending in a general northerly direction about 10 miles from the coast. From this highland country numerous streams flow eastward into D'Entrecasteaux Channel and the South-West Passage. Commencing as mountain torrents, the streams have cut deep channels through the heavily-wooded foothills, and in their lower reaches, flowing slowly, have embedded themselves in the bedrock below deposits of Pleistocene age. The irregularly indented coast-line is due to the removal of part of the softer sedimentary rocks from the enclosing diabase, the shape being conditioned by the bounding igneous rock.

(2)—Relation to Mining.

The mines are situated in the flat, marshy country extending from South Cape Bay up to Lune River. These marshes and the hills surrounding them are covered with heavy forests and extremely thick undergrowth. The timber these forests provide is of great local value, as large quantities are required underground to support the weak roofs of the mines. Occurring in the lowlands, the coal is raised either through dip-tunnel or shaft openings, and the cost of drainage is considerable. The conditions, however, are ideally suitable for tramway construction and the transport of the product to the sea-coast.

([31]) Milligan, J.: Report on the Coal Basins of Van Diemen's Land. Proceedings of the Royal Society of Van Diemen's Land, Vol. I., Part I., May, 1849.

([32]) Johnston, R. M.: Further Contributions to the Fossil Flora of Tasmania, Part I. Proceedings of the Royal Society of Tasmania, 1893, pp. 171-172.

([33]) Twelvetrees, W. H.:

Report on the Occurrence of Coal near Catamaran River, Recherche Bay, 1902. Secretary for Mines Report, 1902.

Report on the Coalfield in the Neighbourhood of Recherche Bay. Secretary for Mines Report, 1902.

([34]) Twelvetrees, W. H.: The Catamaran and Strathblane Coalfields. Geological Survey Bulletin No. 20, 1915.

E.—*Geology.*

(1)—Geological Map.

Stratified rocks of the Ordovician, Permo-Carboniferous, Trias-Jura, Tertiary, and Quaternary systems are represented in this district. In addition, diabase of Upper Mesozoic age and Tertiary basalt occur and occupy a large portion of the surface.

The Ordovician strata consist of quartzite, quartzite conglomerate, and limestone. It is probable that the quartzite and conglomerate belong to the lower series. They outcrop in the hills north of Ida Bay Caves, and there dip west-south-west at an angle of 40 degrees. The limestone, which rises to a very considerable height, is a dense grey rock, seamed with veinlets of calcite, and apparently is identical with the formation of this age found at Mole Creek, Melrose, and elsewhere. The dip appears to be south of east at a low angle. In this formation the very extensive and beautiful caves of Hastings and Ida Bay occur.

Two miles west of Ida Bay is a low hill of Permo-Carboniferous mudstone-conglomerate, and mudstones of this age fringe the northern shores of Southport. Except where the diabase has intersected them, and where they are overlain by Tertiary and Quaternary sediments and basaltic land-flows, the field is almost wholly occupied by Trias-Jura strata. The intrusion of these strata by diabase has resulted in faulting on a considerable scale, the line of dislocation following the axial direction of the diabase.

In the swamp lands of Catamaran Mine massive diabase does not outcrop, but it lies at no great depth, as shown by boring. Some distance back this intrusive protrudes on all sides, and evidently its influence on the coal, though not apparent, is considerable. Basalt of Tertiary age occurs in thin lava-sheets here and there in the vicinity of Ida Bay.

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

Mudstones and mudstone-conglomerates of the Permo-Carboniferous system are exposed round the northern shores of Southport and at the foot of the Sugar Loaf west of Ida Bay. At Southport the upper arenaceous mudstone members of the formation occur, while the beds cropping near Sugar Loaf belong to the Lower Marine beds of the system. These latter consist of mudstone containing pebbles and boulders of granite, granite-porphyry, quartzite, quartz, &c., and represent the waste materials of far distant formations. The former embrace sandstone and shale members, as well as mudstones, and contain impressions of *Vertebraria* and *Pecopteris lunensis* [35]. A drill-hole sunk near the shore passed through shales and sandstones, and at 500 feet entered conglomerate, and continued through pebbly sandstones containing marine shells to 612 feet. All these strata dip to the south-west toward Ida Bay, where their continuity is interrupted by diabase. The great difference in level between these strata and the mudstone conglomerates of Sugar Loaf Hill indicates a fault of very considerable displacement.

Strata belonging to the Trias-Jura system occupy the greater part of the surface of this coalfield. The productive felspathic sandstones are exposed at surface over considerable areas, but in places this member has been entirely removed. They conformably overlie the uppermost member of the Permo-Carboniferous formation, an arenaceous mudstone. Their thickness, as measured here, exceeds 800 feet. The nature and sequence of the strata constituting this formation are shown in the log records of the boring operations.

Fossil plants occurring in the shale and fireclay of Alpha coal bed are typical of the Trias-Jura.

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(35) Johnston, R. M.: Geology of Tasmania, page 190

Only one coal bed (Alpha) of any considerable thickness has been found in these strata. Records of four drill-holes made in this area show that no coal occurs in the lower members of the Trias-Jura, which here are, in the aggregate, nearly 800 feet thick. The log records of " A " and " B " bores are given hereunder:—

Bore A.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Clay, shingle, and diabase boulders	19	8	19	8
Shale, dark blue	33	10	53	6
Sandstone, grey, brown and blue, hard	88	5	141	11
Shale, broken	9	4	151	3
Sandstone, broken	8	3	159	6
Shale, blue, with coal streaks	29	6	189	0
Sandstone, broken	4	10	193	10
Shale, pink and green talcose	4	2	198	0
Shale and sandstone, broken	10	6	208	6
Shale, broken	6	6	215	0
Clay, with amygdules of calcite	1	6	216	6
Diabase	13	4	229	10

Bore B.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Clay, sandy	8	0	8	0
Shale, micaceous	6	0	14	0
Clay, light micaceous	32	0	46	0
Sandstone, micaceous	39	6	85	6
Conglomerate, white sandstone	1	6	87	0
Sandstone with micaceous iron	44	0	131	0
Shale, white sandy	16	0	147	0
Sandstone, micaceous	101	0	248	0
Shale, grey micaceous	9	0	257	0
Sandstone with iron pyrites	62	11	319	11
Shale, with coal markings	31	3	350	8
Sandstone with micaceous iron	12	10	363	6
Shale with pyrites and micaceous iron	29	10	393	4
Sandstone with micaceous iron	100	0	493	4
Shale, grey	36	8	530	0
Sandstone, grey and hard	114	0	644	0
Quartzite with pyrites	12	6	656	6
Shale, light, sandy	16	3	672	9
Sandstone, blue and hard	16	0	688	9
Diabase veined with calcite	37	9	726	6

Bore-holes " C " and " D " likewise were fruitless. Bore " C," after passing through alluvium and felspathic sandstone, penetrated diabase at 63 feet. The igneous rock was broken at the point of contact, which fact gave rise to the mistaken idea of the occurrence of loose erratic boulders in the felspathic sandstone. Bore " D," about 15 chains north-west from the new main shaft, passed through 20 feet of silt and over 300 feet of barren felspathic sandstone and entered diabase at 365 feet.

(3) The Mode of Occurrence of the Diabase.

The results of all the borings in this neighbourhood clearly indicate that the diabase outcrops to be seen along the sea-shore and on the ridges inland do not represent disconnected dykes and sills, but the upward irregular protrusions of the subjacent laccolithic mass which apparently rises to different horizons in the coal measures and extends throughout the coalfields of the island. Wherever boring has been continued deep enough this igneous rock has been found. The extreme irregularity of its outline is shown by the great variation in depth at which the diabase is met with, and by the fact that it either crowns or forms the backbone of the highest mountains.

Crosscutting of the sill offshoots of the main igneous mass from one horizon to another and a splitting of one igneous sheet into two are not at all uncommon features of this formation. It has been noted that there are many bodies intermediate in thickness between the comparatively thin sills and the great parent laccolith. This adds greatly to the difficulties experienced in arriving at a true conception of the form of intrusion in any particular area, especially where good sections are not available for inspection.

Apparently the thrust came from the south-west, as the diabase sills rise towards the north-east, but the surface of these bodies is so irregular that this cannot be taken as a safe criterion.

(4)—Structure.

(*a*) *Faults.*—Faulting on both a minor and major scale has taken place in this district. The amount is controlled by the height in the strata to which the diabase has risen, and the direction is conditioned by the course of the longitudinal axes of the intruding rock. Complete dislocation has resulted, and little or no folding of the strata has taken place. As the trend of the axes is usually east to west of north, the resultant faults take similar courses, and the amount of displacement is measured by the height of uplift. Minor faulting of the strata is due probably to shrinking following the cooling and contraction of the diabase. Further westward, beyond the confines of this field, great structural faults occur, but owing to lack of time a thorough investigation of the geologic structure could not be made.

(*b*) *Dip of Coal Seams.*—The general direction of dip of the coal seams in this district is north-westerly, and the inclination varies from 6 to 20 degrees. In the South Cape area the strata dip at an angle of 12 degrees to the south-east, and at Ida Bay the coal beds have a south-westerly dip of 10 degrees.

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

The impracticability of tracing the coal beds from one locality to another in this and neighbouring areas makes exact correlation in some places very difficult and in others quite impossible. The only criteria upon which correlation of the seams can with safety be based are the nature of the coal and the enclosing strata, and the position of the coal bed in the felspathic sandstones. These easily recognisable felspathic sandstones peculiar to the Trias-Jura in Tasmania contain the productive measures in these areas. At Catamaran the main coal bed, contained in fireclay at a high horizon in the felspathic sandstones, apparently corresponds with the "Alpha" bed of other districts. A few feet below this it is reported another seam occurs corresponding with the position of "Beta" bed, but insufficient exploration has been done to confirm the latter, and no absolute information has been obtained relating to the occurrence or not of other seams at lower horizons. The Ida Bay seams, containing *Pecopteris lunensis* and *Phœnicopsis*, appear probably at a lower geological horizon than those exposed at Catamaran, and the Southport strata, containing those remains with also *Vertebraria australis* (McCoy), are apparently transition beds between the Trias-Jura and the Permo-Caboniferous.

F.—*The Mining Properties.*

There are four known coal areas in this district. In one area only, namely, Catamaran, has the mining of the coal been established on an industrial basis. Developmental work showed encouraging results, and preparations have been completed for the active exploitation of the seams. The other areas—South Cape, Ida

Bay, and Moss Glen—are not as conveniently situated nor are the prospects as encouraging as the Catamaran.

(1)—The Catamaran Mine.

(*a*) *Number and Area of Leases.*—The Catamaran property now consists of two mineral leases, 8242M, of 100 acres, and 6884M, of 128 acres, and tramway lease 1085W. These leases are charted in the name of H. Jones & Company Limited, of Hobart.

(*b*) *Extent and Method of Mining Operations.*—The discovery of coal in this area dates back to 1900. Since that time the Catamaran mine has been explored intermittently by several syndicates, and during the last decade considerable development work has been accomplished.

The seams outcrop on the eastern and southern sides of a rather extensive swamp, under which they dip in a north-westerly direction at angles of 10 to 11 degrees. The surface is covered with alluvium to depths of 10 to 30 feet, and below this are found the felspathic sandstones and fireclays containing the coal seams. Not many chains westward of the New Main shaft is a fault that forms the limit of the workable ground from this mine in that direction. The seams, however, recur at a higher elevation westward and outcrop at several points on the hillside. There they appear to be rather dirty and small, but under cover their condition improves. Along the old tramway route, south-westward of the main workings, the seam outcrops at surface for many chains. A few shallow pits sunk along the outcrop expose the coal bed to better advantage, and show the seam of coal similar in general character to that of the main workings. It is slaty in structure at the roof, but regains its normal condition in the body of the seam. In this part the direction of dip is only a few degrees west of north, the change from normal indicating an intervening fault.

The workings comprise a well-timbered main shaft and many shallow shafts and dip drives sunk along the outcrop at intervals over a distance of 70 chains. In addition to these exploratory works several bore-holes have been sunk along the strike of the seam near the outcrop, but not one in a position to prospect the seam on the dip.

The New Main shaft (13 feet x 6 feet) of three compartments, is 130 feet deep, and is situated in the swamp land near the boundary between Sections 8242M and 6884M. The timbering is sound and in good condition, and the general arrangements for operation from this opening on a fairly large scale are adequate. A chamber has been cut at the bottom of the shaft, from 8 to 12 feet in height and 13 to 16 feet wide. Preparation has been made to commence the driving of headings in an eastward and a westward direction. Although the appointments are satisfactory, the site of these workings is not well chosen.

After passing through 109 feet of alluvium and felspathic sandstone the coal-bearing bed was cut, and the shaft continued in it for 19 feet. The upper 12 feet of the coal bed is poor and unworkable, consisting largely of stone and clay bands with stony coal. The following section was measured at the bottom of the chamber:—

No. 464, *Alpha Coal Bed.*

	ft.	in.	
Coal, small band (roof).			
Stony material	0	8	
Coal	0	6	
Clay	0	2	
Coal, bright and hard	0	6	
Clay	0	4	
Coal, bright and hard	2	7	Sampled.
Clay (floor).			

Sample 464 was taken from the place where the section was measured, and represents the 2 feet 7 inch-seam of clean coal only. In working it is probable that 4 feet 6 inches of the coal bed will be mined, and in consequence a certain amount of the clay impurity will inevitably find its way into the coal as sent to market.

The analysis reveals a superior composition to the best Cornwall coals. The ash is milk-white in colour, friable and free from clinker.

Twenty-two chains to the north-east of, and 12 feet lower than, the New Main shaft, is the Electric shaft. It is only a prospect opening (6 feet by 3 feet), and 38 feet deep. The coal bed is reported to be 9 feet thick and consists of 2 feet 6 inches of clean coal of good quality, and alternate bands of low-grade coal and stony material. At the time of this investigation the shaft was full of water.

Farther to the north-east on Section 8723M, other prospect shafts were abortive.

Thirty-five chains south-south-west from the New Main shaft is the Pump shaft, 37 feet deep. The coal bed exposed in the bottom of this working consists of—

	ft.	in.
Clay (roof).		
Coal	0	11
Clay stone	0	1
Coal	0	9
Clay stone	0	4
Coal	2	5
Clay (floor).		

The coal bed exposed in another shaft a chain or two southward consists of:—

	ft.	in.
Clay (roof).		
Narrow bands of clay and coal	3	9
Coal	0	7
Stony band	0	1
Coal	0	4
Stony band	0	1
Coal	1	1

Sample 430, obtained from stocks in one of the bins here, fairly well represents the average grade of material shipped to market. In this heap it was noticed that thin bands of white fireclay had been mined with the coal, and this impurity increased the natural ash content considerably.

The following section was measured by W. H. Twelvetrees in the old 21-feet shaft:—

	ft.	in.
Soil	11	6
Coal	0	10
Coaly clod	1	2
Clay	0	5
Coal	0	6
Clay parting	0	2
Coal	0	3
Stony coal	2	2
Shaly band	0	0½
Coal	0	9
Clay band	0	3
Coal, clean	2	8

The coal in the upper part of the bed is decidedly inferior in quality to that resting upon the clay floor.

Two main dip tunnels, connected one with the other, have been driven 300 and 500 feet in a south-westerly direction from points near the Pump shaft. From these workings the bulk of the coal exported from this mine has been obtained. Thirty-seven feet from the entrance to the west drive, and 13 feet below the surface, the coal bed shows the following section:—

No. 465, *Alpha Coal Bed.*

	ft.	in.	
Clay (roof).			
Coal	0	3	
Stony material	0	2	
Coal	0	3	
Stony material	0	2	
Coal	0	10	Sampled.
Stony band	0	1	Sampled.
Coal	0	5	Sampled.
Stony band	0	1	Sampled.
Coal	1	1	Sampled.
Clayey shale, soft	1	7	
Coal	0	6	
Clay (floor).			

Sample 465 was taken from the place where the section was measured, and consists of the clean coal bands (2 feet 4 inches), excluding the enclosed stony partings. The coal at this point had been subjected to the injurious effects of air and percolating water for many years, and had suffered deterioration in proportion.

The following is a section of the coal bed exposed in the next prospect shaft:—

	ft.	in.
Clay (roof).		
Coal	0	7
Stony band	0	1
Coal	0	4
Stony band	0	1
Coal	1	1

Then narrow alternate bands of clay and coal up to 6 feet 1 inch from roof to floor. At this point it will be seen that the bands of clean coal are too thin to be mined at a profit under existing conditions.

A few chains southward from the main dip drive workings a tunnel was driven by Young on the dip of the seam a distance of 150 feet into the hill. This opening is now full of water. It is reported that the soft clay roof required such strong supporting timber that it was considered inadvisable to continue operations from the opening. The seam is thinner here than where exposed in the main workings.

Thirty chains due west from the preceding, the outcrop of the seam approaches the valley of Catamaran River. In this locality two short tunnels a few chains apart have been driven into the hill. This work produced rather discouraging results.

It will be noticed that although the coal bed at the several points where measurements were taken is not less than 6 feet, the average width of workable coal free from bands is only 2 feet 6 inches. In the operation of exploiting this coal bed it will be found advantageous to mine 4 feet 6 inches to 5 feet of the material, holing out the clay bands first.

Owing to a number of reasons, the chief being the extreme wetness of the mine and the softness of the roof and floor of the seam, the exploitation of the coal will be attended with considerable difficulty, and the resultant increase in the cost of extraction will largely offset any advantage this mine may possess over others less favourably situated. The porosity of the surface alluvium and the underlying rocks precludes the possibility of draining off all the surface water, a considerable portion of which ultimately finds it way into the mine workings, and increases in quantity as the workings approach the outcrop. The large quantity of timber required, and the necessity for putting in box sets and close packs, will appreciably affect the rate and cost of production. It is worthy of mention that the lack of precautions in this connection resulted in the collapse of the supporting timber in the dip tunnel workings, and the subsidence of the overlying rock from the surface.

(c) *Quality of Coal.*—The physical and chemical properties of this coal are such that it may be regarded as the best of its kind in Tasmania. It is a rather bright humic (bituminous) to sub-humic variety, with alternate dull and bright laminations. It is soft and brittle, and inclined to slack, and could not withstand frequent handling without breaking up and otherwise deteriorating. The tender nature of the coal is due to the effects of weathering agencies, either by exposure or by water percolation, as evidenced by the increased hardness under thicker cover. The coal bed where examined is under thin cover, and weathering by water percolation from the swamps has doubtless been in slow progress for a very long time.

The coal burns very quietly, without the slightest decrepitation, and makes a very good household fuel. It is highly prized also by blacksmiths, and finds a ready market for steaming purposes. For special uses this coal should command higher prices than the ruling rates for imported coals. This remark applies especially to its superiority over most other coals in blacksmithing and general forge work.

(d) *Production.*—The total quantity reported to the Mines Department as raised to date from this mine is 3527 tons, as follows:—

	Tons.
1905	1224
1906	1303
1911	370
1912	600
1918	30
Total	3527

(e) *Quantity of Coal Available.*—In order to provide a safe working margin the average thickness for purposes of calculation of quantities is put at 30 inches. This also may be regarded as the critical thickness below which the coal could not be profitably mined under the conditions existing here. Actually the coal seam has not been explored over a greater area than 60 acres, but the investigation showed that there have been no serious interruptions within the confines of the swamp land, and it may be safely assumed that the total extent of coal workable from these mine openings is fully 120 acres. On this basis, and allowing 25 per cent. reduction on account of working losses, the quantity of coal available amounts to a maximum of 360,000 tons. In this case, however, it is considered that not more than 60 per cent. of the coal could be mined by the pillar and stall system, and the actual tonnage probably would not exceed 300,000.

(2)—Moss Glen.

(a) *Number and Area of Leases.*—The Moss Glen property, situated a little over a mile due west of Leprena, consists of Lease 8749M, of 200 acres, charted in the name of G. H. Smith.

(*b*) *Extent and Method of Mining Operations.*—Coal was discovered on this property in 1899 by G. H. Smith, and a little exploratory work has been carried out subsequently. These workings consist of several shallow shafts, dip tunnels, and bore holes.

Below the old tramway, 190 feet above sea-level, a dip tunnel has been driven north-west on the main seam of coal. At the end of this tunnel (now full of water) a dyke of diabase was encountered, and operations in this direction were discontinued. The following section was measured by W. H. Twelvetrees at 21 feet from the entrance:—

	ft.	in.
Clay (roof).		
Coal	1	0
Clay, band	0	5
Coal	2	6
Clay, band	0	2
Coal	2	0
Clay (floor).		

The coal bed dips north-westerly at 20 degrees. In many respects it is remarkably like the main Catamaran coal bed, and probably is identical with it, but is neither of such good quality nor comparable in thickness of seam with the bed in that locality.

The numerous other workings gave a little information regarding the seams, but the most important results have been obtained by drilling. These show that the coal seams here are not of any considerable economic value.

"E" bore was put down near the shore at Recherche Bay, at sea-level. The nature of the strata bored through is shown in the subjoined table:—

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Clay, sand and shingle	4	0	4	0
Sandstone, felspathic	147	0	151	0
Shale, carbonaceous	7	0	158	0
Sandstone, felspathic, with shale	42	8	200	8
Shale, with coal veins	1	8	202	4
Sandstone, felspathic	43	8	246	0
Shale, dark	7	0	253	0
Coal, bright	0	6	253	6
Shale, dark sandy	18	9	272	3
Sandstone, felspathic	44	9	327	0
Shale, dark, with veins of coal	14	2	341	2
Coal, bright	0	4	341	6
Shale, dark	32	0	373	6
Coal	0	6	374	0
Shale	0	4	374	4
Coal	0	8	375	0
Shale, dark	32	0	407	0
Sandstone, felspathic	43	8	450	8
Shale, brecciated	3	10	454	6
Diabase	60	6	515	0

"F" bore was sunk from a point 200 feet up the mountain side, a little beyond the faulted seam at the tunnel. Coal markings and veinlets were met with throughout the bore, and at 104 feet down 4 inches of coal were passed through. Boring was discontinued before a depth was attained sufficient to thoroughly test these strata.

The following table shows the nature of strata passed through:—

Strata.	Thickness. ft.	in.	Total Depth. ft.	in.
Surface soil and clay	28	0	28	0
Shale, soft white clayey	4	0	32	0
Shale, soft brown clayey	19	0	51	0
Clay, carbonaceous	4	0	55	0
Shale, soft, with coal veins	1	6	56	6
Shale, band	0	8	57	2
Coal	0	10	58	0
Shale, band	0	4	58	4
Coal	0	6	58	10
Shale, band	0	3	59	1
Coal	0	2	59	3
Shale, band	0	4	59	7
Coal	0	3	59	10
Shale, band	0	6	60	4
Coal	0	3	60	7
Shale, band	0	5	61	0
Coal	0	9	61	9
Shale, band	0	4	62	1
Coal	0	7	62	8
Shale, band	0	2	62	10
Coal	0	6	63	4
Shale, band	1	6	64	10
Coal	0	3	65	1
Clay, with coal veins	13	2	78	3
Shale, soft micaceous	25	9	104	0
Coal	0	4	104	4
Limestone	0	5	104	9
Sandstone and shale	6	4	111	1
Conglomerate	5	8	116	9
Shale	9	3	126	0
Sandstone, felspathic	26	0	152	0

This coal is rather dull and soft, having been greatly affected by weathering agents. The ash content is high, even in picked samples it exceeds 20 per cent. It ignites slowly, and burns fairly well on the open fire, but it cannot be regarded as a good domestic coal.

(3)—Ida Bay.

(*a*) *Number and Area of Leases.*—Ida Bay is an inlet of Southport, near the mouth of Lune River. The mine is situated a mile to the south-west, and the main roadway passes through the property near the workings. It is difficult to delimit the boundaries of the coal-bearing strata, but probably the area does not exceed 300 acres.

(*b*) *Extent and Method of Mining Operations.*—At the base of Sugar Loaf Hill some work was done in 1892 on a coal seam striking west of north, and dipping at a high angle (20°) south-west. At the entrance to the dip tunnel (now fallen in), the roof of the bed is felspathic sandstone, and the floor appears to be of the same material. The extent of these workings could not be ascertained, but the tunnel is reported to be 180 feet long.

Lower down hill is another seam about 12 inches thick, consisting of earthy coal, and apparently of very little value.

Above the tunnel a shaft was sunk 60 feet, with the object of connecting with it, in order to provide for the good ventilation of the workings.

North-westward of the tunnel, and higher up the hill, another seam of coal, 15 inches thick, has been exposed in a trench.

None of the openings were accessible at the time of this investigation, and consequently it was impossible to obtain representative samples.

These constitute all the mine openings that have been made on this property.

There are three known seams of coal on this property, but only one appears to be of workable thickness. Away from the tunnel the strike of the main seam is from 15 to 20 degrees west of north, and the dip 10 degrees to the south-west. In the tunnel the angle of dip is much greater. The thickness of the seam varies considerably, and probably averages 3 feet, but included in this measurement are four narrow bands of clay and stony material.

In appearance the coal is a dull black, with occasional bright layers. It is soft, and in places almost fissile in texture, but increases in hardness and compactness as it gains cover.

It burns quietly and emits considerable heat, but, unwashed, it contains much clay and shaly matter, and is not a good steaming coal, nor is it valuable for domestic use.

Three hundred and thirty tons have been produced in the operations of driving and sinking tunnels and shafts.

(4)—Southport.

Exploratory works for the purpose of testing the coal measures strata have been made on both sides of Southport.

In 1893 a drill-hole ("G") was sunk to a depth of 612 feet, at a point 70 chains northward of the Narrows, and 1 chain west of the beach. The strata passed through consisted of sandstones and black shales to 134 feet, a 3-inch band of coal, hard sandstones and shales to 497 feet, hard conglomerate for 10 feet, then hard, grey, fine-grained sandstone with pebbles, marine shells, and blue shale bands.

On the south side a shaft was sunk by the Government in the early forties without result.

(5)—Recherche Bay.

Two shafts were sunk in the forties on the east side of Recherche Bay. The main shaft is circular and masonry-lined, and is still in good repair. The coal in this seam is of inferior quality, and not more than 2 feet thick.

(6)—Lune River.

Shales outcrop in the road-cutting on the north bank of Lune River, suggesting the possibility of the near presence of a coal bed.[36] A little exploratory work in this locality may lead to important results.

(7)—South Cape Area.

This area is the southern extension of the Catamaran field, from which it lies 6 miles distant.

Coal was discovered in the cliffs of South Cape Bay in 1824 by J. Hobbs, and was reported on again in 1848 by Dr. J. Milligan. According to these reports there are three distinct beds, resting on sandstone and dipping at 12 degrees to the south-east. The principal bed, 40 inches thick, consists largely of stony material, and contains an excessive amount of pyrites. The coal in the other seams is likewise of inferior quality, and not likely to become of economic importance. Two shafts were sunk in the diabase rock about 500 yards inland, with the object of cutting the 40-inch seam exposed in the sea-cliff, but operations were suspended before

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(36) Since the foregoing was written prospectors have opened up a coal bed of three seams, containing 9 feet of coal. The coal occurs under light cover in flat country of considerable extent.

reaching the coal, which was estimated to lie 400 feet from surface. A fruitless attempt was made also to sink to the coal upon the marsh land toward Catamaran.

The following section of these South Cape beds was measured by Dr. Milligan:—

	ft.	in.
Shale and clay	23	0
Sandstone, with clay seams	130	0
Slaty clay	23	0
Sandstone	1	6
Shale	7	4
Coal, black, bright	0	6
Shale and clay	18	10
Coal, with thin shale band	0	10
Shale	2	3
Sandstone	2	6
Clay ironstone	0	6
Sandstone	8	8
Shale and clay	1	6
Coal and shale	4	3
Slaty clay and shale	1	0
Sandstone, clayey	15	0
Clay, including three seams of shale and one 6-inch seam of coal	50	0
Compact clayey sandstone, containing *Thinnfeldia odontopteroides* and other ferns.		

Fossil trunks of trees, probably silicified conifers, have been noted in the face of the sandstone cliff.

(8)—New River Area.

Seams of Tertiary coal occur in the valley of New River, which empties into the sea east of Cox's Bight, at the south end of the island. The coal varies from 3 to 6 feet thick, but is of no present economic value.

Chapter VIII.

NEW TOWN COALFIELD.

A.—*Location and Extent.*

This coalfield occupies the foothills near the north-eastern base of Mt. Wellington, and extends into the western part of New Town, a suburb of Hobart.

The outline of the coal area is very irregular, and probably does not exceed 300 acres in extent.

B.—*Access.*

Situated in part within the boundaries of New Town and only 2 miles from the wharves at Hobart, the coalfield is very easily accessible.

C.—*Previous Reports.*

The only official reports extant on this field are by G. Thureau (37) and F. M. Krausè (38). The investigations were made under an instruction from the Minister for Lands, to ascertain whether or not the diamond-drill could be beneficially employed in the further exploration of the field for coal.

D.—*Topography.*

(1)—General Description.

The coal-measures proper occupy a flat basin of limited extent bounded on the west and south by the diabase-capped spurs of Knocklofty; on the east by the diabase ridge of the Domain; on the north it is separated from another area of the Trias-Jura by a ridge of diabase following the course of New Town Rivulet. Between this comparatively level country and the great mass of Mt. Wellington (4166 feet above sea-level) are a number of broken hills consisting almost wholly of diabase.

The estuary of Derwent River, which extends along the eastern boundary, receives the drainage of the few small streams flowing from this side of Mt. Wellington.

(2)—Relation to Mining.

The coal-bearing strata generally occupying low-lying country between diabase hills is not very well exposed in section. In most cases shaft-sinking is necessary to open a mine on the seams, but at a few places operation by dip-tunnel is possible.

Generally the conditions, with this exception, are not unfavourable to mining.

E.—*Geology.*

(1)—Geological Map.

The accompanying geological map is based on the work of F. M. Krausè. Additions by the writer were made where considered necessary for the purpose of illustrating this report. Besides showing the relationship between the several formations, the map shows the positions of the shafts, dip-tunnels, and adits on the several seams.

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

These beds, pierced by numerous shafts and exposed in road-cuttings, can be followed in sequence, but the order as a whole cannot be ascertained exactly, as the

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(37) Thureau, G.: The Carbonifer us Deposits near New Town, 1883.

(38) Krausè, F. M.: The New Town Carboniferous Deposits, 1883. House of Assembly Paper, No. 59.

several members of both formations are broken by numerous faults and intrusions of diabase. These beds were carefully studied by F. M. Krausè and R. M. Johnston, the former of whom prepared the following section on the supposition that all members of the series are represented:—

	Strata.	Thickness.		Total Depth.	
	Trias-Jura.	ft.	in.	ft.	in.
Upper Coal Measures.	Carbonaceous shale (coal)—Eta seam	1	0	1	0
	Shale and sandstone	21	0	22	0
	Coal, shale—Theta seam	1	6	23	6
	Clay, shale, and sandstone	78	0	101	6
	Coal, shaly—Iota seam	3	0	104	6
	Clay shale	1	9	106	3
	Sandstone, with nodules of pyrites and fern impressions	98	0	204	3
	Coal, shaly } Kappa seam	1	6	205	9
	Clay shale, replete with *Pecopteris* } Kappa seam	1	3	207	0
	Coal shaly } Kappa seam	1	0	208	0
	Shale and sandstone	215	0	423	0
	Coal, shaly	1	10	424	10
	Blue and grey shale, and sandstone	10	2	435	0
Ross Sandstones.	False-bedded sandstone and thin layers of shale	850	0	1285	0
	Sandstone, largely quarried for building	505	0	1790	0
	Permo-Carboniferous.				
	Light grey indurated clay shale	300	0	2090	0
	Breccia and conglomerate mudstone containing granite, quartz, &c.	10	0	2100	0
	Sandy limestone, calcareous shales, and sandstones containing marine shells	280	0	2380	0

Certain beds of the grey shales underlying the coal seams contain an abundance of Mesozoic flora of many forms. The cycad and conifer plants are particularly well represented.

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

Diabase occupies the greater part of the mass of Mount Wellington, and a considerable area of this rock has been exposed in the foothill country by denudation of the sedimentary formations. This intrusive has a very irregular outline, rising to different levels in short distances. Thus, Mount Wellington, only 3 miles distant from the coalfield, is over 4000 feet above the diabase projecting through the coal-measures of the piedmont.

The exposed diabase then represents the upper irregular outline of a great transgressive mass connected with the subjacent laccolith. The intrusion took place at several horizons, completely severing certain members of both sedimentary formations and spreading out sill-like between others. The resultant dislocation of the strata is shown in the elevation of beds to different heights.

(4)—Structure.

(*a*) *Faults.*—Faulting on a minor scale is very common, and several faults of 20 or more feet displacement are known. The main fault in the Meredith's Mine bears South 67° East, and a nearly parallel fault close by, South 40° East. Other more or less parallel faults of similar dimensions occur in the Rosetta, Sims, and Jarvis sections.

(*b*) *Dip of Coal Seams.*—The average dip of the coal seams is 10 degrees to the south-west. There are local variations in the proximity of diabase protrusions, but the prevailing dip is as stated. The variations in direction are from S. 24° W. to south-west.

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

Four coal seams have been worked in this field. Two more seams are reported, but they are only extensions of those already known in faulted position in relation thereto. These seams, Eta, Theta, Iota, and Kappa, are the lowest in the series of eight occurring in the Trias-Jura, the upper seams having been removed by erosion.

F.—*The Mining Properties.*

The mines of this coalfield have long since been abandoned, and the workings are now in a condition of collapse. Forty years ago twelve collieries were in active operation, and a large quantity of coal was raised and sold in the local market.

Meredith's Mine consisted of a shaft 200 feet deep, in which Theta seam was intersected at 195 feet. The coal varies from 15 to 30 inches in thickness, and is of fair quality. The seam is broken by numerous faults, which interrupt the regular working of the mine and make mining costly and difficult.

The Enterprise Mine was the only one equipped with hauling and pumping machinery. The shaft is 110 feet deep, and intersects Theta seam near the bottom. Here the seam is 2 feet 10 inches thick, consisting of 22 inches of coal and 12 inches of shaly parting. In the direction of dip (south-west) of the coal the workings extend nearly 700 feet, following the direction of higher-grade coal. Toward Hobart, as exemplified in the Jarvis and Rosetta Mines, the seam is much broken, and toward the south it becomes much thinner and unremunerative.

Sims' Mine, adjoining the last mentioned, was operated by means of a shaft 140 feet deep. Eta seam was cut at 55 feet and Theta at 120 feet. The upper seam (Eta), nearly 30 inches thick, dips south-westerly at 10 degrees. The coal in its undulating dip is very irregular and of little value toward the south-east.

Besides the mines described, which were the last in operation, several others were worked, with fair success. However, none of them is of sufficient importance to warrant further attention.

(*c*) *Quality of the Coal.*—The coal is a shaly, fissile, anthracitic variety altered by the metamorphic effects of the diabase intrusive. It is of black vitreous to submetallic lustre with a black streak. It ignites only at a high temperature, and burns slowly with evolution of great heat, leaving a compacted residual ash possessing the same shape and bulk as the coal before combustion.

The coal was used in the locality as a domestic fuel, and was sold at prices ranging from 17 to 23 shillings per ton delivered to householders.

(*d*) *Production.*—There is no record of the production of coal from this field. Several mines were in continuous operation for 10 or more years, but only on a small scale. Probably not more than 50,000 tons of coal was produced in the aggregate.

(*e*) *Quantity of Coal Available.*—In essaying an attempt at an estimate of the quantity of coal in this field, the writer feels constrained to safeguard himself by reducing the calculated quantities by half. This has been deemed necessary because the workings have revealed many irregularities in the seams and the presence of numerous minor faults.

On the basis laid down in this work, and making the further allowance mentioned, it is estimated that the available tonnage does not exceed 200,000, and that the probable quantity in addition amounts to about 700,000 tons.

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

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(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 ½ 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	Seam	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.		Total Depth.	
	ft.	in.	ft.	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	3	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.		Total Depth.	
	ft.	in.	ft.	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.		Total Depth.	
	ft.	in.	ft.	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.	Total Depth.
	ft.	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 $2\frac{1}{2}$ 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	11½
No. 3 "	2	10	162	11½
No. 4 "	0	4	227	3½
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, 1869.

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.

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

(48) C. Gould: Coal South of Oatlands, 1869.

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

Strata.	Thickness. ft.	Thickness. in.	Total Depth. ft.	Total Depth. in.
Surface shaft—hard, cemented gravel	37	6	37	6
Coarse 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 sandstone, 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
Coarse 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
Coarse felspathic 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 coarser 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	33·9
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 × $4\frac{3}{4}$ × 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 [50] 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.

[50] 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,

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[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 × $4\frac{3}{4}$ × 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.

([56]) See page 194.

([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. ft.	Thickness. in.	Total Depth. ft.	Total Depth. 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	3½	437	11½
Coal	0	5½	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 $1\frac{1}{4}$ 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 purposes, 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.

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

Chapter XIV.

THE AVOCA COALFIELD.

(1)—Mt. Christie Area.

A.—*Location and Extent.*

Mt. Christie coal area lies 5 miles northward from Avoca, the only organised settlement in the district. Avoca is situated at the point of confluence of St. Paul and South Esk rivers, and is 52 miles by rail from Launceston, the chief port and centre of population in the northern part of the State.

This coal area includes the Mt. Christie Mine lease and parts of Buena Vista and Brambletye estates, amounting in all to 12,000 acres.

B.—*Access.*

The present way of approach to the Mt. Christie Mine is along the Story Creek road for 3 miles, then along the comparatively steep Mt. Rex branch-road for 2 miles. From Avoca the foundation of the road to the turn-off is solid, and the grades are easy, there being a rise of only 275 feet in 3 miles, thence the ascent is over 700 feet in 2 miles, and the road is in a bad state of repair. A much better route is available up the valley of Tommy Creek, along the banks of which a tramway survey was made a few years ago.

The mine openings in the valley of Buffalo Brook are more easily accessible from Hanleth railway-station.

C.—*Previous Reports.*

The occurrence of coal in this district was noticed by A. Montgomery,[66] and was referred to casually by him in a report on the Ben Lomond district submitted to the Secretary for Mines in 1892. In the year 1901 G. A. Waller[67] visited the district in order to investigate the tin deposits, and in a report compiled by him mentions the occurrence of coal measures in the valley of Gipps Creek and on the south-east flank of Ben Lomond. Apparently the main outcrops of coal were unknown to these investigators, for the first official record of the Mt .Christie and Buena Vista seams was made by W. H. Twelvetrees[68] in 1905. In this work detailed descriptions were given of the outcrops near the main tunnel, and references were made also to some inaccessible workings in the neighbourhood.

D.—*Topography.*

(1)—General Description.

The development of the physiographic features in this terrain began in the late Mesozoic or in the early Tertiary, and has continued without serious interruption to the present time. During the long intervening period the main drainage channels occupied by the South Esk and St. Paul rivers have been developed. These master streams, to which all the drainage is tributary, even in the late Tertiary, had reached base level, and, following a long period of relative stability, had by lateral erosion extended their valleys 1 to 3 miles. In

(66) Montgomery, A.: Report on the Ben Lomond District, 1892. Secretary for Mines Report, 1891-1892.

(67) Waller, G. A.: Report on the Tin Mining District of Ben Lomond. Secretary for Mines Report, 1900-1901.

(68) Twelvetrees, W. H.: On Coal at Mount Rex. Secretary for Mines Report, 1905-1906.

the lower part of the minor streams the valleys are wide and the flood-plains are well developed, as in the master stream valleys. The two master streams fed largely by surface run-off, have extreme and rapid fluctuations in height. The subsidence of the land surface in the late Tertiary led to the deposition of the sediments, 50 to 70 feet thick, now occupying the old flood-plains of the broad valleys.

Over these sediments in the valleys of both streams basaltic lava flowed from the probable volcanic crater of St. Paul Dome. Sections of this lava resting on Tertiary sediments are well exposed in the banks and beds of both streams, and remnants of this once extensive flow are scattered here and there over the flood-plains. A subsequent uplift of the region rejuvenated the sluggish streams, which are now actively engaged in cutting through their old beds.

These principal valleys are due not so much to tectonic movements as to erosion. Thus their courses have been conditioned by the presence of sedimentary rocks and by the great buttresses of diabase to the south. However, although the great fault lines are nearly at right angles to these valleys and the strike of the strata is obliquely inclined thereto, there is evidence of subsidence, due to transverse faulting on a comparatively small scale, along a south-west tectonic line.

Flowing into the master streams are numerous mountain torrents, which have carved sharply-incised valleys in the softer formations. It is noteworthy that these streams follow, as a rule, lines of contact between sedimentary and igneous rocks. The igneous rocks, and diabase in particular, forming strong bulwarks against erosion, stand out prominently as residual bluffs and mountains. The resultant topography of this area is one of extremely high relief.

The vertical range between the tops of the highest mountains and the floors of the lowest valleys is over 4000 feet, the highest part (Ben Lomond) being in the northern end of the area. Thus, it will be seen that the area, viewed as a whole, slopes south-eastward toward the sea. As a rule the highest mountains are crowned with igneous rocks, from which the sedimentary rocks have been denuded.

In the northern part of the coalfield Ben Lomond (5160 feet above sea-level) presents bold escarpments of columnar diabase hundreds of feet high. All round this great mountain mass a deep talus of diabase covering the soft underlying sedimentary rocks protects them from continuous disintegration and removal. Glaciation has had little effect upon the configuration of the country south of Ben Lomond.

(2)—Relation to Mining.

The deep dissection of the coal-bearing formations by the South Esk and St. Paul rivers, in addition to the action of their tributary streams, has laid bare the productive measures, and outcrops can be traced without great difficulty along the valley sides. In addition to this advantage in exploration, nearly all the seams can be worked by means of adits or by dip-tunnels.

The main lines of transport follow the valleys of the major streams, and the subsidiary lines follow the tributaries. Thus the topographic features are such that all the coal seams are comparatively easy of access and can be worked economically.

E.—*Geology*.

(1)—Geological Map.

On the geological map the physical features of the area and the relationship between the several formations, both igneous and sedimentary, occurring there are clearly shown. In order to convey an accurate idea of the geology of this area an explanatory sketch will be given of the formation of the several rock masses occupying the surface.

The oldest rocks exposed to view are the Cambro-Ordovician slates and sandstones cropping out in the eastern and north-eastern parts of the field. These rocks are tilted at high angles, and, as a rule, have a south-westerly dip. Intruding them are the great dykes of granite and granite-porphyry of Devonian age, from which the tinstone and wolfram deposits found here have been derived. The granitic rocks solidified under a massive covering of Cambro-Ordovician slates and sandstones, but during the Devonian these latter were largely removed by erosion, and now only small areas of these sedimentary rocks are exposed at surface.

Following the gradual subsidence of the land surface, the Permo-Carboniferous strata were laid down on the uneven floor of the eroded granite and slate. (It is not uncommon to find at the base of this system in one place conglomerates and grits occupying old Devonian valleys, while in others, at a higher elevation, the basal member consists of siliceous sandstones.) There followed a very long period of almost continuous sedimentation, during which the Permo-Carboniferous and Trias-Jura strata were laid down. These formations were disturbed, uplifted, and dislocated by the intrusion of diabase at the end of the Mesozoic era, and the coal beds in them were greatly affected by the heat emanating from this intrusive igneous rock.

During the early Tertiary another cycle of erosion was introduced, and great masses of the younger rocks, especially the sedimentary strata, were removed, exposing again the old Devonian granites and Cambro-Ordovician slates. Into the broad valleys of South Esk and St. Paul rivers basaltic lava was poured from the probably volcanic crater of St. Paul Dome. Scoriaceous and vesicular varieties and basalt of hard, dense texture are found in large masses resting on river drifts on the plains west of Avoca.

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

Owing largely to the intense erosion that has prevailed since the close of the Mesozoic era, these formations have been greatly reduced, and complete sections are nowhere available for examination. The Trias-Jura coal measures in particular have been almost completely removed in some areas, and in others only remnants of this once extensive formation remain. Where they are covered with diabase sheets, and where that protective covering has only recently been removed, fairly complete sections of the felspathic and Ross members are found.

On the south-east side of Ben Lomond, near the source of Story Creek, Trias-Jura strata containing coal-beds are found clinging to the mountain sides at an elevation of 3800 feet above sea-level. The base of this formation cannot be seen, owing to the deep talus of diabase boulders, but apparently it rests directly on Permo-Carboniferous strata, because pieces of limestone of that age were found nearby, and again strata of the latter formation occur over a very large area to the southward. Three miles westward from this outcrop is Dean and Davis' section, in Rodway and Talus Creek valleys. Here, again, at a very high altitude, the Trias-Jura productive measures occur, and are protected by the massive buttresses of diabase surrounding them. In the valley of Gipps Creek, at an elevation of only 1400 feet, the felspathic sandstones that contain the coal-beds appear to abut against a great wall of diabase, but probably pass beneath it. These sandstones are exposed in steep cliffs rising over 200 feet above the level of the creek, on the western side of which horizontal strata of Permo-Carboniferous age occur. These latter resting on a granite base rise to an altitude of 2800 feet, showing that the strata on the west side of the creek have been displaced downwards over 2000 feet to the south-westward.

From an economic viewpoint the most important body of Trias-Jura strata lies to the westward of McGintie Tier. Here both the Felspathic and Ross members are exposed, the former, as determined by boring, being over 400 feet thick, and the latter about 300 feet thick. They rest directly on coarse siliceous sandstone of Permo-Carboniferous age, and are overlain in places by a sill of diabase.

There is a decided local change in the composition of the beds comprising the Permo-Carboniferous formation, as illustrated by the following section (measured from the base upward) observed at the southern end of Mt. Christie:—

	Feet.
Granitic mudstones	—
Siliceous sandstone	60
Grits containing granitic material	40
Arkose	25
Shale, yellow to grey	18
Sandstones, hard, siliceous	140

A complete section is not available here, nor can the transition beds be observed owing to the deep talus covering.

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

The solution of the problem relating to the form of intrusion of the diabase is of very great economic importance. Although a complete interpretation of the evidence obtained here cannot be given, the indications are that the sill form of intrusion is general. Consider, for instance, the mass of diabase between the Mt. Christie Mine and Bonney Plains. This body occupies the higher levels and is completely surrounded by Trias-Jura coal measures. On the east side the strata dip underneath the diabase to the south-west, and on the west side they dip away from the diabase in the same direction, and, apparently, are undisturbed.

At the upper end of a valley leading eastward from Bonney Plains diabase forms the roof of a coal seam exposed in a dip-tunnel driven about 100 feet into the hill. Nearly 3 miles due south of this point, and 500 feet lower, the same seam is exposed again on the other side of the diabase-capped hill, and at various points round the hill the coal seam crops out. Again, on the opposite side of Bonney Plains, seams of coal occur dipping south-westward underneath the igneous rock. From this evidence it appears certain that in some cases at least the diabase occurs in the form of a sill.

Another point worthy of mention in this connection is that round the floor of the diabase mass the sedimentary rock stands out in broad, flat ledges, indicating the base of a sill. While admitting the decisive proof of sill structure here, it must be borne in mind that the sills are not regular. The invasion of diabase from one horizon in the sedimentaries to another is not an uncommon feature, and doubtless there are many dykes through the strata connecting the covering mass with its source below. The structure has been complicated by this intrusion of the diabase at two horizons.

Ben Lomond, 5160 feet above sea-level and 1500 feet above the Permo-Carboniferous strata at its base, is another great irregular sill-like mass. The continuity of the sedimentary rocks has been interrupted by this intrusive body. Apparently the great sill was intruded into the upper members of the Permo-Carboniferous formation, and either upturned or broke through the coal-bearing Trias-Jura strata, remnants of which, carried up by the igneous material, are found high on the eastern flanks of the mountain, and on the western side they are completely surrounded by diabase.

(4)—Structure.

(*a*) *Faults.*—Passing through the centre of this district is one of the great structural faults of the island. On this expedition the fault-line was examined from the western fall of Ben Lomond to the Royal George Mine in the valley of St. Paul River, a distance of 20 miles. It follows the granite contact all the way, and probably it is identical with the fault in this relation observed by H. G. W. Keid in the vicinity of Swansea, as shown on the special fault map (Plate IV.).

The direction of displacement is south-westward, and the amount is between 1500 and 2000 feet. This great fault, resulting directly from the intrusion of the diabase, has caused the general south-westerly tilting of the coal measures. Since then there have been no serious disturbances in this area.

Minor faulting, affecting the coal-bearing strata and interfering with development of the mines, has been considerable. In the main tunnel of Mt. Christie Mine the felspathic sandstones containing the coal-beds have been faulted down, and indurated grey shales show in the end of the workings. It is impossible to determine the extent of the displacements owing to the massive character of the sandstone and the absence of other members from which measurements could be taken, but it is in the vicinity of 60 feet. This movement has affected the coal-bearing rock so much that no further advancement can be made with advantage in this tunnel. There are indications of minor faulting in several places on Buena Vista coal area, the most important being one passing between the Mt. Christie Mine and Stevenson's workings. Except these, this coal area is comparatively free from serious faults, and there are few other displacements observable that interfere with the active development of the mines.

(*b*) *Dip of Coal Seams.*—The dips of the coal seams and of the sedimentary rocks are generally to the south-westward, and at varying angles of inclination. This is in conformity with the dip of the great fault plane; but the strata on the east side of the fault dip to the south-east, in the valley of Castle Carey Rivulet, and near Gipps Creek they are nearly horizontal. The direction of dip of the faulted strata varies from 190° to 260°, and the degree of inclination from 5° to 15°. The dips of the coal beds are caused in the first place by the diabase, and secondly by the great displacement on the west side of the fault that followed the intrusion.

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

The coal beds of this field are all in the felspathic sandstones and intercalated fireclays and carbonaceous shales. As observed elsewhere in neighbouring areas, the thickest beds of coal occur near the summit of these sandstones, but some of the lower seams are of workable size. The upper beds have not been traced very far, but the middle group has been exposed in many places by means of tunnels and trenches. Owing largely to the diabase sill cover, the broad talus of stone, and the deep mantle of soil, it is quite impossible to follow the seams uninterruptedly from place to place. On the Mt. Christie Syndicate's lease five seams of coal have been discovered, but correlations of these with some others in the adjoining Buena Vista property cannot be made with certainty until more work of an exploratory character has been performed.

In some places where seams had been exposed by tunnelling it was found that the approaches had collapsed, and entry in some was both difficult and dangerous, and in others quite impossible. Alpha bed is not exposed, but Beta, Gamma, Delta, and Eta occur.

Coal bed Beta is exposed in prospect openings in the main and upper adits of the Mt. Christie Mine, and what appears to be the same seam outcrops above the homestead on the Mt. Rex road. This coal bed is exposed in the shafts at location 4, and in adits at locations 5, 6, and 7, on Buena Vista property. The diabase is nowhere far above it, and at location 6 forms the roof.

Coal bed Delta is stratigraphically 150 feet lower than Beta bed, and in many respects differs therefrom. It is 3 to 4 feet thick, containing only one band of stony material, and consists of hard, dense coal of thinly banded texture. Eta bed consists of a 3-feet seam exposed on Buena Vista and Brambletye.

These beds are apparently the same as those worked in the Mt. Nicholas and Cornwall areas. Poor exposures and interruptions by igneous rocks preclude the tracing of the beds continuously, but on relative positions and character of the coals they may be definitely correlated with those in neighbouring districts. Local variation due to numerous causes is noticeable, but there are decided characteristics that aid the investigator in identifying particular seams.

F.—*The Mining Properties.*

(1)—The Mt. Christie Mine.

(*a*) *Number and Area of Leases.*—The mining rights over 160 acres of coal-bearing country contained in the Mt. Christie property is controlled by a local syndicate operating under Lease 8727M, registered in the name of P. F. Hennessy. The property consists of a triangular section adjoining the eastern boundary of Lot 10,133, charted in the name of H. R. Falkiner.

(*b*) *Extent and Method of Mining Operations.*—Since the discovery of coal seams here by James Stevenson in 1904, very little work of a developmental character has been performed. The workings consist of two short tunnels and a few surface openings. A start has now been made in operating from the main tunnel to exploit the Beta seam, and a small quantity of coal has been produced and placed on the market. Operating under existing conditions the mine owners have very little chance of success. The cost of cartage from the mine to Avoca railway-station (a distance of 5 miles), amounting to 12s. 6d. per ton, absorbs over 50 per cent. of the value of the coal delivered in the trucks. After deducting this amount from the price received for the coal, 11s. 6d. per ton is left to defray the costs of mining, development, and loading.

On the southern fall of Greenstone Hill an adit has been driven about 50 feet in a north-westerly direction, on a bed of coal reported to be 6 feet thick. The approach to the adit has collapsed, and being inaccessible the report could not be verified.

Four chains to the south-west an adit has been driven 175 feet on a bearing of 350 degrees along the strike of Beta bed of coal, from 9 to 12 feet thick. Progress in this direction was interrupted by a fault of very considerable displacement (about 60 feet), coursing N. 75° E. This fault is visible at surface, and passes directly below the upper tunnel already referred to. It is quite evident that the coal bed exposed in the main adit is identical with that in the upper workings, but in faulted position. From this it follows that the limit of operations from the main adit has been reached.

At 122 feet from the entrance to the main adit the seam has been followed on a bearing of 312 degrees for 63 feet, where the fault has been found again. At 134 feet a bord has been driven 45 feet on a bearing of 53 degrees. The coal bed at this point is 9 feet thick, and is getting thinner as the surface is approached. The following section was measured at this point:—

No. 684, Beta Coal Bed.

	ft.	in.	
Felspathic sandstone (roof).			
Shale, black, carbonaceous	0	6	
Coal, bright, laminated	2	7	
Sandstone, carbonaceous, felspathic	0	2	Excluded.
Coaly clod, black, soft	0	5	Excluded.
Fireclay, white, soft	0	6	Excluded.
Coaly clod, with streaks of bright coal	0	2½	Excluded.
Clay, white, soft	0	2	Excluded.
Coal, hard, dense, steely texture	0	2	
Coal, bright, laminated	0	11½	
Shale, brown, band	0	1	
Coal, dense, with thin bright laminations	0	6	
Shale, brown, parting	0	0½	
Coal, dense, unlaminated	0	5½	
Shale, brown, parting	0	0½	
Coal, dense, unlaminated	0	6½	
Sandstone, grey, felspathic	0	1½	
Coal, bright	0	3½	
Sandstone, grey felspathic	0	1	
Coal, bright, dense, partly laminated	1	2½	
Coal, strong, with bright bands of rich material	1	0	
Fireclay, grey, firm (floor).			

Sample 684 consists of coal free from clay, shale, and sandstone bands, and sample 685, taken at the same place, includes the thin shale partings that could not be separated in mining.

The coal bed is overlain by a great thickness of felspathic sandstone, which forms a firm, sound roof, free from rolls or irregularities of any kind. Underneath the sandstone roof the presence of a 6-inch band of soft carbonaceous shale prevents adherence of coal to roof, and enables the miner to break down the undercut coal without difficulty. It is usually broken in two benches, the soft bands of clay being excavated first in the operation of holing underneath.

This coal is of the humic type, but varies greatly at different points in the seam. The upper bands consist of very bright laminated coal, rich in hydrocarbons; while the lower bands consist of a dense, hard, unlaminated variety, with only occasional bright streaks. It possesses a bright to dull black colour, brown streak, dull to brilliant lustre, and dense texture; the fracture is brittle, hackly, and, in the lower bands, is splintery and conchoidal. The bright coal is friable, and tends to slack more readily than the hard, tough, dense variety.

The bedded impurities consist of felspathic sandstone, fireclay, shale, and clod. Directly below the uppermost coal band there are 18 inches of impurities, which are easily separated in the operation of mining, and are rejected. The half-inch and inch partings of brown shale are loose, and break with the coal. However, an appreciable proportion of this material is separated in screening, and dumped with the slack. Nearly all bands of impurities are loose, but the sandstones are adhesive, although not very difficult to part from the coal. Pyrites in insignificant amount occurs in the form of "sulphur balls," and as films between laminæ. Calcite is found as films on the faces of the coal in the joints and fractures, and occasionally in the form of veinlets.

With the exception of the main fault in the north end of the workings, and a slight roll in the roof observed at the entrance, there are no irregularities that interfere with mining.

The floor of the seam, consisting of firm, grey fireclay, rests on felspathic sandstone. Being fairly hard, and only a few feet thick, there is no tendency to heave.

All the workings of this mine on seam Beta have been described. No attempt has been made so far to explore other seams outcropping along the hillside, although where exposed the coal appears to be of good quality, and the prospects are decidedly encouraging.

(*c*) *Quality of Coal.*—The upper 31-inch band is of very good quality for domestic use, and should prove equally efficient for steaming. It ignites quickly, and burns with a long, yellow, smoky flame, giving out great heat in the process. After a little preliminary crackling, due largely to contained moisture, it burns quietly, emitting jets of flame, swelling and agglutinating in the operation.

The lower dense, slightly laminated, variety possesses good coking qualities, and because of this fact may prove to be of greater value than at present anticipated.

(*d*) *Production.*—Altogether, not more than 500 tons have been produced from these workings since operations commenced in 1904. The present rate of output—only two men being employed—is about 15 tons per week.

(*e*) *Quantity of Coal Available.*—Until more exploratory work has been done no attempt can be made to determine the quantity of coal available in this mine. Very little development work has been performed on the main seam, and nothing has been done on the others, consequently there is insufficient evidence in hand upon which an accurate estimate could be based. The faulting of the seams adds to the difficulties in this connection.

With these reservations the quantity available is put at 50,000 tons.

(2)—Buena Vista Coal Mine.

(*a*) *Number and Area of Leases.*—The owners of this property, under the provisions of the old "Crown Lands Act," hold the coal-mining rights. The property includes Lots 10,133, 228 and 211, and several other large blocks between Castle Carey Rivulet and Buffalo Brook, the whole aggregating over 10,000 acres; but how much of this is coal-bearing has not been determined, because the larger part of the surface of the area is occupied by diabase.

(*b*) *Extent and Method of Mining Operations.*—Exploratory mining works are jotted here and there all round Mt. Christie and the other diabase-capped hills to the south. These mine openings consist of shallow shafts, dip-tunnels, and adits. In addition to these works several bore holes were drilled through the coal measures to test the known seams and others not appearing at surface.

It is reported that Bore A was drilled 100 feet without result; Bore B, 300 feet deep, passed through several seams of coal; and Bore C was drilled 500 feet, and at that depth had passed through a seam of 4 feet thick. All of these holes bottomed on sandstone.

Although the coal beds are readily accessible to the railway, very little coal has been produced. This is due to the fact that the seams are generally not of sufficient thickness to justify mining on a large scale under conditions obtaining up to the present time. There appears to-day a better outlook for the industry, and probably at least two of these seams, because of the high quality of the coal, will be exploited in the near future.

Location 4.—About 40 chains westward of the main tunnel on the Mt. Christie property, and nearly 140 feet lower, are four prospect shafts, two at least of which passed through Beta coal seam. Because of water in the shafts the coal bed could not be examined on this visit, but the following section in descending sequence is given in the report already referred to furnished by W. H. Twelvetrees:—

	ft.	in.
Felspathic sandstone (roof).		
Coal	3	0
Clay, band	0	4
Coal	0	9
Clay, band	0	2
Coal	3	2
Shale, band	0	1
Coal	0	6
Shale, band	0	$0\frac{1}{2}$
Coal	3	7
Fireclay (floor).		

The components of this coal bed correspond closely with that exposed on the Mt. Christie property, and apparently these seams are identical. In the shaft the seam is horizontal, while in the adit referred to it dips at an angle of 10 degrees This local variation in dip is not unusual, and is caused by the unequal adjustment of the strata after faulting. It is rather unfortunate that the coal bed at this point is only a few feet below the surface, and it does not gain cover until it enters the hills on both sides.

Location 5.—Ten chains west of Location 4 an adit 30 feet long has been driven on a coal seam bearing S. 15° E. This resembles in every respect the Beta seam exposed at Locations 4 and 2. At the time of this investigation the roof at entrance had caved and access was both difficult and dangerous. However, part of the seam at the end of the adit was visible, and the following section of it was measured:—

	ft.	in.
Felspathic sandstone (roof).		
Coal, dull and earthy	2	0
Clay and coaly shale bands	2	6
Coal with two thin bands of shale	2	6+
Floor not visible.		

The coal, under such light cover, was soft and dirty; consequently representative samples could not be obtained.

How far the seam extends westward underneath the diabase has not been determined. In any case the workable ground from this opening is very small, as a fault interrupts the regular continuity of the seam in that direction.

Location 6.—

No. 688, Beta Coal Bed.

	ft.	in.
Diabase (roof).		
Soft clay and decomposed diabase	2	0
Coal, dull black, altered	0	8
Clay, soft, brown parting	0	0½
Coal, dull with few bright streaks	1	3
Clay, soft, brown parting	0	0½
Coal	1	3
Clay, soft, brown	0	2
Coal	1	0
Clay, soft, brown	0	1
Coal	2	0+
Undetermined.		

The bottom of the seam was not visible owing to the caving of the roof and the presence of water in the tunnel. For the same reason it was not possible to ascertain the nature of the material composing the floor.

Samples 688 and 689 were taken from the side of the dip tunnel 40 feet from the entrance, where the section was measured. Number 688 represents the clean coal and Number 689 includes the clay parting. The coal is very soft and wet, and had been greatly affected by long exposure to the atmosphere and percolating waters.

This is the only recorded occurrence in Tasmania of diabase forming the roof of a coal seam. The igneous rock presents no peculiar features. It is rather fine in grain and jointy, and exhibits incipient columnar structure without radical change from the normal rock found in large masses in every quarter of the area. Evidently the chilling of the contact rock was rapid, for there is no gradation from hard diabase to the soft clayey decomposition product resting directly on the coal. In this clayey material soft laumontite, a salmon-coloured zeolite of secondary origin, occurs.

The upper 8- and 15-inch bands of coal have been altered by the heat and hot solutions emanating from the once molten diabase overhead. From this coal nearly the whole of the volatile components have been removed, leaving behind soft earthy material consisting largely of carbon and ash. Near the bottom of the bed the coal has not been seriously affected, and appears similar to that occurring in the Mt. Christie Mine and at Locations 4 and 5.

The bedded impurities consist of thin brown clay and shale bands which will be difficult to separate in mining. They are soft and do not adhere firmly to the coal.

Like the occurrences of this seam in other parts, the floor probably consists of fireclay, 3 or 4 feet thick, resting on felspathic sandstone.

Most of the coal is so damaged and seamed with clay and shale bands that even hand-sorting would be but moderately successful in obtaining a product of sufficiently high quality to place on the market.

Location 7.—At the horseshoe bend in South Esk River, opposite Eastbourne Railway-station, an adit has been driven 40 feet into the hillside on a coal seam apparently identical with that exposed at Location 8. Owing to the deep soil cover the seam does not appear at surface and the roof of the workings has caved; in consequence the coal bed could not be examined.

Location 8.—On the southern fall of Mt. Christie Range, about 30 chains from South Esk River, a shaft and tunnel exposed a coal seam about 5 feet thick. These openings were inaccessible at the time of investigation, and the meagre information regarding this coal was obtained at second-hand. The coal is reported to be of poorer quality than the other exposures on this property, and it is seamed with numerous bands of clay.

Location 9.—Twelve chains south from the main adit of Mt. Christie Mine, and close to the western boundary of that property, an adit has been driven 60 feet on a bearing 230 degrees along the course of coal bed Delta. This bed occurs at a 90-feet lower stratigraphic horizon than Beta bed. The seam dips at an angle of 8 to 10 degrees to the north-west, a direction contrary to that of other outcrops in the neighbourhood.

At 40 feet from the entrance the coal bed was measured and sampled. The section exposed here is—

No. 686, Delta Coal Bed.

	ft.	in.
Felspathic sandstone (roof).		
Shale, carbonaceous	0	2
Coal, bright, dense, hard	2	4
Coal, stony	0	2
Coal, bright, firm	0	5
Fireclay, hard, grey (floor).		
Felspathic sandstone.		

Sample 686 represents the coal seam free from partings, and Sample 687 includes the 2-inch band of stony coal.

The roof consists of hard felspathic sandstone free from irregularities of any kind so far as exposed. It is separated from the underlying coal by a 2-inch band of carbonaceous shale, the presence of which is of considerable advantage in mining. The coal is hard and dense, with indistinct laminae, and with the exception of a 2-inch band of stony material is free from bedded impurities. Picked samples burn with a long yellow flame, and leave a moderate amount of grey ash. Fires in the dump converted the coal into coke of very excellent quality. Laboratory investigation confirmed the coking properties of this coal.

The hard fireclay floor, the sound roof, the dense and tough nature of the coal, and the absence of easy holing bands, suggests the advisability of shooting the coal from the solid. The fireclay floor, although firm and fairly hard, can be picked without difficulty, enabling the operators to enlarge the gangways without affecting the soundness of the roof. This seam is not very thick, but the coal is of such good quality, and the conditions for mining are so favourable, that operators should have no difficulty in establishing here a profitable enterprise. Unfortunately the workings are only 30 feet under cover, but as the tunnel is advanced toward Mt Christie the thickness of roof sandstone rapidly increases, providing a greater width of coal above adit level.

Location 10.—About 10 chains south-east of Location 8 is another abandoned adit opening which extends 40 feet into the hill from the right bank of Tommy Creek. The approach and entrance are so badly caved that the seam (Eta) cannot be examined, but it is reported nearly 30 inches of coal occur here. The mine opening, 60 feet lower than No. 7, follows a course 70 degrees west of south, and the seam exposed in it dips to the north-west at 7 degrees. Unlike Delta seam, the roof-stone is fireclay, 4 feet thick, which is overlain by massive felspathic sandstone.

Sample 690, taken from a small heap stacked at the entrance, is not truly representative of the quality of the coal. If the heap consists of selected coal, then the quality represented is high; if it consists of average-grade material, then the quality represented is low, because of the deteriorating effects of exposure to the elements.

The coal in the upper part of the bed is bright, whereas that in the lower part is dull and dense in texture. A fresh fracture shows a number of streaks of bright vitreous lustre alternating with dull layers. Silica, calcite, and iron salts are conspicuous along fracture and joint planes.

It is firm and tough, and is capable of withstanding rough handling in transportation without excessive slacking.

Location 11.—On the west side of Bonney Plains an adit, bearing N. 70° W., has been driven 200 feet on Delta coal seam, dipping south-westerly at angles of 7 to 12 degrees. At the time of this investigation the adit was half full of water, and could not be drained in the time available owing to the collapse of the roof near the entrance. This difficulty prevented the writer from obtaining a complete section of the coal bed. At 100 feet from the entrance the following section appears above water-level:—

	ft.	in.
Felspathic sandstone, brown (roof).		
Coal, soft, dull	0	6
Sandstone, brown, soft	4	0
Coal, bright, laminated	1	0
Fireclay, soft, grey	2	3
Coal	0	6
Undetermined	—	
Felspathic sandstone (floor).		

Sample 691 was taken from a heap of coal on the dump. The coal had been exposed to the weather for many years, and the bright, laminated variety was rather soft and crumbly, but the dense, steely kind was very hard and brittle. It is banded and laminated and breaks with an irregular splintery fracture.

Although it has caved near the entrance the roof-stone appeared to be very firm and strong. The bottom of the bed was under water, and the character of the floor-stone could not be determined.

(c) *Quality of Coal.*—On Buena Vista the coals may be divided into three grades—namely, anthracite, coking humic (bituminous), and non-coking humic. The anthracite variety is probably an alteration product of humic coal by the action of heat and hot solutions from the intrusive diabase, but doubtless the change has been brought about partly by earth movements inducing regional metamorphism. The coal bed, where it is least affected by the intrusive igneous rock, contains coal of decided humic nature, and the complete change from humic to anthracitic can be traced. Beta bed is only 50 to 70 feet below the base of the diabase sill, and at Location 6 the igneous rock rests directly on the coal. At this point the coal at the contact has been greatly altered, but at the bottom of the seam it has apparently not suffered to such an extent.

The coking humic of Delta seam may prove to be of extraordinary value in the near future, as Tasmanian Trias-Jura coals as a rule are non-coking, and one possessing this property should receive considerable attention.

Steaming tests of this coal have been made on the s.s. "Togo" and t.s.s. "Loongana," with satisfactory results; while numerous tests have been made of its steaming qualities in stationary plants.

(d) *Production.*—The production of coal from from the several mine openings on this property has been very small.

Although there is a small local demand and a larger market in Launceston for domestic coals of this quality, the future development of the area will depend largely on the possibility of using it in place of Newcastle coal for gas-making. The fact that it is a good coking coal adds greatly to its value in this connection, but it will be in demand only when supplies of the higher grade coals are cut off.

(*e*) *Quantity of Coal Available*.—In arriving at an approximate estimate of the coal tonnage in this area, the investigator is confronted with the same difficulties that are presented in the neighbouring Mt. Christie area. Here data are not available for a reliable estimate, because a large portion of the area is occupied by diabase, which, although apparently spreading sill-like over the coal measures, is probably connected with the underground reservoir of igneous rock by narrow dykes. The few scattered exposures of coal occur along the fringe of the diabase, and the uninterrupted continuity of the seams has not been proved. Certainly, the data furnished by natural exposures and supplemented by the records of prospect shafts and bores are sufficient to form an approximate estimate of quantity in the parts tested, but no attempt has been made to ascertain how far the coal seams extend underneath the diabase, and the probable quantity in the parts covered by this rock cannot be estimated.

Data are really insufficient to afford a basis for even a fair guess as to the total tonnage in this area.

(2)—Ben Lomond Area.

(*a*) *Number and Area of Leases*.—Several years ago four sections, aggregating 320 acres, were leased from the Crown for the purpose of mining for coal. The little exploratory work performed gave discouraging results, and the prospect was abandoned.

(*b*) *Extent and Method of Mining Operations*.—About 4000 feet above sea-level on the south-east fall of Ben Lomond a little exploratory work was performed many years ago on a seam of coal exposed in the banks of Story Creek. This work consisted of a 50-feet tunnel driven north-east on the uppermost of the three seams occurring here. In the tunnel where the sample was taken the following section was measured :—

No. 692, *Beta Coal Bed.*

	ft.	in.
Felspathic sandstone, grey (roof).		
Fireclay, grey … … … … … … … …	1	3
Coal, dull-black … … … … … … …	0	5
Sandy clay binder … … … … … … …	0	6
Coal, dull, dirty … … … … … … … …	1	3
Fireclay, grey … … … … … … … … …	0	3
Coal, dull … … … … … … … … … … …	0	9
Fireclay, black, hard, binder … … … … …	0	3
Coal, dense, conchoidal fracture … … … … …	1	0
Clay, black, hard, binder … … … … … … …	0	1
Coal, hard, dense … … … … … … … …	0	10
Clay binder … … … … … … … … … …	0	2
Coal, bright … … … … … … … … …	1	4
Clay, hard, binder … … … … … … … …	0	2
Coal … … … … … … … … … … … …	0	2
Fireclay, hard (floor).		

Below this bed 50 feet of coal-bearing strata are exposed. They consist of thinly-bedded fireclay and sandstones containing two seams of coal. The upper seam is only 12 inches thick, but the lower is 2 feet, and is contained in 5 feet of carbonaceous shale. Underlying the shale are 2 feet of grey fireclay resting on felspathic sandstone.

These beds are replete with plant fossils typical of the Trias-Jura.

A mile farther northward, it is reported, the same series of seams outcrop again, but very little work has been done to prove their quality and their extent.

At first sight it appears that these coal measures dip beneath the diabase, and perhaps they do extend into the mountain a short distance, but as they are remnants only of a mass uplifted by the igneous rock, their area is very small and they are of no economic importance.

Location 12.—A reward claim, 7342M, of 80 acres, has been granted to J. B. Dean and F. R. Davis for their discovery of coal measures near the junction of Borrowdale and Talus creeks. This is another uplifted mass of coal-bearing strata, of no great extent. Occurring high on Ben Lomond Range, 20 miles from a railway, it is not likely to come into prominence for many years, as the easily-accessible beds will, in the nature of things, be worked out first. The writer was unable to visit this property.

(3)—THE MERRYWOOD AREA.

(a) *Number and Area of Leases.*—The section enclosing this mine is now held under lease by J. Inglis, of Launceston, and is 80 acres in extent. Outside this section there is a very considerable area of unexplored coal-bearing country, the mining rights over which are held by the landowners.

(b) *Extent and Method of Mining Operations.*—Situate in the valley of the northern tributary of St. Paul River, this mine is 16 miles by road from Avoca. The cutcrop of coal reaches an altitude of 1700 feet above sea-level, and is exposed here and there for 2 miles along the southern fall of the Montgomery Mountain Range, of which St. Paul Dome is the most prominent peak. Overlying the coal-bearing felspathic sandstone is a great mass of diabase that occurs here in sill form with dyke feeders. It is noticeable that at Merrywood the diabase overlies the productive measures, while at St. Paul Dome, 2 miles to the westward, a dyke of diabase is seen intruding the Permo-Carboniferous strata. Other dyke-like intrusions occur in the neighbourhood. Apparently the lateral spreading of the diabase intrusive is very irregular, as it is found at more than one horizon in the sedimentary formations. At Merrywood the diabase cover has been removed over an area of 60 acres, and erosion has exposed the uppermost coal seam. Since the discovery of this seam, about 15 years ago, in the coal-bearing zone of the Trias-Jura, a considerable amount of exploratory work has been performed. These workings consist of an adit driven 130 feet on a bearing N. 20° E., and two shafts, one of which is reported to be 60 feet deep. At the time of this investigation neither the tunnel nor the shaft was accessible, and, consequently, unweathered samples of the coal could not be obtained.

Merrywood Coal Mine.—The following short section was measured in the creek bed:—

No. 693, *Beta Coal Bed.*

	ft.	in.
Felspathic sandstone (roof).		
Yellowish-grey fireclay	8	0
Coal, hard, laminated, dull to bright	2	2
Clay parting, yellowish-grey	0	2
Coal, dense, with bright laminae	1	10
Clay, parting, yellowish-grey	0	2
Coal, dense, hard, unlaminated	2	1+
Undetermined.		

Sample 693 was obtained from the seam exposed in the creek bed where the measurement was taken. It consists of coal free from the large clay bands, but includes those of small thickness that could not be separated in mining. This coal had been subjected to the action of flowing water and exposure to the atmosphere for very many years, and is not fairly representative of the class of coal opened up in the tunnel. A remarkable feature of the coal is its hardness, especially so in the lower bands. In every respect it is similar to that of the Mt. Christie Mine. The seam corresponds in all particulars with the Beta seam of that mine, and in view of the regularity of this bed the occurrence here is one of considerable importance.

Owing to the cover of surface debris, the full thickness of the seam could not be ascertained, but it is reported by the Messrs. Rubenach that it is 10 to 12 feet thick in the tunnel.

The coal bed is overlain by 8 feet of fireclay, containing numerous impressions of plants, conspicuous among which are *Pecopteris odontopteroides*, *Thinnfeldia obtusifolia*. These plant remains are of the species found so commonly in the Trias-Jura formation in Tasmania. Resting on the hard fireclay, which forms a fairly sound roof for the mine, is 60 feet of felspathic sandstone.

(*c*) *Quality of Coal*.—The coal is a relatively hard sub-humic variety, of dull, vitreous lustre, hackly to conchoidal fracture, and dense to seamy texture. The variation in character between the upper and lower parts of the seam is very pronounced. The lamination due to alternate layers of dull and bright coal is perfectly preserved in the upper part, but in the lower the lamination is indistinct and the coal is dense and horny in appearance. The cleat is not well developed.

None of the lower seams have been exposed. In fact, no attempt has been made to explore for other seams, owing to the fact that the coal will not bear heavy transportation charges such as prevail here, and can scarcely hope to compete as a domestic fuel with the more easily accessible Cornwall and Mt. Nicholas coals.

A large area of coal can be operated from adits, and the conditions generally for mining are decidedly favourable. At the present time there is no local market, and the mine is too far from a railway to compete in the Launceston market with mines more favourably situated. From Avoca, the nearest railway centre, the road follows the valley of St. Paul River to Red Rock in easy grades, thence it crosses the stream, and continues northward to Merrywood estate. From this point to the mine there is a rapid ascent of 500 feet. Under the circumstances, there does not appear to be any immediate prospect of the early exploitation of this coal seam.

(*d*) *Production*.—No coal has been produced to date.

(*e*) *Quantity of Coal Available*.—The limits of Merrywood coal area cannot be defined until much more exploratory work has been performed. A large part of the area between Ormley railway-station and St. Paul River is not underlain by coal, but beds are exposed at several places in the hills and mountains intervening, and between outcrops all of it is considered possible coal land.

Owing to the lack of precise data as to the thickness and extent of the coal seam, any estimates of tonnage must be regarded as merely approximate. The estimate given hereunder is probably under rather than over the correct amount, as in it no account is taken of the lower coal beds which, in all probability, underlie the area under discussion.

Definite proof of the continuous extension of the coal seam through 200 acres of land has been established. On a basis of 1200 tons per foot per acre, and assuming that the seam contains an average thickness of 6 feet of coal, the quantity available in this area amounts to 1,440,000 tons.

(4)—Lewis Hill Area.

According to Crisp, a 6-foot bed of coal was opened several years ago high on the north side of Lewis Hill. The old prospect tunnel could not be found at the time of investigation, but coal "mush" was seen at several horizons in the felspathic sandstone, and loose pieces of coal were found in the main creek heading in the hill. The pieces picked up consist of hard coal, dull-black in colour, with occasional bright layers, vitreous in lustre, fine-grained to dense texture, and hackly to conchoidal fracture. It does not slack on exposure, and cokes in the open fire. It is of the humic variety, but has been affected by heat derived from the overlying diabase. All coal beds of this series are to be expected in the 600-feet of felspathic sandstone exposed on the hillside, and indications of some of them were observed.

The next point toward the west at which coal is reported is behind Royal George Tin Mine. This bed was opened, and found to contain 4 to 6 feet of fairly clean humic coal. Apparently it is identical with the top seam in Lewis Hill and that opened at Merrywood, but this could not be determined.

The coal beds of this area are readily accessible from the valley of St. Paul River. They are very favourably situated for mining, and when a demand for greater supplies arrives this neglected area will receive due attention. Owing to lack of time, only the northern fringe of the area was examined, and its extension westward toward Campbell Town and southward toward Swansea remain to be investigated. Diabase here again overlies the productive felspathic sandstones. Whether the coal beds extend far underneath the igneous intrusive can be determined only after costly exploratory works have been made. The diabase rock in this area appears to have been intruded at a horizon directly above the coal-bearing sandstones, and there is good reason for believing that the seams extend considerable distances underneath the igneous cover. Interruptions by dykes are common, and development and exploitation will be hindered thereby.

Chapter XV

LONGFORD COALFIELD.

A.—*General Description.*

Longford township, situated 14 miles south of Launceston, is the centre of a large agricultural and pastoral district, part of which comes within the boundaries of the Launceston Tertiary basin. The Trias-Jura coal measures cropping out near Norwich and Hadspen settlements have been exposed by the denudation of the Tertiary deposits. These measures consist of felspathic sandstones and intercalated shales, similar in every respect to the coal-bearing strata of this age occurring in other parts of Tasmania.(69) The following fossil flora have been identified in the shales exposed at Norwich:—

Filices—

Sphenopteris lobifolia	Morris
Thinnfeldia obtusifolia	Johnston
Thinnfeldia media	Woods
Pecopteris caudata	Johnston
Alethopteris australis	Morris
Danæ morrisianæ	Johnston

Equisetaceæ—

Phyllotheca australis	Brongniart
Phyllotheca Hookeri	—
Annularia, Sp. *Indet.*	—

Coniferæ—

Zeugophyllites elongatus.

The principal seam, 3 to 4 feet thick, outcrops near the Longford-Muddy Plains road, in a creek flowing between low diabase hills. It has been ascertained that the seams tend to thin northward toward the diabase hills, while shafts sunk southward prove the gradual thickening of the seams in the direction of dip toward the south. This circumstance gave rise to the idea that the coal measures were continuous under Longford Plains, where there is a great expanse of country uninterrupted by intrusive diabase, although superficially covered by clays, lignite, sandstone, &c., of Tertiary age.

With the object of testing the strata underneath the Tertiary beds, a hole was drilled near Longford to a depth of 600 feet, through successive bands of clay, lignite, and sandstone, containing numerous impressions of well-known Tertiary plants, and near the bottom entering greyish blue, fine-grained sandstone of undetermined age. The sandstone in many respects resembles the Ross member of the Trias-Jura formation, but further information is necessary before it can be authoritatively identified. If this rock proves to belong to the Ross member the coal-bearing felspathic sandstones must have been removed by early or pre-Tertiary erosion. On the evidence in hand it seems likely that the coal measures do not exist, as was once generally supposed, underneath the greater part of the Launceston Teritary basin.

At Belmont, near Longford, two holes, 690 and 894 feet in depth, were drilled through clay, lignite, drift, and sandstone, without reaching the coal measures strata.

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(69) Johnston, R. M.: Geology of Tasmania, page 179.

Several prospect shafts have been sunk to the coal at Norwich, and a small quantity has been raised from the principal seam.

During the period 1916-1919 over 800 tons of coal was raised by two men operating in the Pateena Mine. Since 1919 production has ceased. The main entry is by dip tunnel, which is now full of water. The pumping and hauling difficulties could have been obviated by a low-level adit, but the distance to be driven is considerable, and perhaps at this stage of development the extra cost of this work is not warranted.

B.—*Quality of the Coal.*

The coal, consisting of alternate dull and lustrous bands, is similar to that obtained from the Cornwall and Mt. Nicholas Collieries. It is rather friable near the surface, but improves in toughness under heavy cover. The ash content is high, and the proportion of moisture is excessive. Although this coal is not suitable for steaming purposes, it is a fairly good household fuel.

C.—*Quantity of Coal Available.*

The exact extent of this coal area has not been determined, the surface being occupied almost wholly by Tertiary sedimentary deposits and basaltic lava, which form a thick cover over the underlying formations.

Outcrops of the productive measures, and actually of the coal seams, occur many miles apart, but the intervening country has not been systematically prospected by drilling or shaft-sinking in order to ascertain whether the strata are continuous.

Under the circumstances, it is impossible to estimate the quantity of coal available.

Chapter XVI.

THE MERSEY COALFIELD.

A.—*Location and Extent.*

The portion of the Mersey district, which is the special subject of this investigation, lies between the Rivers Mersey and Don, and extends from Spreyton, a distance of 8 miles south, toward Railton. Devonport, an important shipping centre for interstate trade, is situated 2 miles north of Spreyton, near the mouth of Mersey River.

The coal-bearing strata extend over 20,000 acres, and, probably, the seams occupying one-fifth of this area, can be profitably mined.

B.—*Access.*

Situated so close to Devonport, in a thickly-populated district, and with railways passing along the east and west boundaries, this coalfield is easily accessible, and possesses splendid facilities for cheap transport.

C.—*Previous Reports.*

The earliest official record of the occurrence of coal in the Mersey district is contained in a report submitted to Parliament by Chas. Gould,(70) in 1861. In this report Gould refers particularly to the work performed in the neighbourhood of Tarleton.

In 1883 G. Thureau (71) investigated the coalfield, and reported the results of his work to Parliament. Accompanying this report is a geological sketch map of the area.

In 1884 Thureau (72) prepared a supplementary report, and included a geological cross-section of the field.

W. H. Twelvetrees (73) examined this district in 1911, and refers briefly to the coal measures in the published account of his investigations.

It may be mentioned here that a considerable amount of the information contained in this report has been compiled from the works of earlier investigators.

D.—*Topography.*

(1)—General Description.

The area considered in this report is drained by Mersey and Don Rivers, which flow northward to Bass Strait from their sources in the central highlands. In general the country is decidedly hilly, even mountainous, but where the coal seams are found the slopes are gentle, and the surface in few places exceeds an altitude of 500 feet. The rather sluggish rivers have broad flood plains, below which they are now entrenched.

(70) Gould, Chas.: Report upon the Mersey Coalfield. House of Assembly Paper No. 135.

(71) Thureau, G.: Report on the Mersey Coal Deposits, May, 1883. House of Assembly Paper No. 52.

(72) Thureau, G.: Supplementary Report on the Mersey Coal Deposits, Nov. 1884. Parliamentary Paper No. 64.

(73) Twelvetrees, W. H.: The Tasmanite Shale Fields of the Mersey District. Geological Survey Bulletin No. 11, pages 108–110.

Taken as a whole, this area is part of an old peneplain, minutely dissected by the numerous streams that traverse it, and partly hidden beneath thick sheets of basaltic lava. The hills and mountains are erosion residuals of the old planated surface.

(2)—Relation to Mining.

Most of the coal mines described in this report are in the valleys, and, in many cases, actually within the borders of the old flood plains.

In consequence of this, and the comparatively small number of outcrops, prospecting operations have been rather difficult. In some cases the shaft method of exploitation has been found necessary, in others the dip tunnel way of attack is followed; but operation by adits is not possible. With these exceptions the topographic conditions are rather favourable.

E.—*Geology*.

(1)—Geological Map.

Within the boundaries of the area mapped (Plate XXXIV.) rocks ranging in age from the Pre-Cambrian to Recent are present. There are, however, many gaps in the series, and the structural relationships of the several formations are rather obscure. Although the relative order of succession is known, the precise age of certain formations has not been definitely established.

The following formations are represented:—

Pre-Cambrian quartz and mica schists.

Cambrian sandstones and slates with Dikelocephalus.

Silurian West Coast Range conglomerate; limestone, sandstones, and slates.

Permo-Carboniferous marine and terrestrial deposits.

Tertiary, Quaternary, and Recent unconsolidated sediments.

Within the limits of the map all the areas of the coal-bearing formations that are worthy of attention are shown.

(2)—The Permo-Carboniferous Section.

The uppermost members of this formation consist of bluish-grey marls and mudstones, replete with marine fossils typical of the period. These beds are about 100 feet in thickness, and repose on 300 feet of land and freshwater beds, consisting of sandstone, marl, shale, and conglomerate. It is in this series that the coal seam is found.

The coal seam is usually overlain by a coarse loosely-aggregated sandstone, but in some places 3 to 5 feet of shale intervenes. The horizon of the coal is in the upper 100 feet of the freshwater sandstone series. Underlying these are Lower Marine beds of pebbly sandstones and conglomerate containing an abundance of shell fossils. At Tarleton these Lower Marine beds are 105 feet thick, and rest on Silurian limestone. This is illustrated in the following section, as revealed by boring for a supposed lower coal seam at Tarleton:—

Strata.	Thickness.		Total Depth.	
Terrestrial Deposits—	ft.	in.	ft.	in.
Clay	15	0	15	0
Sandstone	33	9	48	9
Conglomerate, with pyrites	3	0	51	9
Shale	5	0	56	9
Coal	1	6	58	3
Sandstone	36	6	94	9
Conglomerate	2	0	96	9
Sandstone, dark	6	6	103	3
Shale	2	0	105	3
Sandstone	2	0	107	3
Shale	5	0	112	3
Marl	32	3	144	6
Sandstone	2	0	146	6
Pebbly marl, with carbonaceous matter	41	0	187	6
Pebbly marl, with sandstone	77	3	264	9
Marine Beds—				
Pebbly sandstone, with marine shells	20	9	285	6
Conglomerate, with marine shells	36	0	321	6
Conglomerate and sandstone, with shells	48	6	370	0
Silurian limestone	30	6	400	6

In this coalfield land and freshwater beds are intercalated between Lower Marine and Upper Marine beds. These measures are considered as belonging to the Greta horizon of New South Wales, where coal measures also intervene the Lower and Upper Marine. In the Mersey area the fauna for the most part is very similar in both the Lower and Upper Marine beds.

The following flora occur in the brown and black shales overlying the coal seam:—

Glossopteris browniana	Brongniart
Glossopteris ampla	Dana
Glossopteris indica	Schimper
Gangamopteris angustifolia	McCoy
Gangamopteris cyclopteroides	Feistmantel
Noeggerathiopsis hislopi	Bunbury

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

The diabase occurs here as a transgressive mass in the form of irregular dykes, and, to a lesser extent, in sill-like bodies. This basic irruptive covers Brown Mountain in the form of a sill 400 feet in thickness, with its lower limit 900 feet above sea-level. On Dooley Hill, in Latrobe, it is 150 to 200 feet thick, and descends to sea-level. A thin sheet occurs on the summit of Kelcie's Tier, 700 feet above Don River, and it is found in the form of a dyke crossing the properties of the Tasmanian Shale and Oil Company's works, near Latrobe. There are other occurrences of similar characters in the area.

(4)—Structure.

(*a*) *Faults*.—Normal faults of small throw are very numerous, and interfere considerably with the development of the mines. Faults of greater displacement are common also, and limit the mines to small areas. These major faults are generally axial in direction, but transverse faults occur. In the more severely deformed beds, and especially near the diabase, the effect of faulting is even greater.

(*b*) *Dip of Seams.*—The general dip of the Permo-Carboniferous strata is northerly, varying from a few degrees east to an equal amount west of north. There are local changes due to intrusions of diabase, but these are few, and occur mainly along the western fringe of the area. The angle of inclination varies from 5 to 15 degrees, and in general is about 9.

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

Two coal seams are represented here, of which the lower is the most persistent and important. They cannot be correlated with any known seam in Tasmania, and apparently occur here in a distinct coal basin.

F.—*The Mining Properties.*

(1)—The Coalfield in General.

(*a*) *History and Leases.*—According to Jas. Fenton([74]) coal was discovered between Don and Mersey Rivers in March, 1850. The Mersey Coal Company was formed to work the seam and operations were continued with varied fortune for a number of years, but after the expenditure of a large amount of money the mine was abandoned, and the workings have since collapsed. In 1861 the Alfred and Don were the only collieries in operation, the Denison and Sherwood Mines, together with those of the Mersey Coal Company, having been abandoned. As time went on other areas were explored; new mines were opened, and they, in their turn, after a short existence were closed.

At the present time the Spreyton Mine at Tarleton and the Illamatha Mine at Spreyton are producing coal sufficient for local requirements. The owners of the latter mine, however, are likely to suspend operations, having worked out the coal to the boundaries of their section.

(*b*) *Extent and Method of Mining Operations.*—Everywhere the seam is interrupted by faults, and this results in sporadic development. Large areas of unworked ground are left between the several collieries, and operations are of necessity performed on a small scale. The limitation of the workable ground from any particular opening has had a very detrimental effect upon the development of the industry.

It is apparent, under the circumstances, that the coalfield as a whole is more favourable for small enterprises than for the establishment of large mines.

Much unexplored and likely ground still remains, and as the demand increases further development will follow.

(*c*) *Quality of Coal.*—This is dealt with briefly later in the report in connection with the Spreyton Mine. the coal from which is of average quality.

(*d*) *Production.*—No official record has been kept of the production of coal from these mines prior to 1905. According to Thureau([75]) 85,000 tons had been raised during the 25 years preceding 1883. Since then one or two mines have been in almost continuous operation, and at the same rate of output over 136,000 tons would have been produced. On this assumption the estimated total production amounts to 211,000 tons.

([74]) Fenton, Jas.: A History of Tasmania. Hobart, 1884, page 259.
([75]) Thureau, G.: Report on Mersey Coal Deposits, 1883.

(*e*) *Quantity of Coal Available*.—The investigator is confronted with so many difficulties in arriving at an idea of the quantity of coal remaining, owing to lack of reliable data upon which calculations could be based, that some hesitancy is felt in attempting an estimate. After a very careful investigation it is considered that the tonnage available is equal to that extracted, and the probable tonnage is put at 300,000.

(2)—Spreyton Mine.

(*a*) *Number and Area of Leases*.—The Spreyton Colliery is at Tarleton, and is contained within the boundaries of Sections 375M and 3837M, each of 40 acres, and charted in the names of J. Allison and J. Allison, Jun.

(*b*) *Extent and Method of Mining Operations*.—This mine has been in almost continuous operation for 40 years, and a very large quantity of coal has been produced therefrom. The workings consist of dip tunnel openings about 1200 feet in length.

The long-wall system of extraction is followed. Very little variation is noticed in the character of the coal, and the seam is 18 to 24 inches thick. Working conditions have been made difficult by numerous faults which occur in a most irregular manner.

Sample 153 represents the average grade of coal sent to market.

(*c*) *Quality of Coal*.—The coal finds a ready sale at Latrobe and in the neighbourhood, and sufficient is produced to supply these requirements. It emits a good heat and burns quietly on an open hearth. For domestic use the pyrite content is a disadvantage, but in other respects it is suitable.

It is used locally for steam and forge purposes.

(*d*) *Production*.—The total production of this mine is not known. During the past decade 7772 tons of coal were raised and marketed, details of which are given in the subjoined table:—

Year.	Tons Produced.	Men Employed.	Yearly Output per Man.
1911	1,496	7	213
1912	956	6	159
1913	1,167	7	163·8
1914	1,000	6	166·6
1915	270	1	270
1916	673	6	112·1
1917	350	—	—
1918	421	—	—
1919	657	4	164·25
1920	782	3	260·3
1921	—	—	—

(3)—The Illamatha Coal Mine.

The Illamatha Coal Mine, at Spreyton, has been worked with success for a number of years.

The workings consist of dip tunnels, one of which is over 1000 feet long, and several other openings of an exploratory character.

Operations at this mine ceased lately, the present lessee having worked out the coal on his section. There is still a large quantity of coal available in the adjoining properties, and probably these reserves will be attacked from the Illamatha Mine.

The production during the past decade is shown in the following table:—

Year.	Tons of Coal Produced.	Number of Men Employed.	Yearly Output per Man.
1911	128	2	64
1912	110	2	55
1913	160	1	160
1914	74	1	74
1915	188	1	188
1916	512	3	170·6
1917	463	—	—
1918	932	—	—
1919	2,139	10	213·9
1920	2,538	11	230·7
1921	—	—	—

Operations on this mine are not carried on continuously throughout the year; consequently the figures relating to the rate of production are not of much use for purpose of comparison.

(4)—Alfred Colliery.

Alfred Colliery, situated a mile east of the township of Tarleton, consists of adits driven into the eastern face of a hill at a little above the level of the alluvium, cutting the seam at 390 feet from the entrance to the main opening. The seam dips north 10 degrees east at an inclination of 9 degrees, and is about 18 inches thick. At this locality the outcrop is completely concealed by drift and gravel. The roof, consisting of very coarse sandstone, is firm and hard, and requires very little support after the removal of the coal. It varies in thickness, and is in some places separated from the coal by a bed of black shale or clod.

A fault of undetermined displacement to the south-east and coursing in a north-easterly direction limits the workings on the south, and another occurring a short distance to the north interferes with operations in that direction. In consequence of this the available quantity of coal from this colliery was found to be inconsiderable.

At a distance of a few hundred yards north of the colliery a seam has been exposed at several points by means of adits. It varies in thickness from 6 to 13 inches, and is overlain, as in the other case, by coarse sandstone, but with an intervening bed of bluish shale. This shale thins rapidly from 3 feet in the face of the hill to less than 1. A thin band of white sandstone occurs also between the shale and the coal. There is an interval of 300 feet between the seam at this locality and at the Alfred Colliery, but they are identical, having been separated by faulting.

A bore-hole drilled in 1858 reveals the following section of strata:—

Strata.	Thickness.		Depth.	
	ft.	in.	ft.	in.
Surface soil and clay	6	0	6	0
Indurated clay	6	0	12	0
Gravel	6	0	18	0
Blue marl	14	0	32	0
Sandstone, streaked yellow and white	20	0	52	0
Sandstone, coarse, grey	10	0	62	0
Sandstone, fine, grey	11	0	73	0
Shale	0	6	73	6
Sandstone, grey	5	0	78	6
Sandstone, very coarse	2	0	80	6
Coal	1	6	82	0

In the endeavour to discover a second and thicker seam a bore-hole was put down in this colliery to a depth of 250 feet below the seam at present worked, but without important economic results.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Soil	3	0	3	0
Sand and gravel	14	0	17	0
Sandstone, brown	4	2	21	2
Sandy shales, dark grey, fissile	5	10	27	0
Sandstone, grey	7	3	34	3
Shale, grey	1	6	35	9
Sandstone, grey	9	6	45	3
Shale, grey	1	0	46	3
Sandstone, coarse grey	6	8	52	11
Shaly parting	0	1	53	0
Coal	1	4	54	4
Fireclay	0	5	54	9
Sandstone	3	10	58	7
Shale, dark grey	4	0	62	7
Sandstone, grey	3	3	65	10
Shale, dark grey	3	3	69	1
Sandstone, dark grey	8	0	77	1
Shale, dark	9	0	86	1
Sandstone, dark grey	4	3	90	4
Shale, grey and black	35	6	125	10
Sandstone, grey	1	0	126	10
Shale, grey and black	13	9	140	7
Sandstone, dark grey	1	10	142	5
Shale, grey and black	64	5	206	10
Sandstone in beds	3	9	210	7
Shale, dark grey	3	10	214	5
Sandstone, very hard	0	11	215	4
Shale, hard grey	18	8	234	0
Sandstone, dark	2	9	236	9
Shale, dark grey, sandy	1	6	238	3
Sandstone, light grey	6	5	244	8
Shale, dark grey	4	4	249	0
Sandstone, light grey	7	10	256	10
Shale, dark grey, sandy	1	6	258	4
Sandstone, grey	1	11	260	3
Shale, grey, sandy	0	9	261	0
Sandstone, grey	34	1	295	1

(5)—The Denison Mine.

This seam outcrops close to the southern corner of Tarleton town boundary, and has been worked by means of a number of short adits. In general the rock section is similar to that in Alfred colliery, but here the black shale attains a thickness of 6 feet, and a 6-inch seam occurs in places above it. Only small areas of coal were worked here, as the country is dislocated by numerous north-west faults. Upon driving 300 feet due west from the south-westernmost tunnel a great downthrow was met with, which limited operations in that direction. Another large fault crossing the old tramway bounds the workings on the east side, throwing down against the coal highly fossiliferous marls containing *Spiriferæ, Producta, Fenestellæ*, &c.

Three-quarters of a mile north of Denison Colliery a shaft was sunk 40 feet in the bed of a creek, running from the north end of Bonney's Tier, crossing at 20 feet down a fault with a downthrow to the north-east. A bore was continued from the bottom of the pit through sandstone and marl, and coal was struck at a further depth of 15 feet. Fossiliferous sandy clays, exposed on the upthrow side of the fault, contain *Spiriferæ*, &c., similar to those occurring in Denison Colliery.

(6)—Tarleton.

A bore hole sunk near the south boundary was completed 100 feet without success, and another upon this property was carried to a depth of 135 feet with a like result. The following section was observed:—

Strata.	Thickness.		Depth.	
	ft.	in.	ft.	in.
Gravel	2	0	2	0
Clay, indurated	16	0	18	0
Fine sandy marl	14	0	32	0
Fine grey sandstone	18	0	50	0
Clay, dark cream	0	6	50	6
Fine dark grey sandstone	19	0	69	6
Very coarse grey sandstone	2	0	71	6
White clay	4	3	75	9
Very coarse sandstone	22	3	98	0
Clay, light coloured	2	0	100	0
Coarse grey sandstone	31	6	131	6
Strong dark grey sandstone	3	6	135	0

It will be observed that the strata passed through here differ considerably from those found in the 250-feet bore at the Alfred Colliery. Taking this fact into consideration, together with the character of the members below the coal exposed in the great bend of the Mersey, there can be little doubt that the seam underlies this spot.

Two small shafts have been sunk south of this, one on either side of Swan Bay, but not deep enough to afford any further evidence. A shaft sunk on the northern side of the township reached coarse sandstone at 40 feet. It is probable that the same seam underlies at a moderate depth the country between Tarleton and Swan Bay; but the existence of faults renders the position uncertain.

(7)—Sherwood Mine.

This colliery was one of the first opened in the Mersey district, and for a time the rate of production was fairly high.

The coal in the shaft was struck at 60 feet, and in the bore hole, 130 yards away to the east of north, at 85 feet from the surface. During the productive period this colliery was connected by tramway (3 miles long), with a jetty on Mersey River.

The 2-feet seam only was cut in the main shaft, but in the bore-hole two thin seams—one a foot thick, and the other 6 inches—overlie the main seam.

This is shown in the rock section obtained from the log record:—

Strata.	Thickness.		Depth.	
	ft.	in.	ft.	in.
Surface soil and clay	7	0	7	0
Gravel	1	0	8	0
Indurated clay	6	0	14	0
Marl	32	0	46	0
Grey sandstone with shaly bands	37	0	83	0
Shale, light coloured	2	0	85	0
Coal	0	10½	85	10½
Fireclay	1	0	86	10½
Coal	0	6	87	4½
Fireclay	1	0	88	4½
Soft grey, gritty, coarse sandstone	2	0	90	4½
Shale, black	1	7½	92	0
Coal	2	0	94	0

A bore-hole sunk on the western bank of Caroline Creek, immediately opposite to the first-mentioned, passed through 120 feet of strata (principally soft marl) without reaching coal, but a seam has been worked further westward, at the foot of Brown Mountain. In the bed of the creek, west and south-west of the shaft, occur blue sandy marls, with spirifers and other marine fossils.

The coal in this mine contains, in addition to pyrite, a considerable amount of arsenopyrite in well-crystallised form.

It is considered that there is still a large quantity of coal available for extraction in this quarter.

(8)—The Mersey Coal Mine.

The Mersey Coal Company carried on operations, both in the vicinity of the River Don and on a 100-acre section half a mile west of Latrobe. Active development commenced in 1852, and continued without interruption until 1860, when the mine ceased to be self-supporting. During this period a large quantity of coal was raised and shipped to market.

The coal appears to dip to the north or east of north in the immediate vicinity of the River Don, cropping out at widely separated points in the bed of the river, where the thickness of the seam was rather in excess of the average in the other collieries. In some of the workings the coal seam was found to be much broken by faults. It was cut off on the north by a fault of considerable displacement coursing south of west, with downthrow to the north, thus bringing fossiliferous marls in juxtaposition with the coal. A small fault junctions with the latter, crossing the river a little below it. In this the downthrow was in the opposite direction or to the south, and, in consequence, marls containing *Spiriferæ, Producta*, &c., are exhibited in the river close to the shaft.

Several shafts were sunk at some distance from the main workings, reaching the coal in 18 or 20 feet. One, sunk a short distance from the eastern bank of the river, and carried to a depth of 50 feet, passed through marls and shaly impure limestones. Further down stream, and close to the river, a bore-hole was drilled nearly 250 feet below the coal (which was passed through in the first 7 feet) without any other seam being cut.

Further up-stream the seam outcrops between two faults, and dips at a high angle. It is exposed again near the point of confluence of Coal Creek and Don River, which is about a mile and a half southward from the company's main workings.

In Coal Creek the seam is exposed where the stream changes its course from the general southward trend, and here again within a very short distance of the coal blue sandy clays and marls containing spirifers are found. The sequence of the strata from the fossiliferous marls to the coals is unfortunately interrupted, so that it is impossible to ascertain whether a fault intervenes in this instance also.

The deep shaft of the company, which is at a distance of 1 mile from the river, was entirely sunk through fossiliferous beds.

(9)—Don Mine.

Don Mine is situated to the west of Tarleton, within a mile of Don River, in a break of the interstream range, and lies ½-mile north of Mersey Colliery.

The coal seam was proved by means of three bore-holes placed at the points of a triangle. In these the seam was cut at depths of 70, 90, and 100 feet respectively, and the included area was supposed to be free from faults. Upon opening the mine, however, two faults were discovered—one a downthrow of 20 feet to the south; the other of 14 feet to the east. The coal is of average thickness (20 inches), and the seam is identical with that worked in other collieries. Blue sandy clays containing marine fossils in abundance were passed through in the upper part of one of the bore-holes.

The workings consist of a main shaft (now destroyed) and several minor openings. From this mine over 25,000 tons of coal was raised prior to 1883

(10)—Dulverton Mines.

South-west of Dulverton two collieries were in operation some years ago. These are the Dulverton and Teasdale Collieries. The seam has been worked for many years, but its small size and the faulted nature of the ground make profitable working difficult.

(11)—Other Occurrences.

Coal deposits occur in Nook Valley at about 450 feet above sea-level.

On Conley's 45-acre block a seam of good bright coal was found in the creek by J. Sloane some years ago.

On the eastern side of the valley, on Bott's 83-acre block, a coal seam has been exposed on the flank of the hill, dipping westerly toward the tasmanite bed. This seam is 17 inches thick, and lies below dark shaly beds containing fragments of *Glossopteris* leaves.

In Redwater Creek, a tributary of the Mersey, about 6 miles from Tarleton, the seam outcrops at intervals of several hundred yards, and dips to the north-east.

Chapter XVII.

GEORGE TOWN COALFIELD.

A.—*Location and Extent.*

The George Town coalfield is situated in the vicinity of the mouth of the Tamar Estuary, lying on the eastern side thereof. It lies about 2 miles in a straight line from George Town, and about a similar distance from Bell Bay.

The probable area of the coal-bearing country is approximately 5 square miles.

B.—*Access.*

The field is accessible by road from both George Town and Launceston.

C.—*Previous Reports.*

The late W. H. Twelvetrees visited the locality in October, 1904, and his report thereon is entitled " Report on the Coal near George Town."

D.—*Topography.*

(1)—General Description.

The coal-bearing area lies to the east of Mount George Range and to the north of the Tippagory Range. It extends eastwards towards Lefroy and northwards towards the sea-coast, although its exact limits in these two latter directions have not been even approximately determined. The surface consists of minor undulations, and does not exceed 600 feet in elevation.

(2)—Relation to Mining.

The absence of anything approaching high relief in the coal-bearing area renders mining by adit impossible. Exploitation will have to be carried out by means of shafts.

E.—*Geology.*

(1)—Geological Map.

No geological map of the area is included in this publication. So little work has been done on the area that data sufficient for the compilation of a map having any value are not available. The coal-bearing area, however, consists of rocks of the coal-measure series, bounded on the west and south by diabase, and on the east by Cambro-Ordovician slates, and on the north by coastal sand-dunes.

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

The coal seams apparently belong to the Trias-Jura system, and the containing beds consist of sandstones, shales, and conglomerates. Not enough data are available to allow anything approaching a complete section to be made

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

The diabase on Mount George and Tippagory Range appears to be in the form of a transgressive mass and not in the nature of a sill. This cannot be regarded as having been definitely established, but on the evidence available seems most likely.

(4)—Structure.

(*a*) *Faults.*—In the undeveloped state of the field and the absence of exposures due to high relief, nothing can be said at present on the existence or otherwise of faults. The proximity of the diabase, however, and the knowledge of the structure of similar coalfields in Tasmania, lead to the conclusion that minor faults are likely to occur.

(*b*) *Dip of Coal Seams.*—The coal seams where exposed show a dip of about 10 degrees to the north. The coal measures, however, in the various exposures seem to be generally horizontal with but a slight inclination northwards.

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

Two seams have so far been located. These are 8 inches and 6 inches in thickness. It is impossible to correlate these seams with those occurring in other fields in Tasmania.

F.—*Unleased Coal-bearing Area.*

There are no leases held on this coalfield, the whole area consisting of Crown land, which comes within the operation of "The Mining Act," but is, at the time of writing, unleased in any part.

The total area of potential coal measures is approximately 5 square miles.

The number of seams so far located is only two, of 8 inches and 6 inches respectively.

The coal is of fair quality, and belongs to the sub-humite class. The analysis is indicated in Table 1.

The quantity of coal available is impossible of calculation, as the most that can be said at present is that the area which possibly carries the coal seams is 5 square miles. The exact thickness and extent must be determined by future boring.

Chapter XVIII.

PREOLENNA COALFIELD.

A.—*Location and Extent.*

The Preolenna coalfield lies to the southward of Wynyard, on the North-West Coast, being distant therefrom 13 miles.

The extent of the field has not been definitely determined, but there occur in the eastern portion of the coal-bearing area, approximately, 1000 acres, which are coal-bearing. In the western portion of the area there is in the vicinity of 1000 acres, but the exact area has not been determined, as the western limit has not been delineated.

B.—*Access.*

A road exists connecting Wynyard with the coalfield, but the last few miles of this road are in a very bad state, and unfit for carting heavy loads. The total length of this road is 19 miles. A narrow-gauge tramway connects the main North-West Coast railway at Flowerdale with a spot within 4 miles of the coalfield. This tramway is now being extended into the centre of the coal-bearing area.

C.—*Previous Reports.*

In 1895 A. Montgomery, then Government Geologist of Tasmania, examined the Wynyard District, and published the following Report:—" The Mineral Fields of the Gawler River, Penguin, Dial Range, Mt. Housetop, Table Cape, Cam River, and portion of the Arthur River Districts." In that report he predicted that coal would be found in the hinterland of Wynyard. Six years later the coal was actually discovered, and in that year (1901) G. A. Waller (then Assistant Government Geologist) visited the discovery and dealt with it in a report entitled " Report on the Recent Discovery of Cannel Coal in the Parish of Preolenna."

In 1903 the late W. H. Twelvetrees visited the field, and his report thereon is entitled " Report on the Kerosene Shale and Coal Seams in the Parish of Preolenna."

In 1912 Loftus Hills visited the area, and made a geological examination. His report is contained in Bulletin No. 13 of the Geological Survey of Tasmania, entitled " The Preolenna Coalfield, and the Geology of the Wynyard District."

D.—*Topography.*

(1)—General Description of the Topography.

The coalfield is situated on the northern slopes of the Campbell Range. The main coal outcrops are, approximately, 1200 feet above sea-level, and the crest of the Campbell Range in the near neighbourhood reaches 1530 feet.

The Flowerdale and Inglis Rivers have cut back into this range, and developed two main gorges, namely, that of the Jessie River, a tributary of the Inglis, and the Upper Flowerdale. These gorges have very steep sides, and, combined with the occurrence of the Diabase Range between them, they give the effect of considerable relief to the topography.

The whole of the country is broken, with the exception of comparatively level country on Section 4967-M, which is in the vicinity of the proposed terminus of the tramway.

The main topographic features are shown in the geological map, Plate XXXV.

(2)—Relation to Mining.

The coal seams outcrop mainly in the two gorges mentioned above. This presents favourable conditions for mining, as tunnels can be driven in from the sides of the gorge on the coal outcrops. The details of the topography, however, do not permit of the loading of the coal into the railway trucks by gravitation, because the railway terminus naturally is located on the comparatively level country between the two gorges. The coal, therefore, although mined by adits, will have to be hauled up the slopes of the gorge, or from shafts to the level of the comparatively flat country near the tramway terminus.

All spoil, waste rock, &c., however, obtained from mining can be tipped out in unlimited amounts at the tunnel mouth, and only the coal will have to be hauled.

E.—*Geology*.

(1)—Geological Map.

The geological map of the Preolenna coalfield is contained in Plate XXXV. This map shows the approximate geological boundaries, and the positions of the main coal outcrops. It also shows the positions of the proposed bores.

The map only shows the Permo-Carboniferous system, together with the diabase and basalt, but does not go sufficiently far south to show the underlying Pre-Cambrian quartzites and mica schists on which the Permo-Carboniferous system rests.

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

The portion of this section represented in the Preolenna coalfield is confined absolutely to the Permo-Carboniferous. Of this system there are visible in the coalfield itself the following series in descending order:—

The Tomago coal measures.
The Upper Marine mudstones.
The Greta coal measures.
The Lower Marine mudstones.

The full thickness of the latter is not visible in the coalfield itself, but taking cognisance of the section exposed between the coalfield and the sea-coast the generalised columnar section shown in Plate II. can be drawn. This shows that the coal occurs at two horizons, namely, the Greta coal measures and the Tomago horizon.

In previous reports it has been impossible to decide whether these Upper coal seams belong to the Permo-Carboniferous or the Trias-Jura, as no fossil evidence was available. Their classification as belonging to the Tomago is based on the recent discovery on Mt. Pelion of an undoubted *Glossopteris* in the shales associated with the coal at an exactly corresponding horizon as these upper coals at Preolenna.

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

The occurrence of diabase in the coalfield is completely confined to the Diabase Range. This is a narrow range running north and south.

Basing conclusions on the recognised mode of occurrence and habit of the diabase worked out in detail in the other coalfields of Tasmania, there seems to be no doubt that this occurrence of diabase is in the form of a dyke. Nothing is known of its behaviour underground, but it may be expected to continue indefinitely downwards without an enlargement having any economic bearing on the area of the coalfield.

(4)—Structure.

(*a*) *Faults.*—No faults have so far been discovered in the Preolenna coalfield, but it must be remembered that the mining work carried out is of relatively small extent. The occurrence of the transgressive diabase dyke would seem to indicate that faults will almost certainly be met with. They, however, will be minor faults, and not of such size as to seriously interfere with mining.

(*b*) *Dip of Coal Seams.*—The coal seams have a dip somewhat greater than is generally characteristic of the coal seams of Tasmania. The average dip is towards the west, or a little north of west, and amounts to about 14°.

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

As mentioned above, the coal occurs at two distinct horizons. The seams in the Greta coal measures number four. The number represented in the Tomago has not been ascertained. A number of outcrops occur, but these could quite possibly be the one seam faulted into various positions. On analogy with the Pelion field, not very far distant, the indications are that there is only one seam developed. Future exploration, however, will definitely determine this.

The development of four seams in the Greta measures show a distinct geographic variation occurring in this series from the Mersey Valley to Preolenna, for in the former area only one seam is developed. The step has not been taken, therefore, of giving these four seams special names, as they apparently are a special development quite locally at Preolenna.

In addition, there is the possibility of a fifth seam of coal occurring in one part, at least, of the Preolenna coalfield.

The coal seams vary in thickness from about 9 inches to 24 inches, the greater number of the outcrops showing a thickness of from 15 to 24 inches.

The coal seams are characterised by the fact that without exception they belong to the kerogenites or humic kerogenites.

Several of the coal seams show at various places the occurrence of high-grade kerosene shale, and it is specially noteworthy that this shale is not confined to any one seam, but makes and disappears in the various seams in a manner totally characteristic of this class of coal.

F.—*The Mining Properties.*

(1)—The Preolenna Coal Company.

(*a*) *Number and Area of Leases.*—This company controls the following leases:—5704-M, 4967-M, 4970-M, 5964-M, and 5965-M, the total area of these being 1440 acres.

(*b*) *Extent and Method of Mining Operations.*—The extent to which mining operations have been carried out on these properties consists of the driving of adits from the northern side of the Jessie Gorge.

In addition to the preliminary work of short adits and cuts into the side of the hill to open up the coal seams, there have been carried out the driving of the following tunnels on a larger scale:—

At the 7-Mile two tunnels have been driven. One, known as the "Up-cast Tunnel," has been driven 220 feet, and headings to right and left of between 100 and 200 feet at both the 100 and 200 feet points.

At a lower level the main tunnel, 7 feet by 5 feet 6 inches, has been driven 400 feet. It is intended to continue this to 750 feet.

At the 8-Mile a tunnel, 10 feet by 5 feet 6 inches, carrying a double tramline, has been driven 600 feet. The designed length of this tunnel is 1300 feet, which will open up the four seams at this level.

As there has been no appreciable output from the mine it is obvious that there is nothing further to state with regard to the method of mining that has been used. There is no doubt, however, that the correct method of mining these seams, with an average dip of 14°, and in places being as great as 25°, is to work to the rise.

Although the coal seams do not exceed 2 feet in thickness, yet several of them are within a few feet of each other, and it will undoubtedly be possible, in places at least, to work two seams with the one heading.

(*c*) *Quality of Coal.*—The coal of the four Preolenna seams so far investigated consists of many varieties of the kerogenites and humic-kerogenites. They are therefore high-grade coals, especially useful for gas-making and steam-raising, as well as for household, purposes. Their greatest utility, however, lies in their suitability for destructive distillation at low temperatures to produce oils. This phase of their usefulness will be gone into fully in a subsequent publication dealing with the "Oil Shales of Tasmania."

The general quality of the Preolenna coal is shown in the table of analyses of Tasmanian coals. (Table I.)

In fact, the Preolenna coals are the highest-grade coals found in Tasmania, being very much superior to the Trias-Jura coals. This is distinctly shown in the table of analyses above referred to.

Constituting, as they do, the only source of high-grade gas and coking coals in Tasmania, these Preolenna coals constitute an asset of great potential value to the State quite apart from their value as sources of oil.

It must be remembered, however, that the sulphur content of these coals is rather high, but against this must be remembered the undoubted fact that by washing in modern washing machines this amount of sulphur can be reduced to the average sulphur contents of ordinary coals.

A test made on the Tasmanian railways shows that the Preolenna coal can replace the imported New South Wales coal with very satisfactory results.

The value of this coal for gas-making is very marked, as the yield of gas per ton is at the rate of over 12,000 cubic feet with a most exceptionally high candle-power.

(*d*) *Production.*—The production to date has consisted merely of a few hundred tons for experimental and other purposes.

(*e*) *Quantity of Coal Available.*—Calculating on the four known seams in the Greta coal measures, and ignoring the seam or seams in the Tomago measures, and taking the thickness of the seams as two seams of 2 feet each, and two of 15 inches each, a total thickness of 6·5 feet is obtained. The exact area over which these seams extend throughout the 1440 acres held by this company has not been determined, but for the purposes of calculation of the coal reserve it is justifiable to assume that the three bores indicated on the geological map have proved coal to exist at those points. On this assumption the coal-bearing area is, approximately, 750 acres. This gives a coal reserve of 5,000,000 tons. This is a minimum estimate, and will probably be increased as further exploration is carried out.

(2)—S. W. Margetts.

Number and Area of Leases.—One lease (No. 7034-M—320 acres) is charted in the name of S. W. Margetts. This lies between portion of the Preolenna Coal Company's holdings and the State reserve. It carries several coal outcrops, and undoubtedly contains a reserve of coal, but the extent cannot be indicated at the present, as no appreciable work has been carried out.

(3)—The State Coal Reserve.

An area of 975 acres lying to the south-west of the Preolenna Coal Company's holdings has been reserved by the State. Coal and kerosene shale outcrops have been located in the eastern portion of this area, but no systematic exploration has yet been carried out. It, however, is a potential coal-bearing area, and undoubtedly constitutes an appreciable addition to the coal reserves of the Preolenna coalfield. The number of seams and the quality of the coal may be expected to resemble the conditions in the Preolenna Coal Company's area.

G.—*Unleased Coal-bearing Area.*

An extension of the coalfield will lie to the west and north-west of the area indicated above. In the absence of any systematic attempt at prospecting in that area, it is impossible to say what is the total area of the coal-bearing country.

Chapter XIX.

BARN BLUFF - PELION COALFIELD.

(1)—Barn Bluff Area.

A.—*Location and Extent.*

Barn Bluff is situated on the extreme north-western end of the Central Plateau of Tasmania, being only a few miles distant from the Cradle Mountain. It is 45 miles in a straight line from Burnie, and a similar distance from Devonport.

The potential coal-bearing area is, approximately, 7 square miles.

B.—*Access.*

Access to the Barn Bluff area is difficult. A road negotiable by ordinary motors is available to two points, namely, Lorinna and Pine Creek. From Lorinna there is a rough road available for horse vehicles for a distance of 22 miles. The remaining 6 or 7 miles to the Barn Bluff area consists of a track passable only for pack horses.

From Pine Creek to Waldheim the journey is accomplished by pack horses, and it is then 7 miles over the mountain by blazed trail to Barn Bluff.

The best route for a road to Barn Bluff is *via* Lorinna to the Forth Bridge, thence by the Brown River Valley to Barn Bluff. This would entail the putting of the road from Lorinna to Forth Bridge into good order, and the surveying and forming of a road from Forth Bridge up the Brown River Valley to Barn Bluff.

The nearest point to the railway system is Staverton, which is 40 miles by road. Railway-construction presents many difficulties, and would undoubtedly be costly.

C.—*Previous Reports.*

The area was first reported on by A. Montgomery, in 1893, being included in a report submitted to the Secretary for Mines in that year on "The Country Between Mole Creek and the Mt. Dundas Silver Field, and On the Discovery of Coal at Barn Bluff."

In 1901 G. A. Waller visited the area, and his report is included in the Secretary for Mines' Report for 1901, entitled "Report on the Mineral Districts of Bell Mount, Dove River, Five-mile Rise, Mt. Pelion, and Barn Bluff.

In 1919 A. McIntosh Reid, Assistant Government Geologist, included the coalfields in a cursory examination, and the results of his observations are included in Geological Survey Bulletin No. 30.—"The Mt. Pelion Mineral District."

D.—*Topography.*

(1)—General Description.

The Barn Bluff coalfield constitutes portion of the high plateau country, having an elevation of from 3200 to 5000 feet. The actual coal-bearing area lies beneath the approximately conical mass of Barn Bluff, and extends northwards under the spur which connects that mountain with Cradle Mountain.

The coal horizon outcrops on the eastern side of the steep-sided gorge of the Fury River, and on the eastern side at the heads of the valleys of the various branches of the Brown River. A potential coal area is also located under Mt. Inglis, outcropping round the slopes of that mountain at an elevation of, roughly, 3200 feet, which is slightly above the general level of the plateau country in that area.

The main topographic features are shown in the geological map, Plate XXXVI.

(2)—Relation to Mining.

Outcropping, as the coal horizon does, above the general level of the plateau and on the side of the steep Fury Gorge, the topography obviously presents very favourable conditions for mining by adit, and the movement of the coal by gravitation. The topography, therefore, is very favourable for mining, excepting in so far as this factor has made access to the district and transportation problems somewhat difficult.

E.—*Geology*.

(1)—Geological Map.

The geological map of the area is included in the map of the Barn Bluff-Pelion Coalfield, Plate XXXVI. In this map the outcrop of the coal horizon is indicated in addition to the other geological data. The glacial moraines are not shown, but their general location is indicated on the map.

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

The only portion of these two systems represented in the field is the Permo-Carboniferous. This system is seen to be resting on the denuded edges of the Pre-Cambrian quartzites and mica schists. The basal beds are the glacial conglomerates, which pass upwards into the Lower Marine mudstones, which are comparatively poorly developed in the area. Above these are the Greta coal measures, which contain the one coal seam developed in the area. Above the coal measures occurs a considerable thickness of the Upper Marine mudstones.

The details of this section are represented in Plate II. up to the top of the Upper Marine mudstones.

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

The diabase occurs on the upper part of Barn Bluff, at Mt. Brown, and on Cradle Mountain. The amount of erosion that has taken place, and the very high relief, allow close observation to be made of the relation of this diabase to the sediments of the lower flanks of the mountain. These exposures show clearly that the diabase occurs resting on top of the Permo-Carboniferous sediments or on the truncated edges of the Pre-Cambrian quartzites and mica schists. This shows clearly that the diabase is in the form of a sill, the overlying sediments having been removed by denudation, and, in fact, the greater part of the diabase also having been removed by the same agency, exposing the residuals now left at Barn Bluff, Mt. Brown, and Cradle Mountain. This diabase is, in fact, part of the western sill-like off-shoot from the asymmetric transgressive igneous mass of the Central Plateau.

(4)—Structure.

(*a*) *Faults.*—No faults have been definitely located, but probably small faults exist.

(*b*) *Dip of the Coal Seams.*—The coal seams are practically horizontal, what dip there is being towards the west, and only consisting of, at most, 1 or 2 degrees.

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

There is only one seam in the area. This occurs in the Greta coal measures at the horizon shown in Plate II.

This coal seam is of the kerogenite or humic-kerogenite type, and, as quite characteristic of this type of coal, may consist of the variety pelionite in one part, and of a totally different type of cannel coal in another.

The outcrop of the seam has been found in several places on the eastern side of the saddle connecting Barn Bluff with Cradle Mountain, in places consisting of 8 inches of a humic-kerogenite without any pelionite, while in another place, a few chains away, it carries in the centre of coal of that type a thin seam of typical pelionite.

The high-grade pelionite, which has been found in the glacial moraine at the eastern foot of Barn Bluff in slabs up to 8 inches in thickness, represents this seam varied to the extent of consisting of practically wholly of the substance to which the name of "pelionite" has been given, which is, in fact, a special variety of the kerogenites and humic kerogenites. The part of the seam from which these fragments have come has not yet been disclosed.

F.—*The Mining Properties.*

(1)—The Tasman Oil and Products Company.

(*a*) *Number and Area of Leases.*—This company holds Section 8622-M (398 acres), together with the following areas held under licences to search for coal:—P. Evans, 3200 acres; A. Nicholls, 3200 acres; G. S. Hope, 3200 acres; Black and Manton, 3200 acres; W. A. Neudie, 3200 acres.

Of this total area, the coal horizon occurs in only two of the licences to search areas, namely, P. Evans (including Barn Bluff and the saddle connecting with Cradle Mountain) and G. S. Hope (including the greater part of Mt. Inglis), and in only the northern portion of Section 8622-M. To search for coal in the remaining part of the area would be absolute waste of money, as the geological map distinctly shows.

(*b*) *Extent and Method of Mining Operations.*—Up to the present the less said about the extent and method of mining operations in this area the better. There has been a total absence of method, efficiency, and sincerity on the part of those in charge of operations on the spot. Instead of systematic trenching or boring for the coal horizon, operations have been confined to starting so-called open-cuts in the moraine to extract the fragments of pelionite therein. The only method which is likely to give any tangible result in this area is to prospect along the line of outcrop shown in the geological map, Plate XXXVI., by trenching or a series of shallow bores.

(*c*) *Quality of Coal.*—The coal seam, where exposed in outcrops, consists of a humic-kerogenite rich in gas and oil, but rather high in sulphur. At one spot it carries a thin seam of pelionite in the middle. The problem to be solved by further exploration is the exact variation in the quality of the coal, as determined by the variation in the type of coal, and the portion of the coal area which carries appreciable high-grade pelionite similar to that in the fragments in the glacial moraine. This pelionite gives up to 130 gallons of oil to the ton on distillation, and its exact value and utilisation in that direction will be left for discussion in the forthcoming publication dealing with the "Oil Shale Resources of Tasmania."

(*d*) *Production.*—Only a few hundredweights have been produced to date from the glacial moraine, and no appreciable production can be expected until the actual seam has been located and exploited.

(*e*) *Quantity of Coal Available.*—In the undeveloped state of the field it is impossible to make any accurate estimate of coal reserves. It may reasonably be assumed, however, that an 8-inch coal seam will occur over an area of 1200 acres. This gives a possible coal reserve of 1,600,000 tons.

(2)—The Great Pelionite Petroleum Oil and Products Syndicate.

(*a*) *Number and Area of Leases.*—Some licences to search for coal are held by this syndicate in the names of R. J. McCutcheon, C. B. McCutcheon, and J. Forster.

The land held by the two latter consist for the greater part of Pre-Cambrian quartzites and mica schists, the remainder consisting of the basal conglomerates of the Permo-Carboniferous.

The 3200-acre licence to search, in name of R. J. McCutcheon, is the only one on which any work can be justified, as the coal horizon occurs in the eastern half of this area.

No work has been carried out on these sections.

(2)—Mt. Pelion Area.

A.—*Location and Extent*.

The Mt. Pelion area lies to the south-east of Barn Bluff, being distant therefrom 7 miles. The coal outcrops occur on the northern slope of the Pelion group of mountains, and the potential coal-bearing area extends southwards to Lake St. Clair.

The area of the Mt. Pelion area proper consists of about 25 square miles.

B.—*Access*.

The same general remarks in regard to access as given for the Barn Bluff area apply to this area also, with the following modifications.

Access is possible from the Forth Bridge by means of a good pack-track 7 or 8 miles in length. Access is also possible from Liena by a pack-track 22 miles in length, Liena being connected by a good motor road (10 miles in length) with the Mole Creek terminus of the main railway system.

C.—*Previous Reports*.

The reports that have dealt with the Barn Bluff area have also included Mt. Pelion. The literature therefore given under the Barn Bluff area will also apply in this case.

D.—*Topography*.

(1)—General Description.

The area is one of distinctly high relief, consisting as it does of the Pelion group of mountains which lie at the head of the Forth Valley. The precipitous faces on the northern sides of these mountains have been caused by the eating back of the Forth River into the range. The elevations vary from approximately 2000 feet at the northern boundary of the area to 5000 feet of the high mountain peaks.

The main topographic features are shown in the geological map, Plate XXXVI.

(2)—Relation to Mining.

The topography makes mining by adit system in this area ideally possible. The only difficulty that the topography presents in the mining problem is in the matter of access as described above.

E.—*Geology*.

(1)—Geological Map.

This is included in Plate XXXVI. In this map the main geological systems are shown, but no subdivisions in the Permo-Carboniferous are indicated.

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

In this area the Trias-Jura system is absent, but there is developed as complete a section of the Permo-Carboniferous as occurs anywhere in Tasmania. This is shown completely in Plate II. in column " Barn Bluff-Pelion." Every subdivision of the Permo-Carboniferous as developed in Tasmania is there represented—from the basal conglomerates resting directly on the Pre-Cambrian quartzites to the top of the Tomago coal measures.

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

The same remarks apply here as were made in regard to the Barn Bluff area.

The deep gorges cutting through the diabase into the underlying sandstones in innumerable instances show beyond any shadow of a doubt that the diabase is in the form of a sill, the overlying sandstones having been completely removed by denudation. In fact, denudation has proceeded so far as to completely remove the diabase from some of the mountains; for example, the north-western peak of Mt. Pelion East; while in other cases only a small relic of the diabase is left, for example, the main peak of Mt. Pelion East.

(4)—Structure.

(*a*) *Faults.*—There is no evidence observable of the existence of faults of any magnitude.

(*b*) *Dip of Coal Seams.*—The coal seams are practically horizontal.

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

The coal occurs at two separate horizons in the Permo-Carboniferous—namely, the Greta Coal Measures and Tomago Coal Measures. Each horizon carries one seam. In fact, the Greta horizon is represented below Mt. Ossa by carbonaceous shales only, no coal seam being developed; but to the west, under Mt. Pelion, coal is developed in a thin seam.

In the Tomago coal measures there is only one seam developed. This has a total thickness, including bands, of 30 inches. It outcrops along the steep cliff face of sandstone below the diabase of Mts. Ossa and Doris.

It is specially important to note that no pelionite whatever has been discovered in the Mt. Pelion area, this particular variety of the kerogenites being confined, as far as present discoveries go, to the Barn Bluff area.

F.—*The Mining Properties.*

(1)—The Adelaide Oil Exploration Company Limited.

(*a*) *Number and Area of Leases.*—This company holds a number of 3200-acre licences to search areas extending from Mt. Pelion, Mt. Oakley, and Mt. Pillinger to as far south as Lake St. Clair.

(*b*) *Extent and Method of Mining Operations.*—No mining has been carried out by this company, and at the date of the examination (December, 1921), no prospecting had been done.

(*c*) *Quality of Coal.*—The quality of the Tomago coal is shown in the table of analyses (Table I.).

The ash content is high and the coal does not possess the properties characteristic of the coal at the Greta horizon by giving oils on distillation.

The use of these coals, therefore, would be confined to ordinary purposes, and the quality cannot therefore be said to be any better than the average Trias-Jura coals of Tasmania.

As stated above, considerable portion at least of the area contains no coal seam at the Greta horizon, and much further exploration will have to be made before any statement can be made as to the quality of this Greta coal in the Mt. Pelion area.

(*d*) *Production.*—No production whatever has taken place.

(*e*) *Quantity of Coal Available.*—In the undeveloped state of the field only a rough approximation of the amount of coal available is possible. This must be based on the Tomago coal seam, 2 feet in thickness. A reasonable area over which it is justifiable to assume that coal exists, on the geological evidence, would be 2000 acres. This would give a possible coal reserve of 4,800,000 tons.

Chapter XX.

THE TERTIARY BROWN COALS AND LIGNITES.

The brown coals and lignites of Tasmania are of Tertiary age, and although widely distributed throughout the State they cannot be regarded as of very great industrial importance.

The general character of this class of coal resembles those at Morwell, in Victoria. The following analyses will indicate the general character of the brown coals and lignites of Tasmania:—

	Per cent.
(1) Brown coal from Lette's Bay, Macquarie Harbour:	
Moisture	20·8
Volatile carbonaceous matter	33·45
Fixed carbon	33·5
Ash	12·25
(2) Brown coal from Rosevale, West Tamar:	
Moisture	15·1
Volatile combustible matter	39·1
Fixed carbon	29·2
Ash	16·6

The thickness of the brown coal seams in Tasmania is not known up to the present time to exceed 4 feet. In places the coal is near the surface, but no occurrences are known where such a seam could be worked by open-cut methods with anything less than 20 feet of overburden to remove. It is doubtful, therefore, whether these brown coal deposits will have any commercial value for very many years to come.

The main localities of occurrences are as follow:—

Generally throughout the Launceston Tertiary basin.

In the valley of the Tamar.

On the North-West Coast, underlying the basalt, especially in the hinterland from Table Cape, and extending to the vicinity of Waratah.

In various localities down the West Coast; for example, the Que Valley and in Macquarie Harbour and Port Davey.

In the southern part of the island there is an extensive occurrence in the Derwent Valley, in the vicinity of Macquarie Plains, and at other isolated localities.

In the Rosevale district, on the West Tamar, a 4-ft. seam has been opened up by shafts, and a few tons extracted and used for manurial purposes. It has, however, had no application as a fuel, and is not likely to until such conditions are discovered which would enable the deposit to be worked by open-cut methods, and to such an extent as to warrant the erection of a briquetting plant.

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	1700	" "	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	" "	1,116,000
Sandfly	6	17	800	Sub-anthracite and non-caking humic	5,300,000
Cygnet	2	3·9	280	" "	715,000
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 I. 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 ...	4300	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	5,300,000	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	396,000	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	1,440,000	Large
Lewis Hill ...	3	10	...	...	...	200	B2	2,400,000	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	864,000	...
Preolenna ...	4	6·5	...	...	...	760	C	5,000,000	Fairly large
Barn Bluff-Pelion	1	2	...	...	...	3200	B2	7,600,000	Large
Totals	...	...	...	...	124,980,000	...	...	123,013,000	

Chapter II.

THE HISTORY OF COAL DISCOVERIES AND COAL-MINING IN TASMANIA.

There is no authentic record of the early history of the coal-mining industry. The earliest references at hand are found in the letters and reports of Government officials, the Proceedings of the Royal Society of Van Diemen's Land, and in the historical writings of James Fenton and others.

So far as can be learned the Saltwater River seams on Tasman Peninsula were the first discovered and exploited in Tasmania. These mines were worked by the Imperial Government to provide fuel for the various penal establishments in the neighbourhood, and a large quantity was conveyed to Hobart for household use. Operations ceased here when the penal settlement was abandoned about 45 years ago.

In 1824 J. Hobbs, on a voyage of exploration by boat round Tasmania, discovered coal seams in the cliff-face overlooking the sea at South Cape Bay. Some years later these deposits were explored by the Imperial Government with convict labour, as were also the Recherche Bay seams found in 1834. No further development work has been done there.

In giving an account of his visit to Colebrook in 1843, Strzelecki mentions the discovery of coal by convicts at the site of the present mine opening. At that time the mine was in active operation, and even then had produced a comparatively large quantity of coal. Strzelecki refers also to the occurrence of coal at New Town, Richmond, Pittwater, Ben Lomond, and Fingal. In 1849 J. Milligan investigated the coalfields of the State, and, referring to the Colebrook mine, reports the partial collapse of the workings. He records also the discovery of coal on Schouten Island and at Triabunna, and discusses the progress of development of the older fields.

Coal was discovered in 1850 in the Mersey district, and mining has continued uninterruptedly ever since. The seams are small, and the rate of production has never been large—sufficient only for local requirements. Following the gradual settlement of the country exploration extended into the north-eastern district, and seams were discovered in the Denison River area and at Seymour. There is no record of development here, but it is known that large quantities of coal were shipped from the port of Seymour during a period of 17 years.

The first important development in the coal-mining industry synchronises with the opening of the main trunk railway between Launceston and Hobart in 1876. Three years later the Colebrook mine was reopened by one McShane, and during the succeeding 20 years a large quantity of coal was raised and sold to the Railway Department.

The year 1886, however, was epoch-making in the coal-mining industry. In that year the Cornwall Mine was discovered by G. A. Crisp, of Avoca. A company operating from Launceston was formed to exploit the deposits there, and active development has continued without serious interruption to the present day.

Other mines were opened in the Mt. Nicholas Range, railways for transportation were constructed, and every facility was provided for cheap marketing.

In 1900 the important Catamaran field was discovered, and eight years later William Anderson exposed the Strathblane-Hastings series in the same district.

Lowrie and Harris, in cutting a track from Wynyard to Arthur River in 1901, discovered coal outcrops at Preolenna. The coal of this field is similar to that of the Mt. Pelion-Barn Bluff field, where coal was found by J. Will in 1892.

The remoteness of these fields from lines of transport has been the greatest obstacle to their advancement, but in the case of the Preolenna railway facilities will shortly be provided.

Although the growth of the coal-mining industry has been slow, a great amount of development work has been performed in all the commercially important fields.

A rapid increase in the production is anticipated in the near future, following the establishment of new industries and the development of means of communication and the expansion of the export trade.

Chapter III.

THE TOTAL AND PRESENT RATE OF PRODUCTION.

The early records of the production of coal are not now available, but a fairly close estimate has been arrived at by taking into consideration the average rate of output and the number of years the mines were in operation.

Prior to 1880 it is estimated the production was:—

	Tons.
Seymour mines	50,000
Colebrook (Jerusalem)	50,000
Saltwater River	50,000
Denison River	10,000
Mersey	85,000
New Town	50,000
Estimated total	295,000

Since 1880 statistics of the coal production have been tabulated by the Mines Department. The production and value for each year since 1880 is given hereunder:—

TABLE IV.—TOTAL PRODUCTION OF COAL IN TASMANIA SINCE 1880.

Year.	Tons Raised.	Value.	Year.	Tons Raised.	Value.
		£			£
1880	12,219	10,998	1902	48,863	41,533
1881	11,163	10,047	1903	49,069	41,709
1882	8803	7923	1904	61,109	51,942
1883	8872	7985	1905	51,993	44,194
1884	7194	6475	1906	52,895	44,962
1885	6654	5989	1907	58,891	50,057
1886	10,391	9352	1908	61,067	51,907
1887	27,633	24,870	1909	66,161	56,237
1888	41,577	37,420	1910	82,445	48,609*
1889	36,700	33,030	1911	57,067	26,214*
1890	50,519	45,467	1912	53,560	24,568*
1891	43,256	38,930	1913	55,043	25,367*
1892	36,008	32,407	1914	60,794	27,853*
1893	34,693	27,754	1915	64,536	30,418*
1894	30,499	24,399	1916	55,575	27,736*
1895	32,698	26,159	1917	63,412	38,673*
1896	41,904	33,523	1918	60,163	37,676*
1897	42,196	33,757	1919	66,253	47,004*
1898	47,678	38,256	1920	75,429	64,005*
1899	42,609	38,349	1921	66,476	63,446
1900	50,633	44,227			
1901	45,438	38,451	Total	1,880,138	1,419,878

* Value at pit's mouth.

The total production to date is estimated at 1,880,138 tons, valued at £1,419,878.

Since 1886 the Cornwall Mine has contributed over one-third, and, with the neighbouring Mt. Nicholas Mine, more than one-half of the total production.

The total output of the Cornwall Mine to date is 829,556 tons. The other coalfields have yielded only a comparatively small amount.

The present rate of production is at the rate of 75,000 tons a year, or not half of that required for local consumption. Imported coals are used largely for gas-making and coke-manufacture, and for steam-raising on railway engines and steam-boats. Unfortunately coals suitable for gas-making are not mined to any extent in Tasmania at the present time, and few produce a firm coke. The market then for local coals is at present limited to household and railway requirements, and the output is controlled accordingly.

Chapter IV.

THE DESIGNING OF THE METHOD OF EXPLOITATION BASED ON GEOLOGIC STRUCTURE.

In a region such as that comprising the coalfields of Tasmania, where the coal measures have been uplifted and disturbed by enormous masses of igneous material, the exact relationship between the intruded and intruding formations is in some cases very difficult to interpret. That a thorough comprehension of the structural geology of any particular part is essential becomes apparent when it is realised that without such knowledge it would be impossible to arrive at the best methods of operation and the selection of the most advantageous positions for mine openings.

The failure in the appreciation of this fact in the past led in some cases to much useless expenditure and the discouragement of the operators. Instances are known in which the sites for mine openings were chosen within a few feet of faults, the existence of which was not discovered before the completion of long adits and dip tunnels and the driving of headings therefrom. These haphazard methods have had a ruinous effect on the industry, the direct result in extreme cases being the abandonment of the mines before sufficient work of an exploratory character had been performed to ascertain the extent and value of the coal.

It is a rather striking fact that the coalfields of Tasmania are separated from one another by distinct geographical breaks. This division has been brought about by the intrusion of diabase and the resultant faulting aided by Tertiary and post-Tertiary erosion.

Each coalfield in turn has been subdivided by faults of lesser magnitude into groups of mine areas. The problems of their exploitation differ only in the means of access, facilities of transport, and methods of mining, the variation being in accordance with the conditions existing in each locality.

In pegging sections for the lease of the coal-mining rights of any area little thought is given to the importance of the relationship between geologic structure and mining development. It is the common practice to peg sections where the best outcrops occur, and the sites for mine openings are usually located at such points, irrespective of the structural features of the country. Under the circumstances it is surprising that, whether by accident or design, so comparatively few mistakes have been made in this connection. Perhaps original errors of judgment have been obviated in a measure by the grouping of contiguous leases and the amalgamation of interests. Naturally, holders of mining rights would be guided by geographical conditions, and as important changes in the features of the surface are due directly to the geological conditions, it seems probable from this viewpoint that the grouping of mining interests to the greatest advantage of all concerned was performed unconsciously.

In this publication the limits of the geological maps do not necessarily mark the divisions between coalfields, although the present arrangement, originally designed for convenience of description only, happens to possess both a geographical and geological significance.

Attention will now be drawn to other aspects of the question.

In many places the preliminary operation of boring should precede mining development. Most mining engineers of repute realise the necessity for such exploratory work, and this course is usually recommended. But owing to lack of knowledge of local geology disappointing results have been common. For instance, bores have been started in and sunk through Ross sandstones in search of the coal measures from which they had been denuded. Again, near Railton bores were sunk in Silurian limestone in search of Permo-Carboniferous coal seams. Other instances could be given too numerous to mention.

The failure in the location of faults frequently leads to most serious mistakes.

Many years ago, in one of the East Coast mines, a long tunnel was driven parallel to and within a few yards of a fault of 200 feet displacement, the near presence of which was not suspected by the operators, and it was not discovered until a heading had been driven in that direction. On another property a shaft was sunk 300 feet between two faults only 500 feet apart. The small amount of coal available for raising through this mine opening forbade the possibility of the successful operation of the mine.

There are other factors to be considered in the selection of sites for mine openings.

It will be noticed that the site chosen for the main working adit at the Dalmayne Mine is not altogether suitable, as there is not a great tonnage of coal available to the north, and on the south side the seam cannot be profitably worked owing to the costs of pumping and power haulage. Perhaps the main factor that influenced the owners in the selection of this site was the thickness and quality of the coal there. A more favourable site for the main opening may be found 60 chains farther southward, in the valley of Picanini Creek. From this point the whole coal-bearing area can be attacked, and by working to the rise from incline tunnels gravity drainage and transport will greatly reduce the working costs. This position has the further advantage of being within 5 miles of Seymour, a much more sheltered port of shipment than Picanini Point. Numerous minor faults occur in the intervening area, but no serious dislocations have been observed south of the present main tunnel.

From the foregoing it will be seen that many of the mistakes made in the past could have been obviated had closer attention been given to structural features in the design of mine openings.

The procedure which the Geological Survey desires to lay down as the most efficient means of planning the method of exploitation of the coal in any area is as follows:—

(1) Study of the relation of the major faults to the coal-bearing area. These major faults are shown in the maps accompanying this publication and generalised for the eastern and south-eastern portions of Tasmania in Plate IV.

(2) After the investigation of the position of the major faults has shown that a block of coal-bearing ground containing coal reserves sufficient to warrant initial expenditure in opening up for exploitation, and before any such work is started, the area must be systematically bored. The object of this boring is to locate the minor faults. If the boring is carried out systematically the position of the minor faults can be determined, and the third stage of the opening up can be entered upon, viz.:—

(3) The laying out of the surface works which will initiate the attack on the coal seams from the lowest point, so that the whole of the coal can be extracted by working to the rise, whether this rise is caused by dip or by minor faulting. In this way all troubles of haulage and drainage will be obviated at the start.

It cannot be too strongly urged that if the coal resources of Tasmania are to be systematically developed, the designing of exploitation on the above lines is essential if success is to be attained.

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 $1\frac{1}{2}$-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, Illamatha, 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	3·43	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
446	Cream	49·08	2·29	43·27	...	3·65	0·58	0·24	0·75	0·52	...	Sandfly

462	White	68·60	2·29	27·91	...	0·30	0·87	0·20	...	...	...	Hastings
464	Light-brown...	37·44	5·86	18·90	1·30	29·30	1·23	6·35	...	...	...	Catamaran
465	Light-brown...	39·08	5·63	21·17	1·30	28·92	0·79	3·53	...	...	...	Catamaran
478	Dark-cream ...	72·30	7·29	11·51	0·54	5·40	0·36	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
494B	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	...	0·50	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	9·73	31·67	48·39	10·19	2·66	11·80	6463	11,634
Japan (Chikuho 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 firebox 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 $1\frac{1}{2}$-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 $\frac{1}{2}$-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.

([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 VIII.

COST OF PRODUCTION AND MARKET VALUE.

The commercial value of Tasmanian coal for steam-raising and domestic use depends on the cost of production, the distance from markets, and the heat value compared with imported Newcastle coal.

Analyses of the cost of production at the several mines in operation are not available, and in consequence the information supplied herein is incomplete and lacking in detail. From old records it is found that the cost of mining at New Town amounted to 8s. 6d. per ton, and the price obtained, delivered to consumers, from 17 to 24 shillings per ton, according to the varying quality of the coal. These prices of 40 years ago compare very well with present-day rates. Take, for instance, the Nicholas Range mines: the cost of production and delivery into the railway trucks at the Cornwall Mine is about 13s. 6d. per ton, with probably an additional 2s. at the neighbouring Mt. Nicholas Mine, and the price received for large quantities is 19s., leaving a mining profit of 3s. 6d. to 5s. 6d. per ton. The estimated profit on mining given here appears excessive, especially in view of the fact that since its inception the Cornwall Company has raised 829,556 tons, and has paid only £47,398 in dividends. This works out at a little over 1s per ton profit. It must be remembered, however, that no dividends were paid until 1891, and during the following decade the distribution of profits was very irregular. Since 1905 dividends have been paid to shareholders regularly.

The retail price for Cornwall or Mt. Nicholas coal at Launceston is 30s. per ton. Freight from the mine to Launceston is at the rate of 6s. 11d. per ton, and to Hobart 7s. 5d. The foregoing remarks refer to lump coal, for which a much higher price is given than for slack or nut size. Slack and nut coal were almost unsaleable a while ago, but considerable quantities are supplied now to the Electrolytic Zinc Company, of Hobart, at the rate of 5s. per ton in the railway trucks at St. Marys. As there is 16 per cent. of slack in the coal mined a market for this size is of considerable importance to the industry. The retail prices of Newcastle coal in the Launceston market are 47s. 9d. for lump coal and 43s. 9d. for nut size. Taking into consideration the relative calorific values, the margin is in favour of local coals. By far the greater part of the Newcastle coal imported is used for gas-making and coke-manufacture, and for use on steamers and railways. In the near future it is probable that Preolenna coal will partly displace Newcastle in these industries.

Mt. Christie coal is sent to Launceston and sold as a domestic fuel, for which purpose it commands a high price. The value on the trucks at Avoca is 23s. per ton, but from this amount 12s. 6d. has to be deducted for transport cost from the mine to the railway (a distance of 5 miles), leaving only 10s. 6d. to defray the cost of mining.

Catamaran coal for special use should command a high figure in the Hobart market. It is an ideal household coal, superior to Newcastle for smithy work, and possesses good steaming qualities.

York Plains coal, used for hop-drying, is worth 27s. per ton delivered in the railway trucks at the sidings.

The rate of import of coal into Tasmania is approximately equal to the rate of production from local mines. At the present time it is almost exactly equal, as the figures for 1921 show an importation of New South Wales coal of 66,845 tons, while the total production from the Tasmanian mines was 66,476 tons.

By far the larger quantity comes from New South Wales, but occasional small shipments are brought from Great Britain and other countries. It is expected that local coals will come into more general use for domestic and steam-raising purposes, and although the quantity of imported coal may not be reduced, it is considered that the ratio will be in favour of Tasmanian coals.

From time to time small shipments of coal have been sent to mainland States and other countries. The export trade is not likely to develop rapidly until better transport facilities are provided in the eastern districts. One of the largest companies operating near the East Coast has been in negotiation with the South Australian Government for the supply of large quantities of coal, but a definite contract cannot be made until railway and shipping facilities are provided.

The total amount of coal imported into Tasmania since 1889 has been, approximately, 1,766,000 tons, or an average of 53.500 tons per year.

The total quantity exported during the same period has been, approximately, 72,000 tons, or an average of 2100 tons per year.

Chapter IX.

THE POSITION OF THE COAL DEPOSITS OF TASMANIA IN RELATION TO THE LOCATION OF MORE IMPORTANT MINERAL DEPOSITS, RAILWAY COMMUNICATION, AND HYDRO-ELECTRIC POWER.

The more important facts in connection with the coal resources of Tasmania have been presented in the preceding pages. The consideration of the coal resources of Tasmania, however, would not be complete without some summary of the other natural resources of Tasmania, sufficient to enable the economic relationship between them and the coal resources to be indicated and discussed.

In the map published as Plate I. of this publication there are indicated, in addition to the coal-bearing areas, the location of the more important areas which carry deposits of oil shale, iron, tin, copper, cement materials, gold, zinc, nickel, lead, silver, and osmiridium.

In addition, there are shown the more important ports and railway communications of the State, as well as existing hydro-electric power stations and transmission lines. There are also indicated the location of the two great metallurgical establishments which have resulted from the availability of cheap hydro-electric power.

The resources of the State in materials for the pottery, porcelain, glass making, paint making materials, &c., are not indicated in the map, as they are very widely distributed throughout the island.

A study of the above map shows clearly that the greater portion of the mineral deposits occur in that part of the island in which the coal deposits are absent. The one important exception, however, of economic significance is the Blythe iron deposit, which occurs midway between the coal and oil shale fields of the Mersey and Preolenna. This latter fact must be remembered in connection with the additional fact shown by the map, that the Blythe iron deposit is within the 80-mile radius of the Waddamana power-station, and is within 25 miles of the northern end of the region which contains the potential hydro-electric power schemes of the State.

This same map shows that the railway systems of the State provide a main channel of communication connecting both the mineral deposits of the West and North-East Coasts with the coalfields of Mt. Nicholas, Fingal, Ben Lomond, Mersey, and Preolenna. The coalfields of the East Coast, extending from the Dalmayne area southwards, are seen to be completely cut off from the railway systems of the State. This is undoubtedly a serious hindrance to both the development of the coal resources and therefore to the general industrial development of the State. The East Coast is notable in that it presents only one good harbour—namely, Coles Bay. To provide a main trunk line from Dalmayne to Coles Bay would, therefore, fill a very serious gap in the facilities for national development. Such a railway could be constructed at a relatively low cost, as there are no serious, or even appreciable, topographic difficulties. Coles Bay would provide accommodation for all ordinary shipping. The development of the East Coast coalfields cannot be accomplished until such a line is constructed.

In regard to the Southern coalfields—namely, Tasman Peninsula, Sandfly, Cygnet, Catamaran, &c.—the availability of deep water and sheltered harbours along the whole of the coast-line provides favourable conditions for transporting the coal. Development in these areas can therefore take place without the construction of a trunk line of railway.

To connect up with the numerous harbours in this latter case, and with the East Coast trunk line in the former case, is a relatively small matter that can be handled by the individual companies operating.

The Barn Bluff-Pelion area is seen to be also isolated from the railway system. To connect this up by a main trunk line of railway would be a somewhat expensive undertaking.

With the provision of the abovementioned facilities the foundation would be laid for the concurrent development of our coal resources and all those industries based on the mineral resources of the State.

It is further obvious from the map that the location of the area in which the hydro-electric power of the State will be developed coincides very closely with the West Coast mineral belt. The coal reserves are located mainly outside this hydro-electric power area, with the exception of the Barn Bluff-Pelion coalfield.

Another obvious inference to be drawn from the map is the very favourable location in relation to the coal resources of the cement-manufacturing propositions which have been considered in some detail. By the utilisation of our coal in the powdered form, Tasmania must become, possessing as it does immense deposits of the raw materials, a large producer of Portland cement.

The distribution of the natural resources of Tasmania therefore is very favourable for development, for the absence of coal in the immediate proximity of our ore-deposits is counter-balanced by the presence of big reserves of hydro-electric power. In any case the amount of railway construction still remaining to be done to bring all the resources within reasonable haulage distance of one another is very small; and, finally, it must be pointed out that in view of the size of the island any such haulage will not be of any appreciable magnitude.

The map shows clearly the extent and character of our mineral deposits. These, with the addition of our pottery, porcelain, glass making, and paint making materials, added to the big hydro-electric power resources and the availability of the coal reserves essential to industrial development, present a combination of conditions very favourable indeed for the establishment of manufacturing industries combined, as they all are, in a very small compass.

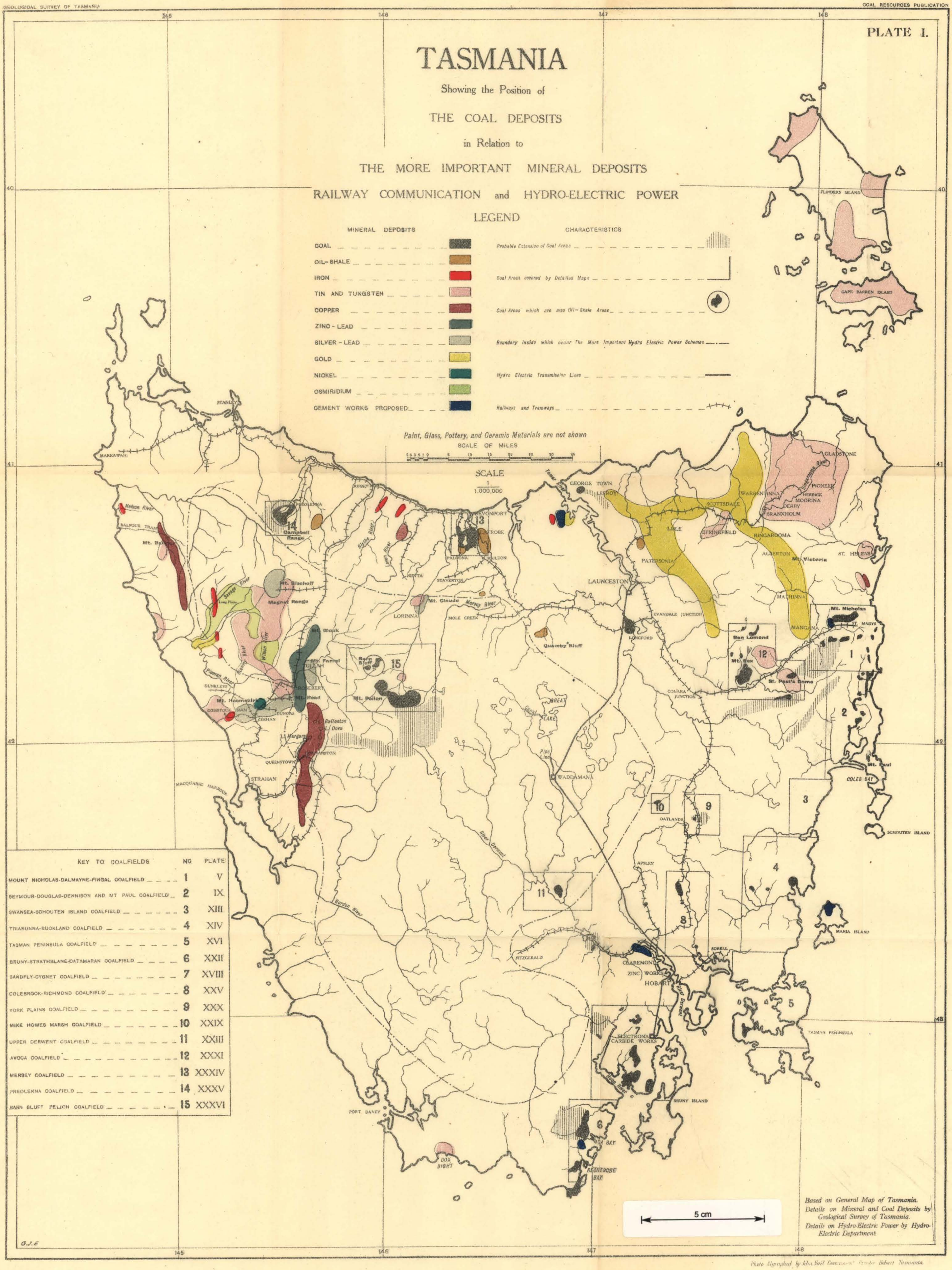
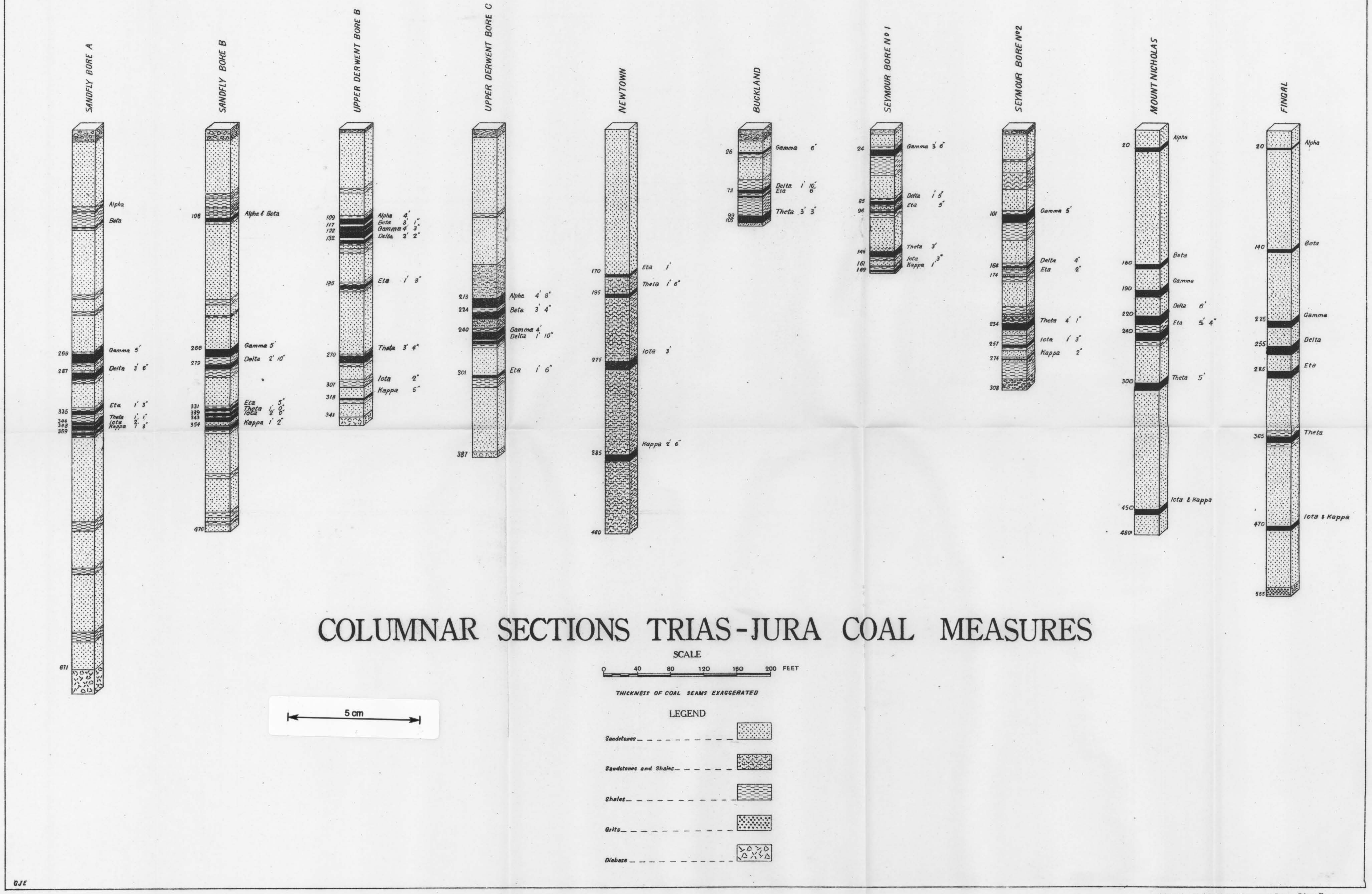


Photo lithographed by John Vail Government Printer Hobart Tasmania

PLATE II.

GENERALISED COLUMNAR SECTIONS OF THE TRIAS-JURA AND PERMO-CARBONIFEROUS SYSTEMS IN TASMANIA

Photo Algraphed by John Vail, Government Printer, Hobart, Tasmania.



COLUMNAR SECTIONS TRIAS-JURA COAL MEASURES

G.J.E.

Photo Algraphed by John Vail, Government Printer, Hobart, Tasmania.

PLATE IV

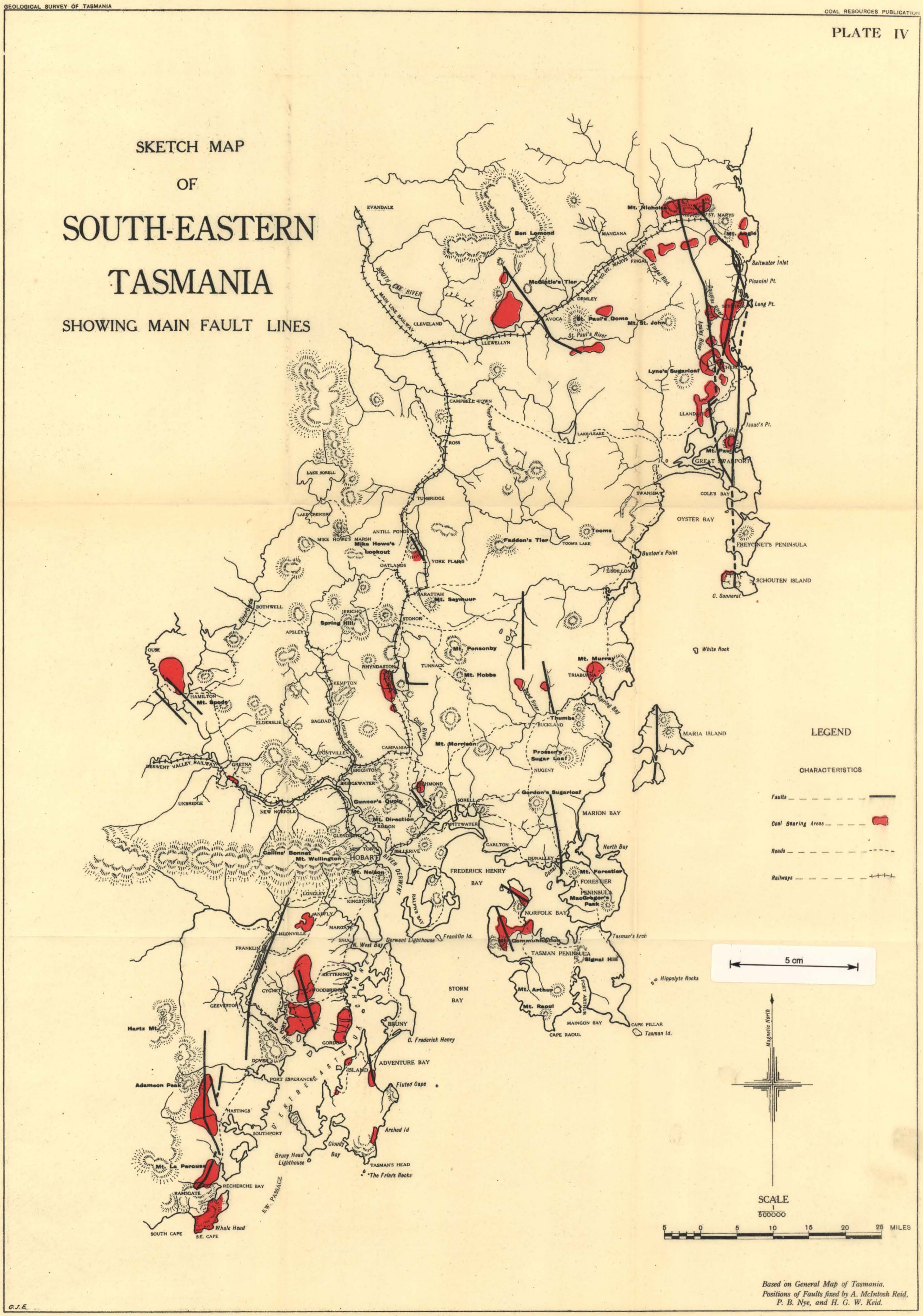


Photo Algraphed by John Vail, Government Printer, Hobart, Tasmania

PLATE V

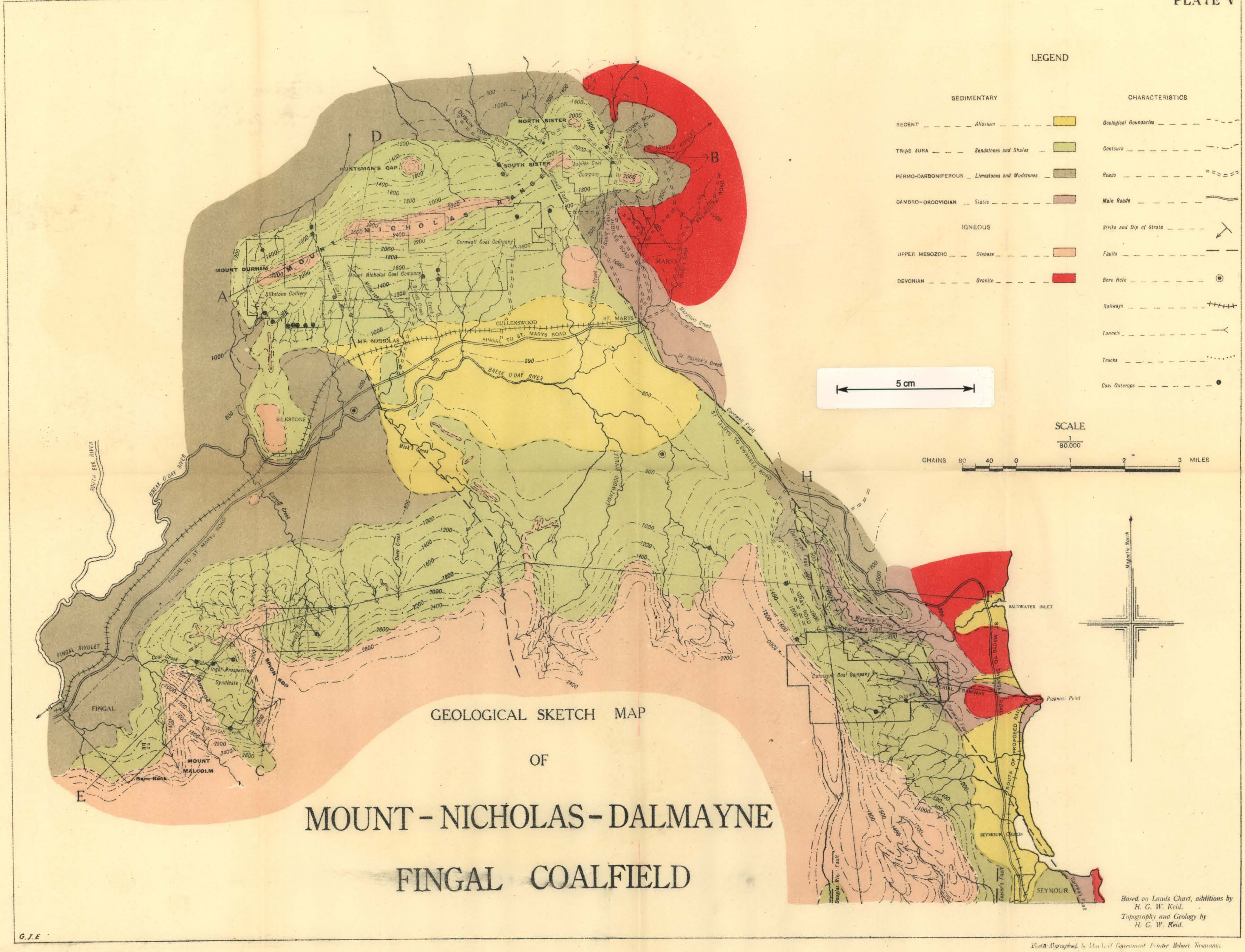

LEGEND
SEDIMENTARY
RECENT — Alluvium
TRIAS JURA — Sandstones and Shales
PERMO-CARBONIFEROUS — Limestones and Mudstones
CAMBRO-ORDOVICIAN — Slates
IGNEOUS
UPPER MESOZOIC — Diabase
DEVONIAN — Granite
CHARACTERISTICS
Geological Boundaries
Contours
Roads
Main Roads
Strike and Dip of Strata
Faults
Bore Hole
Railways
Tunnels
Tracks
Coal Outcrops
SCALE
1/80,000
CHAINS 80 40 0 1 2 3 MILES
Magnetic North
GEOLOGICAL SKETCH MAP
OF
MOUNT - NICHOLAS - DALMAYNE
FINGAL COALFIELD
NORTH SISTER
SOUTH SISTER
HUNTSMAN'S CAP
MOUNT DURHAM
MOUNT NICHOLAS RANGE
Cornwall Coal Company
Mount Nicholas Coal Company
Jubilee Coal Company
Silkstone Colliery
SILKSTONE
CULLENSWOOD
ST. MARYS
MT. NICHOLAS
FINGAL TO ST. MARYS ROAD
BREAK O'DAY RIVER
SOUTH ESK RIVER
FINGAL RIVULET
FINGAL
MOUNT MALCOLM
Bare Rock
Dalmayne Coal Company
SALTWATER INLET
Piccaninni Point
SEYMOUR LAGOON
SEYMOUR
Cornwall Fault
ROUTE OF PROPOSED RAILWAY
Based on Lands Chart, additions by H. G. W. Keid.
Topography and Geology by H. G. W. Keid.
G.J.E.

PLATE VI.

GEOLOGICAL SKETCH SECTION
OF
MOUNT NICHOLAS AREA

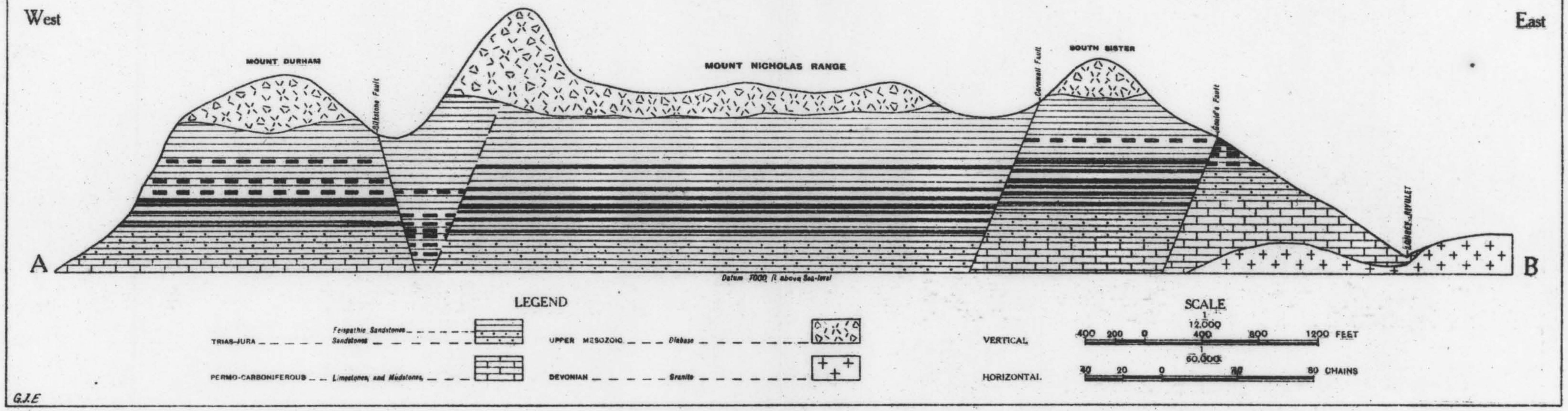


PLATE VII

GEOLOGICAL SKETCH SECTION OF MOUNT NICHOLAS AREA

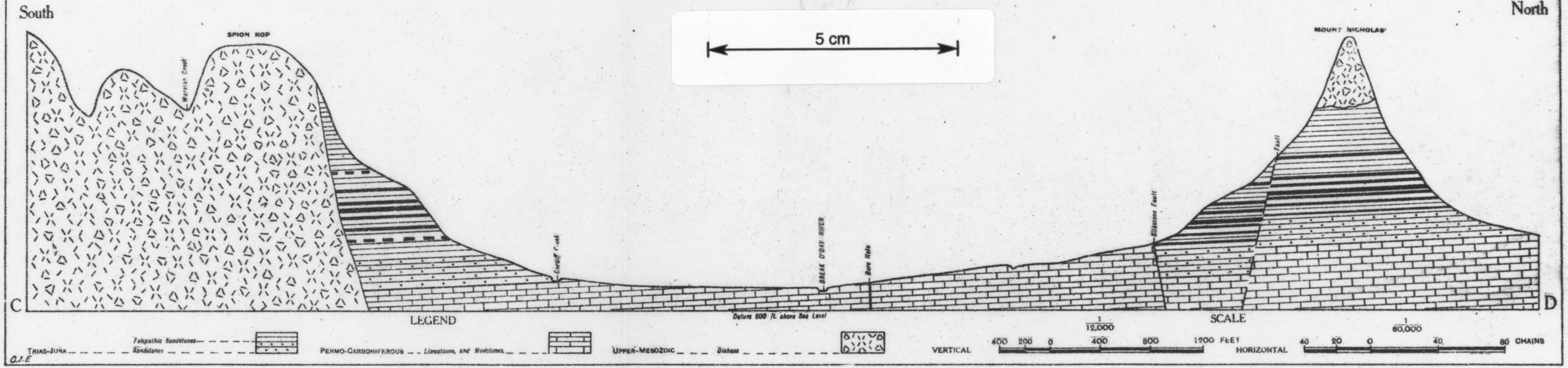
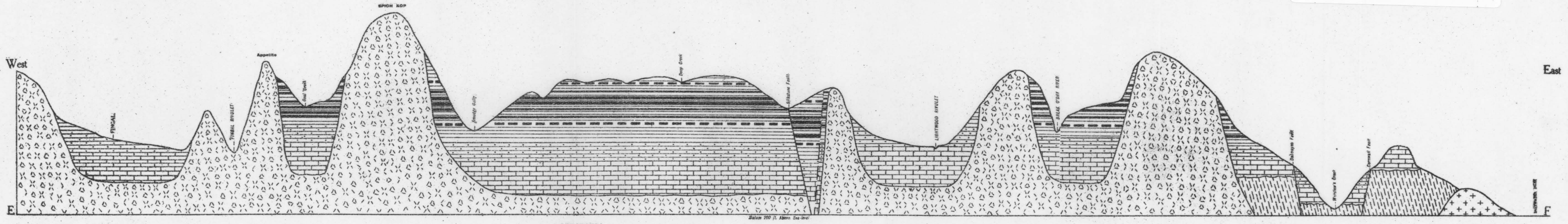


Photo Algraphed by John Vail Government Printer Hobart Tasmania.

PLATE VIII.

GEOLOGICAL SKETCH SECTION FROM FINGAL TO SALTWATER INLET.



LEGEND

TRIAS-JURA — Felspathic Sandstones; Sandstones

PERMO-CARBONIFEROUS — Limestones and Mudstones

CAMBRO-ORDOVICIAN — Slates

UPPER MESOZOIC — Diabase

DEVONIAN — Granite

SCALE

VERTICAL $\frac{1}{12,000}$ — 400 200 0 400 800 1200 FEET

HORIZONTAL $\frac{1}{20,000}$ — 40 20 0 40 80 CHAINS

G.J.S.

Photo Lithographed by John Vail, Government Printer, Hobart, Tasmania.

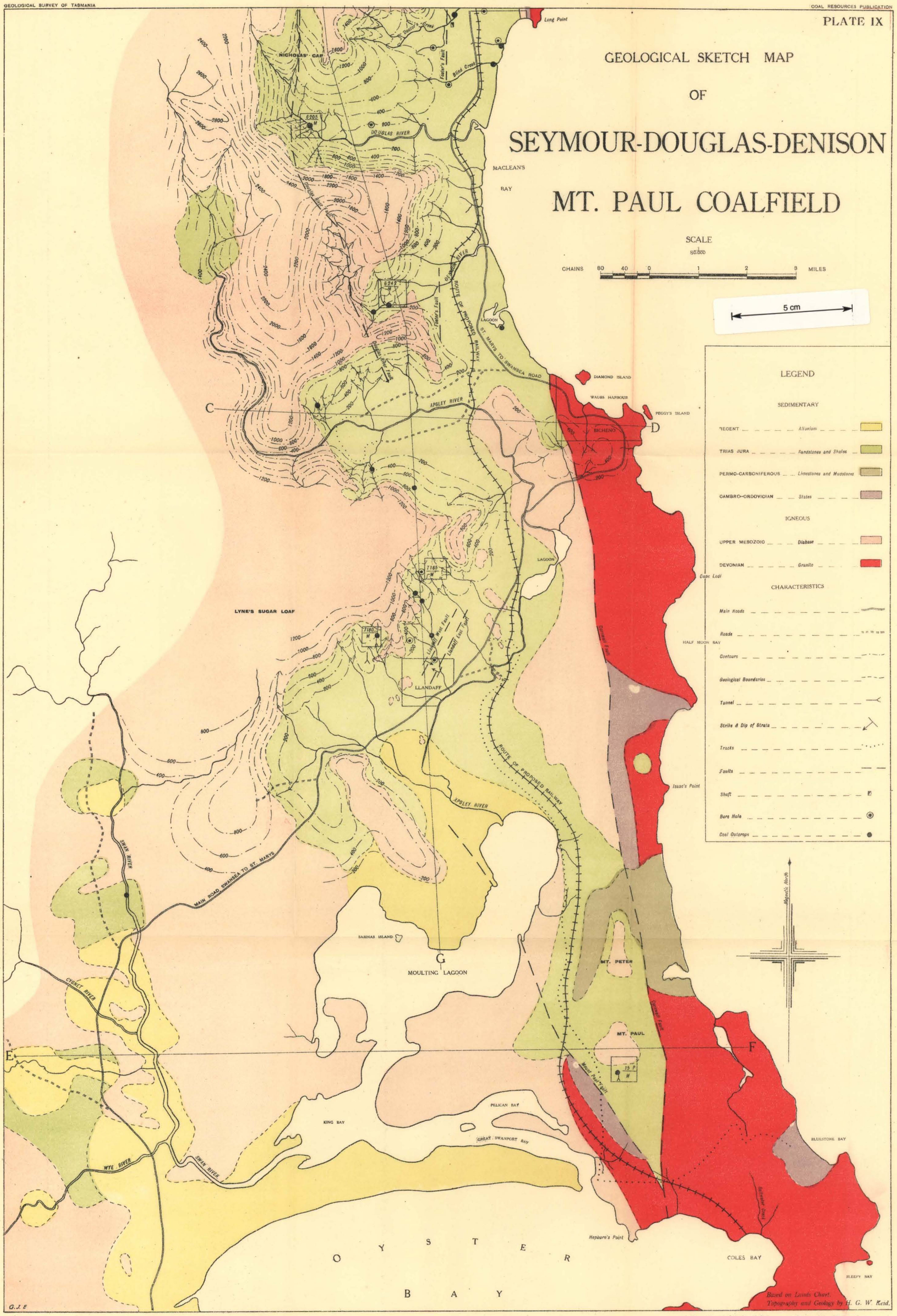


Photo Algraphed by John Vail, Government Printer Hobart Tasmania.

GEOLOGICAL SKETCH SECTION OF THE EAST COAST

Photo Algraphed by John Vail Government Printer Hobart Tasmania.

GEOLOGICAL SKETCH SECTION OF APSLEY RIVER AREA

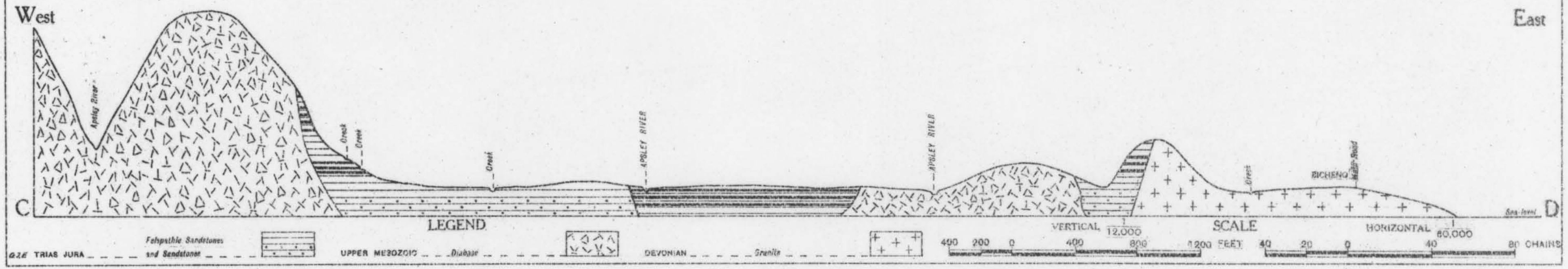


PLATE XII.

GEOLOGICAL SKETCH SECTION OF MT. PAUL AREA

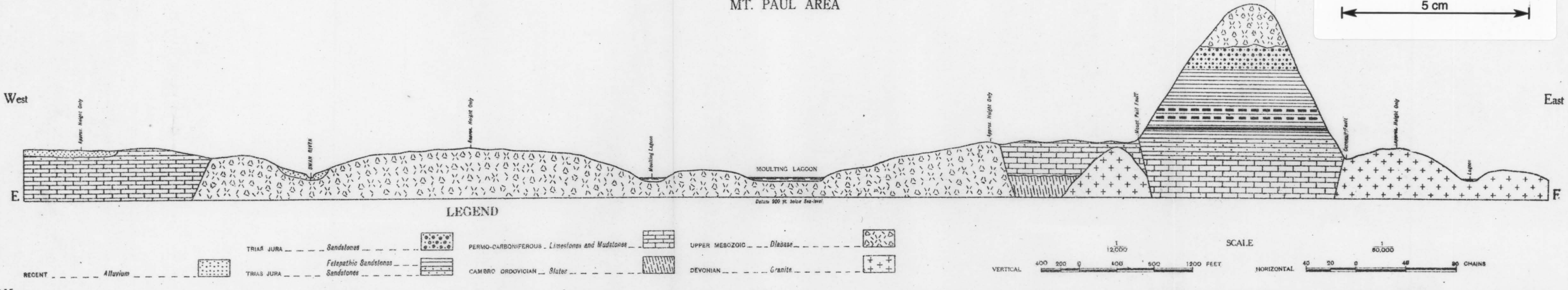


Photo Alygraphed by John Vail, Government Printer, Hobart, Tasmania

PLATE XIII

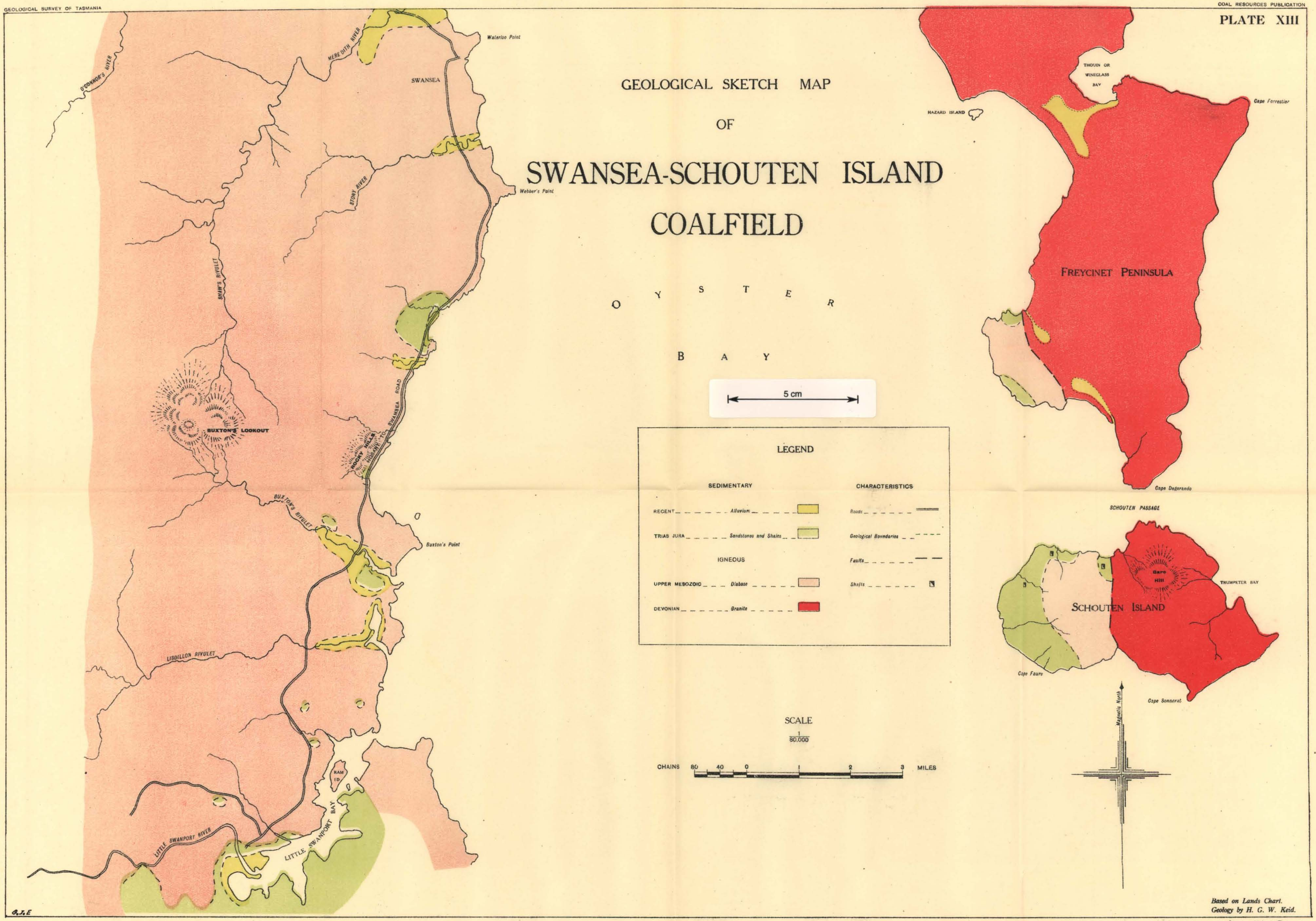


Photo Lithographed by John Vail, Government Printer, Hobart, Tasmania.

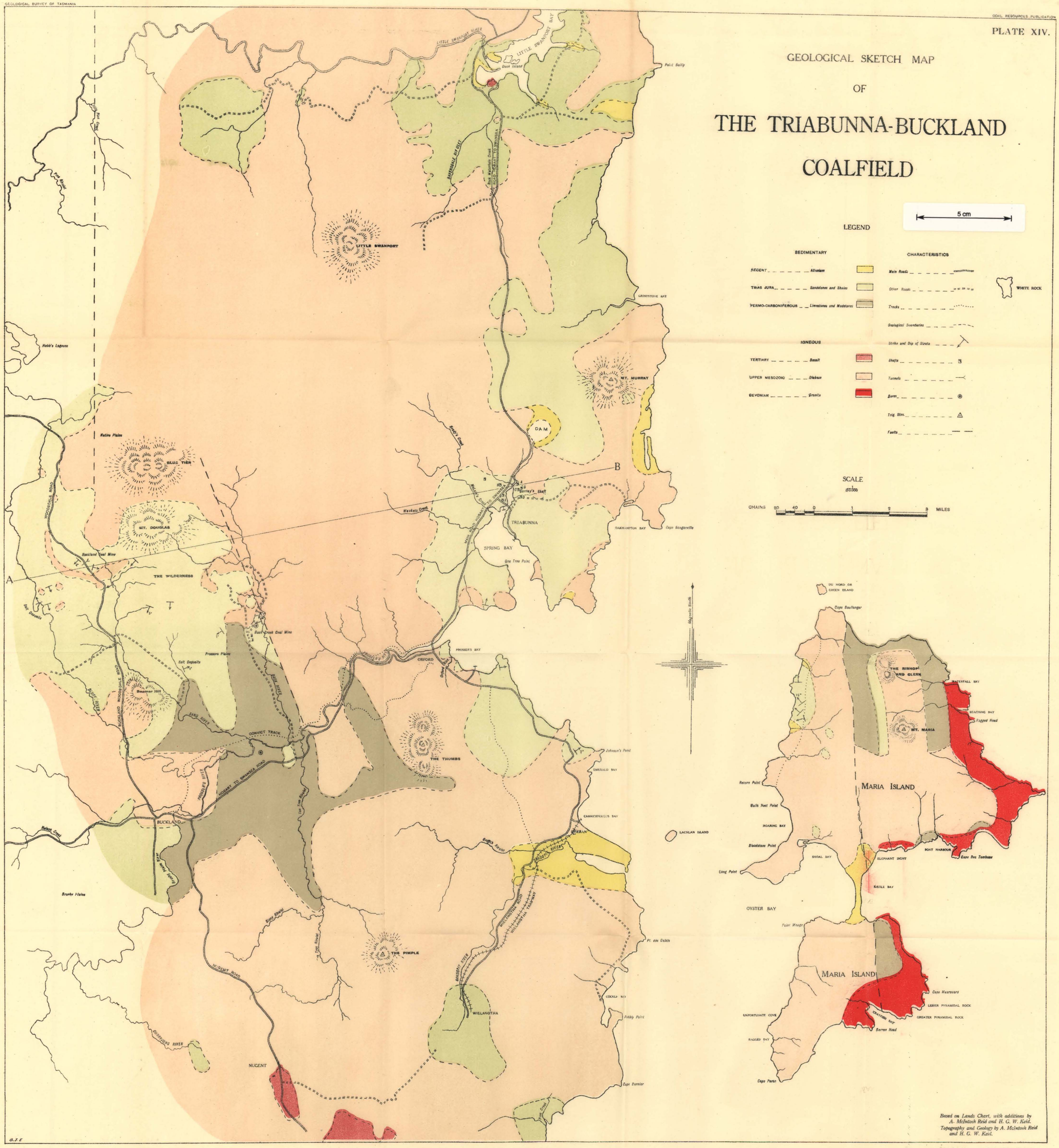
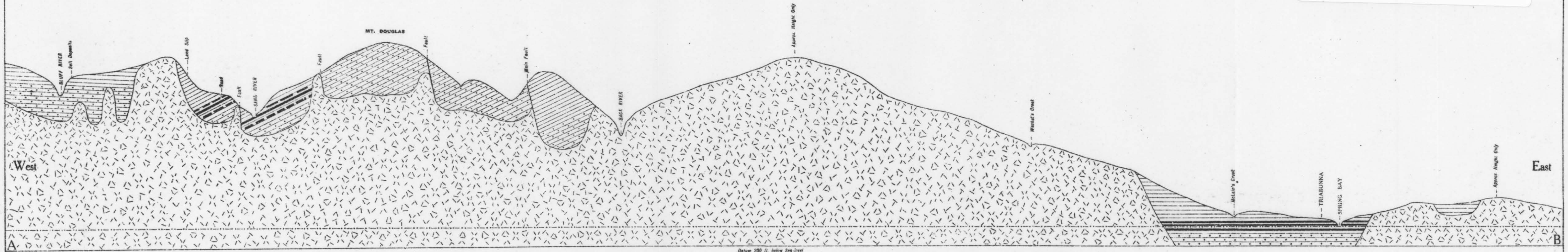


Photo lithographed by John Vail Government Printer Hobart Tasmania.

PLATE XV.

GEOLOGICAL SKETCH SECTION OF BUCKLAND - TRIABUNNA AREA

5 cm



LEGEND

TRIAS JURA	Felspathic Sandstones / Sandstones	[dotted and ruled pattern]
UPPER MESOZOIC	Diabase	[broken-line pattern]

SCALE

VERTICAL $\frac{1}{12{,}000}$ — 400 200 0 400 800 1200 FEET

HORIZONTAL $\frac{1}{60{,}000}$ — 40 20 0 40 80 CHAINS

A.J.E.

Photo Atgraphed by John Vail Government Printer Hobart Tasmania

PLATE XVI

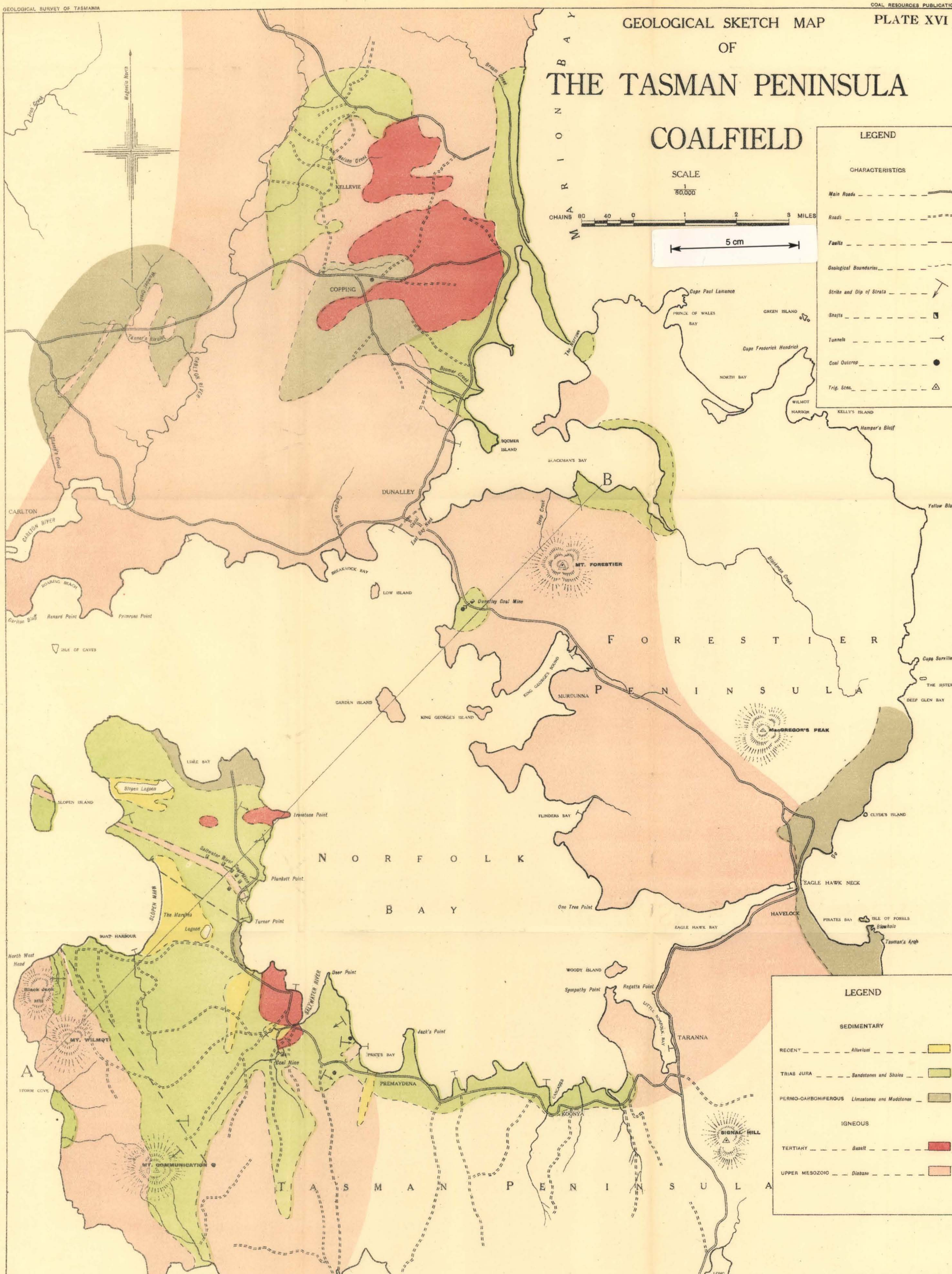
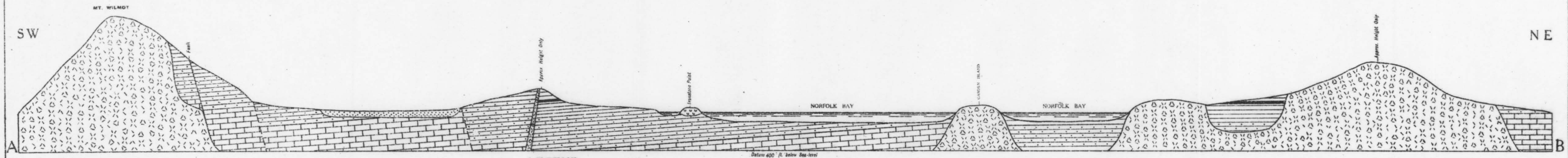


Photo Algraphed by John Vail, Government Printer Hobart, Tasmania.

GEOLOGICAL SKETCH SECTION OF TASMAN PENINSULA AREA



LEGEND

RECENT — Alluvium
TRIAS JURA — Felspathic Sandstones, Sandstones
PERMO-CARBONIFEROUS — Limestones and Mudstones
TERTIARY — Basalt
UPPER MESOZOIC — Diabase

SCALE

VERTICAL $\frac{1}{12,000}$ 400 200 0 400 800 1200 FEET
HORIZONTAL $\frac{1}{60,000}$ 40 20 0 40 80 CHAINS

G.J.C.

Photo Algraphed by John Vail Government Printer Hobart Tasmania.

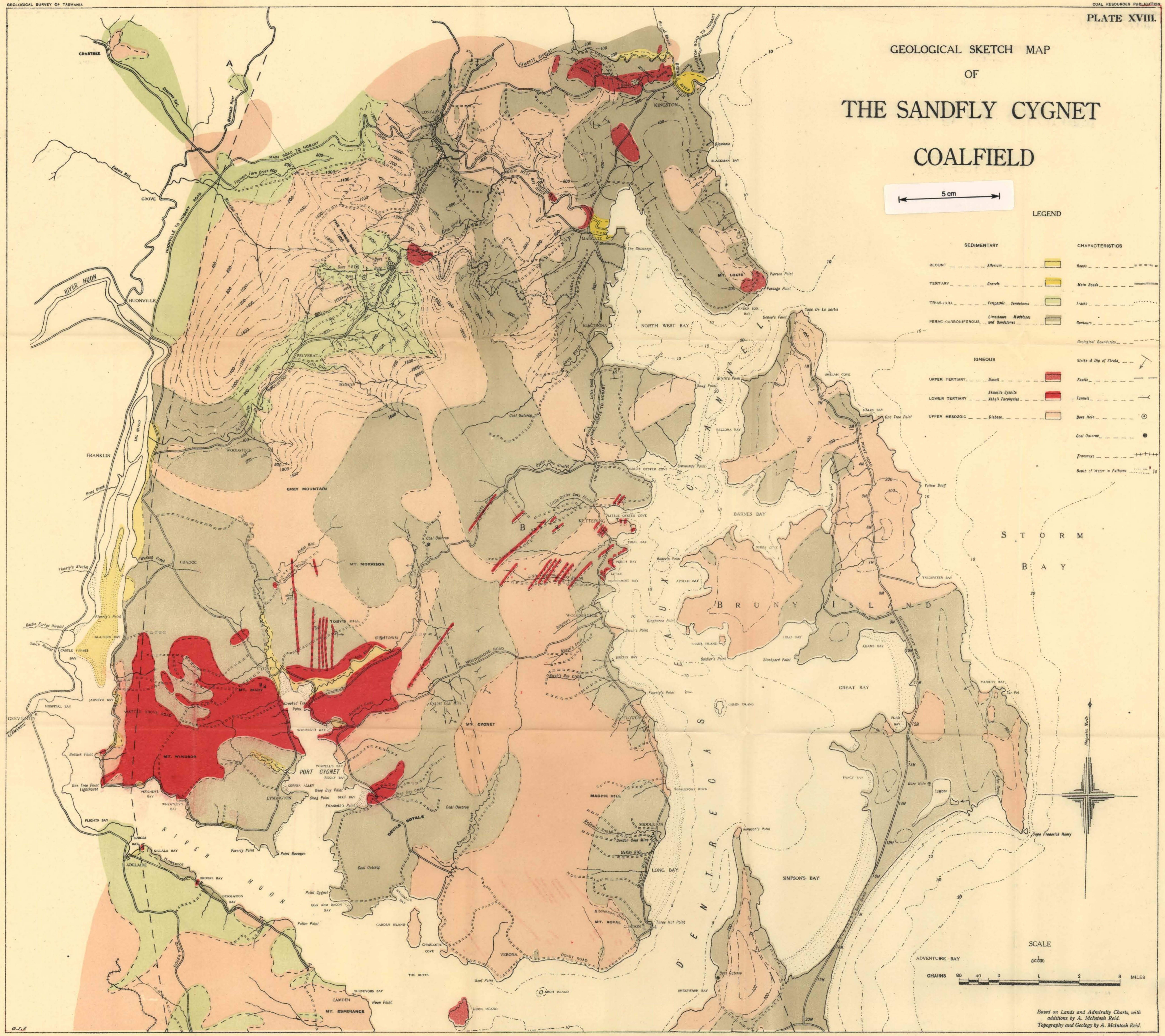


Photo Algraphed by John Vail Government Printer Hobart Tasmania.

PLATE XIX

GEOLOGICAL SKETCH SECTION OF SANDFLY AREA

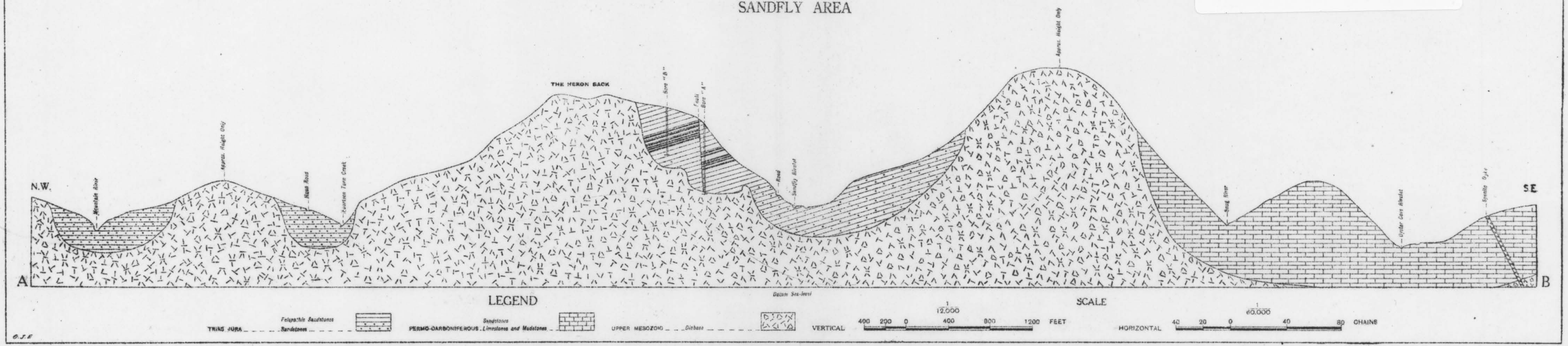
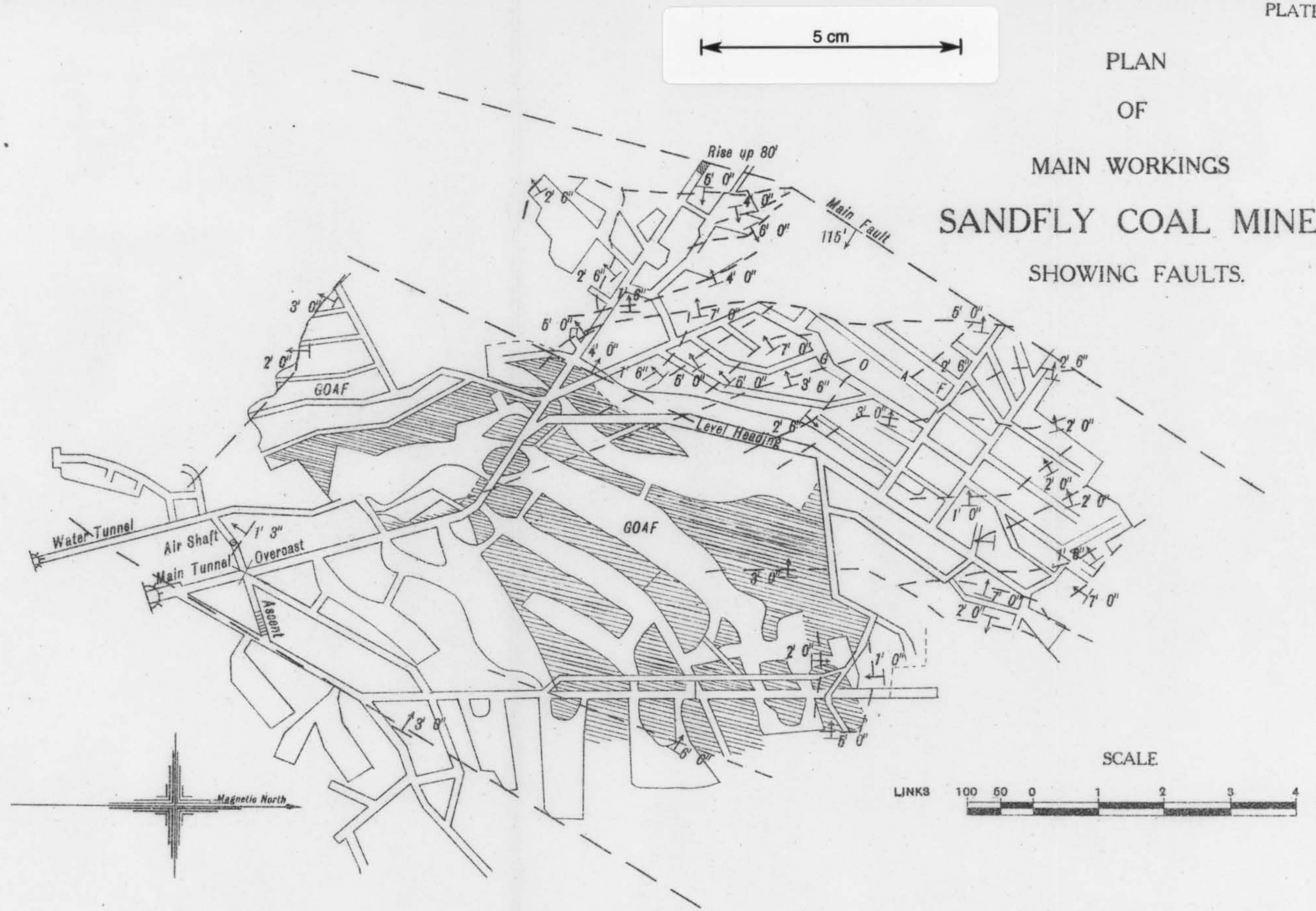


Photo Algraphed by John Vail, Government Printer Hobart Tasmania.

PLATE XX.

PLAN OF MAIN WORKINGS SANDFLY COAL MINE SHOWING FAULTS.



Based on Company's Plan, additions and Geology by A. McIntosh Reid.

G.J.E

Photo Algraphed by John Vail Government Printer Hobart Tasmania.

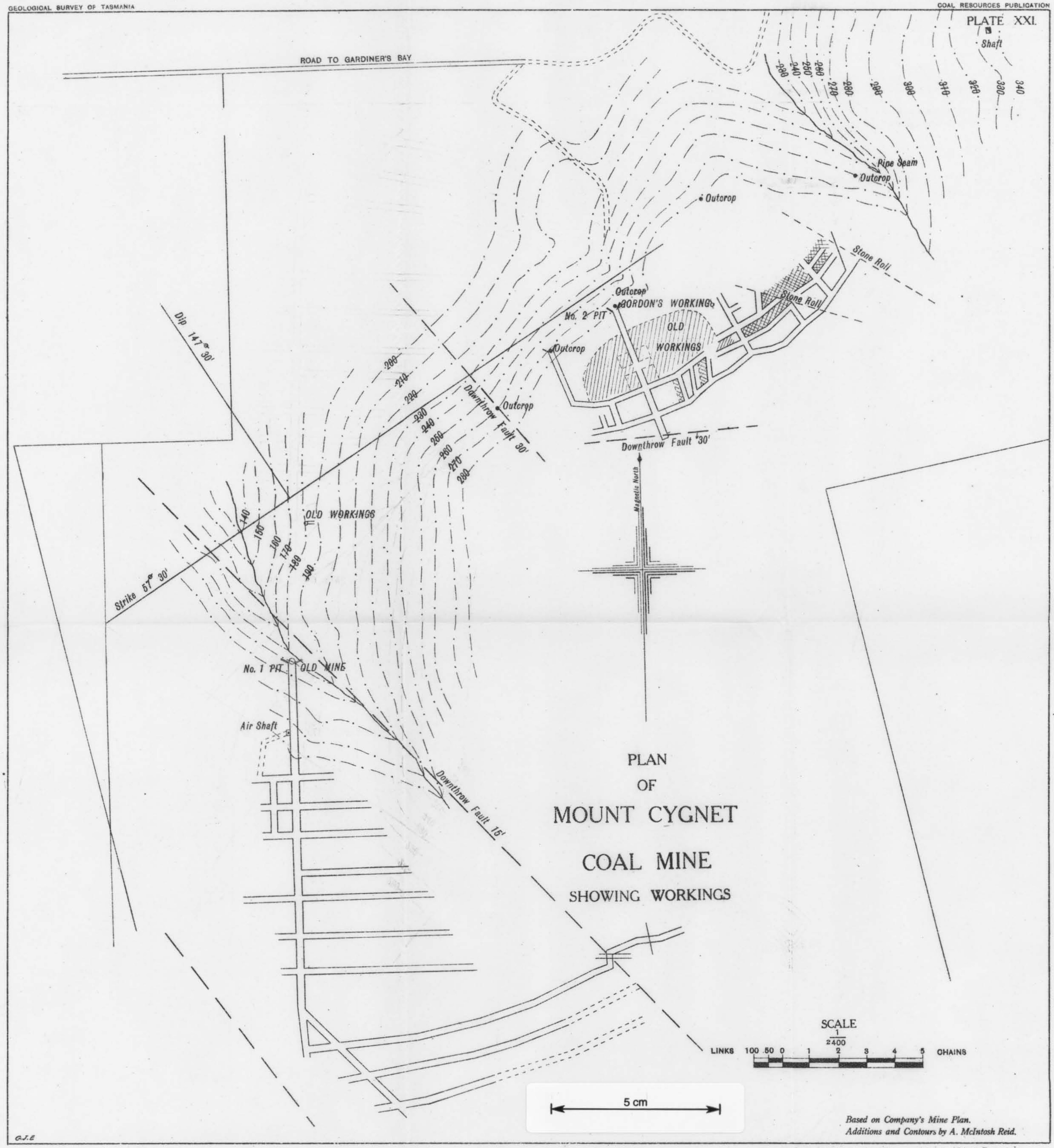


PLATE XXI.
Shaft
ROAD TO GARDINER'S BAY
230
240
250
260
270
280
290
300
310
320
330
340
Pipe Seam
Outcrop
Outcrop
Stone Roll
Stone Roll
Outcrop
GORDON'S WORKING
No. 2 PIT
OLD
WORKINGS
Outcrop
Dip 147° 30'
200
210
220
230
240
250
260
270
280
Downthrow Fault 30'
Outcrop
Downthrow Fault 30'
Magnetic North
140
150
160
170
180
190
OLD WORKINGS
Strike 57° 30'
No. 1 PIT
OLD MINE
Air Shaft
Downthrow Fault 15'
PLAN
OF
MOUNT CYGNET
COAL MINE
SHOWING WORKINGS
SCALE
1/2400
LINKS 100 50 0 1 2 3 4 5 CHAINS
Based on Company's Mine Plan.
Additions and Contours by A. McIntosh Reid.
G.J.E.

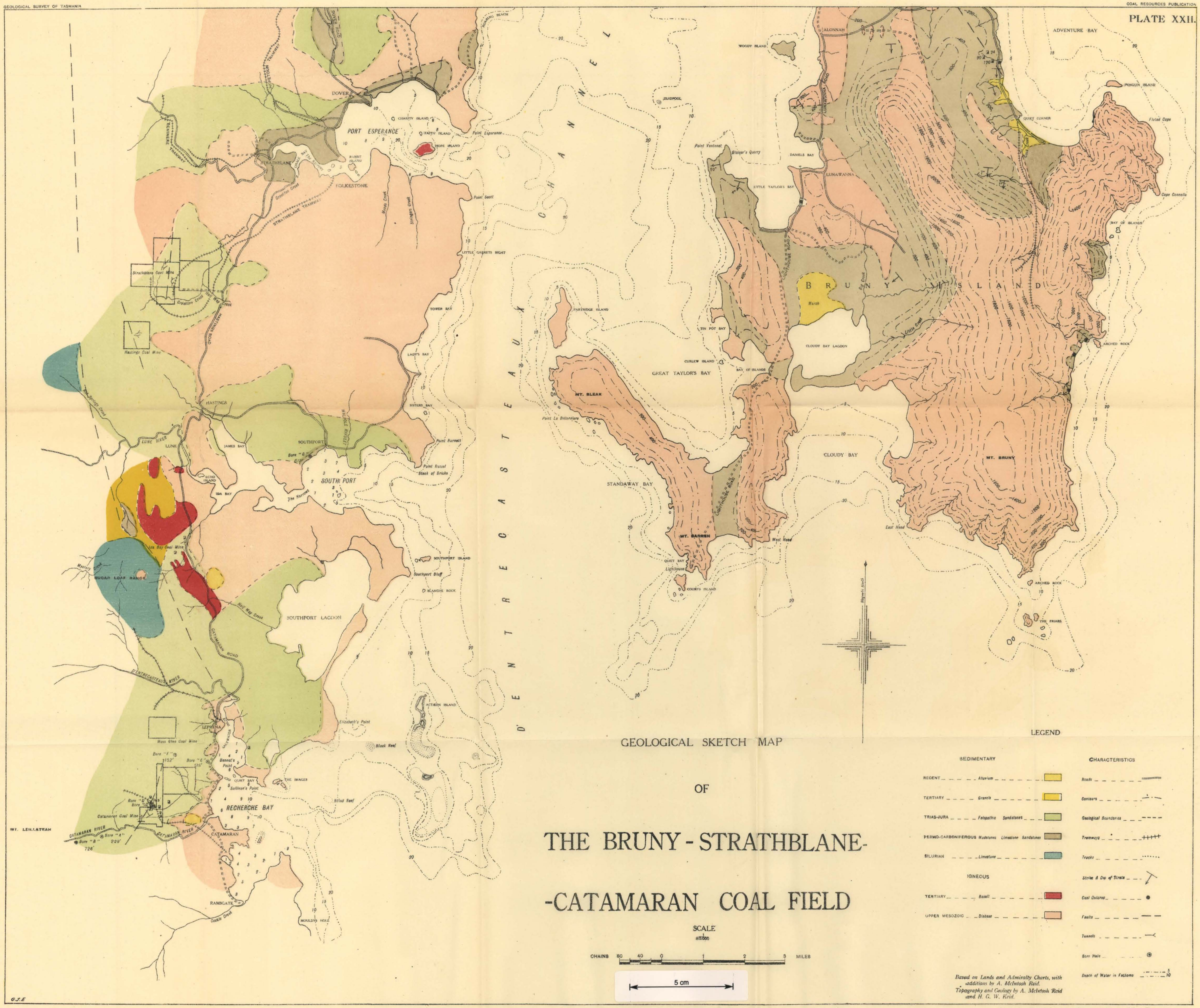


Photo Algraphed by John Vail Government Printer Hobart Tasmania

PLATE XXIII.

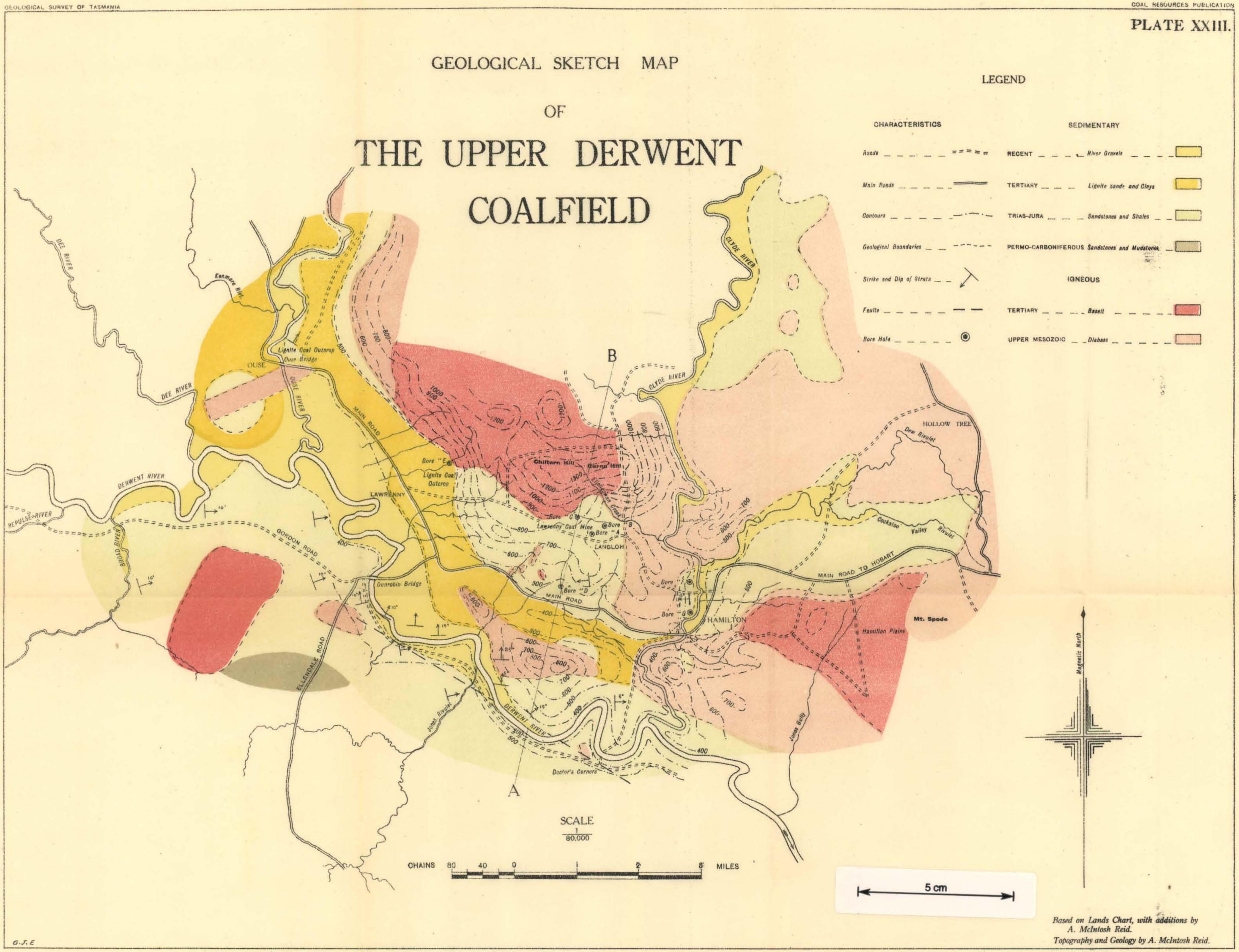
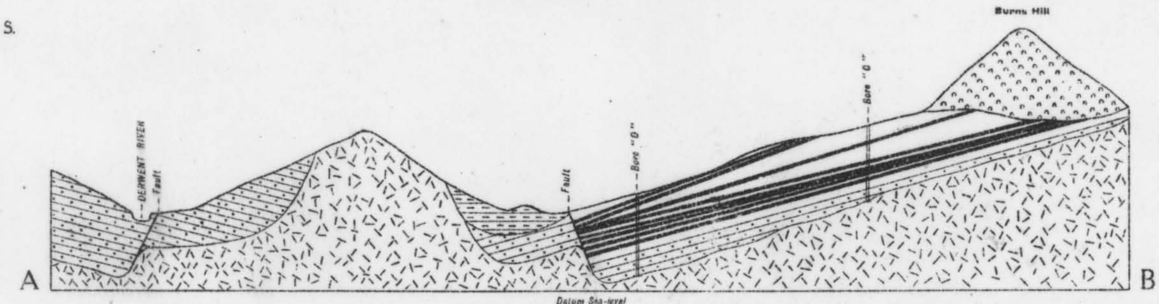
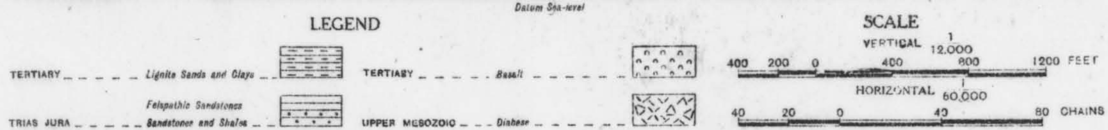


Photo Algraphed by John Vail Government Printer Hobart Tasmania.

PLATE XXIV.

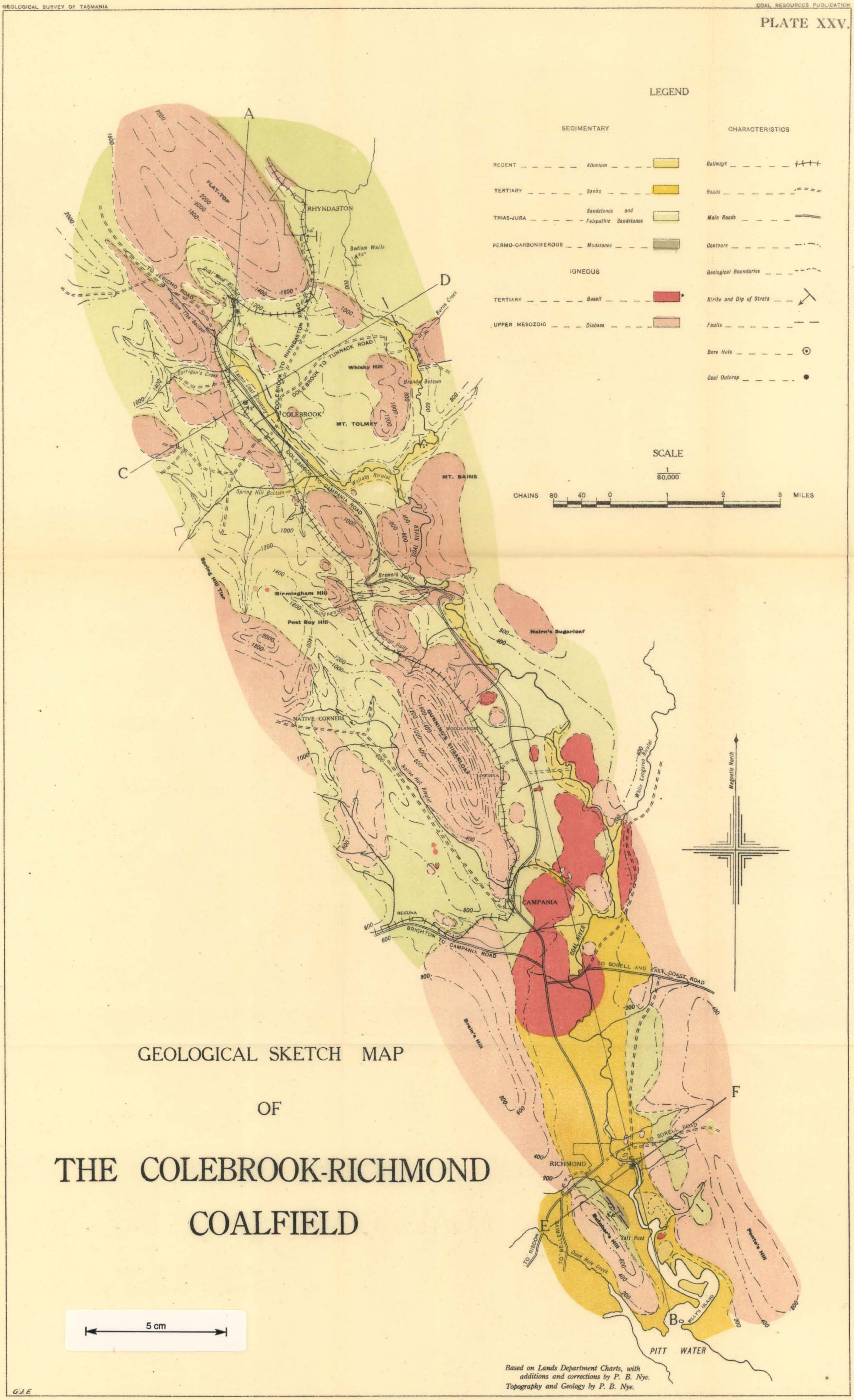
GEOLOGICAL SKETCH SECTION OF LAWRENNY AREA





G.J.E.

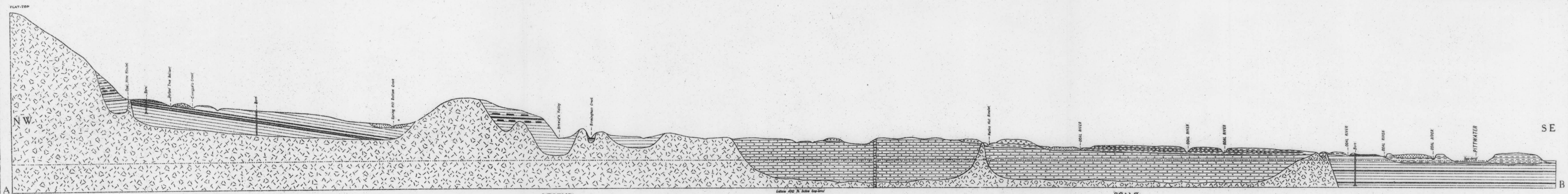
PLATE XXV.



GEOLOGICAL SKETCH MAP OF THE COLEBROOK-RICHMOND COALFIELD

Photo Algraphed by John Vail, Government Printer, Hobart, Tasmania.

GEOLOGICAL SKETCH SECTION OF COLEBROOK-RICHMOND AREA



LEGEND

RECENT — Alluvium

TERTIARY — Sands and Clays

TRIAS JURA — Felspathic Sandstones, Sandstones

PERMO-CARBONIFEROUS — Mudstones

TERTIARY — Basalt

UPPER MESOZOIC — Diabase

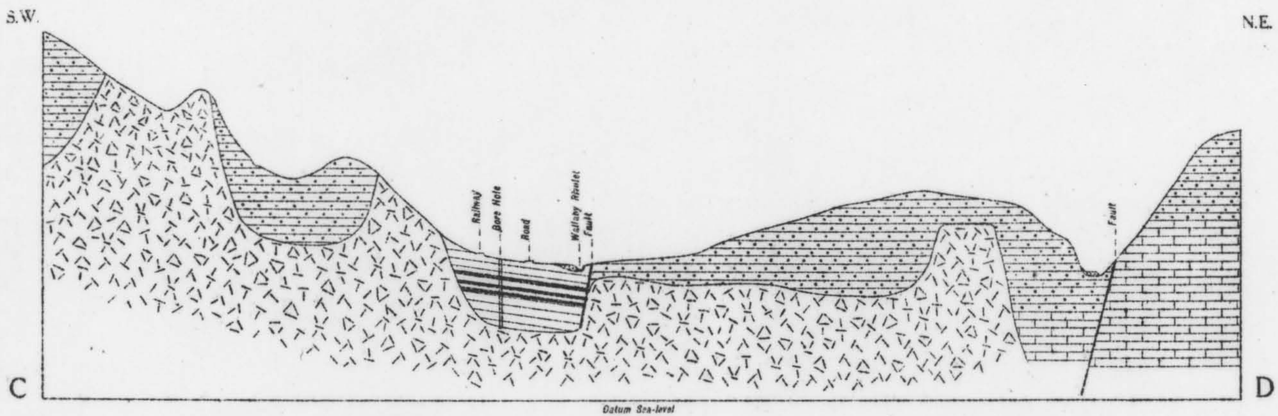
SCALE

VERTICAL $\frac{1}{12,000}$ 400 200 0 400 800 1200 FEET

HORIZONTAL $\frac{1}{60,000}$ 40 20 0 40 80 CHAINS

Photo Algraphed by John Vail, Government Printer, Hobart, Tasmania.

GEOLOGICAL SKETCH SECTION OF COLEBROOK AREA



LEGEND

RECENT — *Alluvium*

TRIAS-JURA — *Felspathic Sandstones* / *Sandstones*

PERMO-CARBONIFEROUS — *Mudstones*

UPPER MESOZOIC — *Diabase*

SCALE

VERTICAL $\frac{1}{12,000}$ — 400 200 0 400 800 1200 FEET

HORIZONTAL $\frac{1}{60,000}$ — 40 20 0 40 80 CHAINS

G.J.E.

PLATE XXVIII.

GEOLOGICAL SKETCH SECTION OF RICHMOND AREA

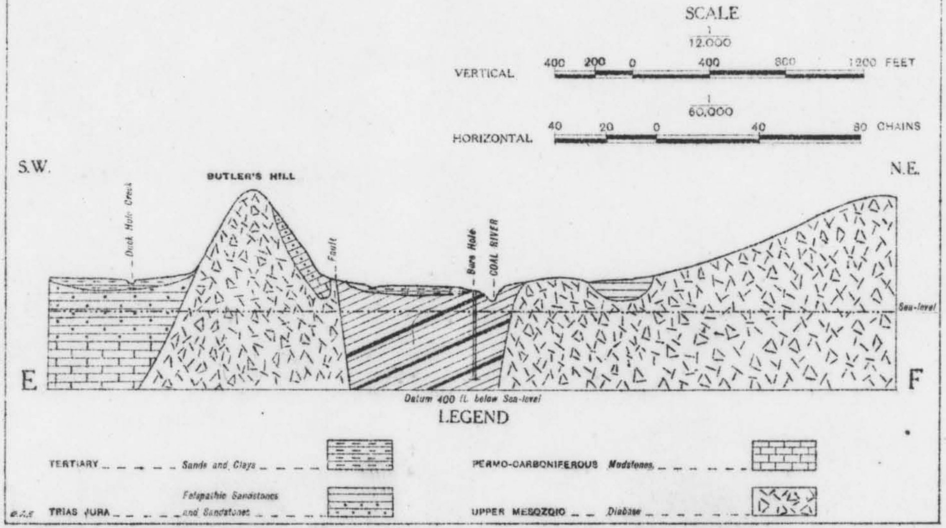
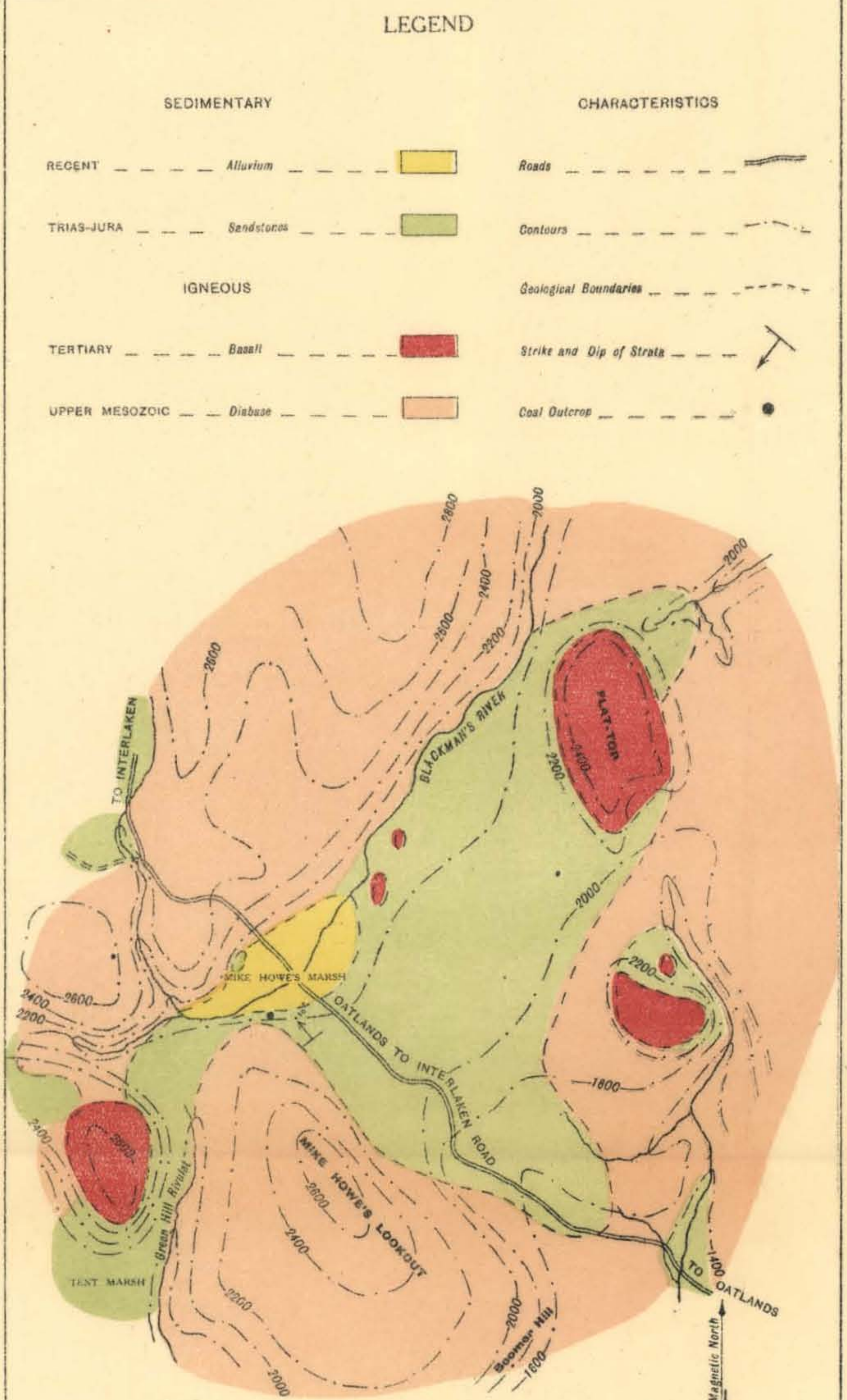


PLATE XXIX.



GEOLOGICAL SKETCH MAP

OF

MIKE HOWE'S MARSH COALFIELD

SCALE $\frac{1}{80,000}$

CHAINS 80 40 0 1 2 3 MILES

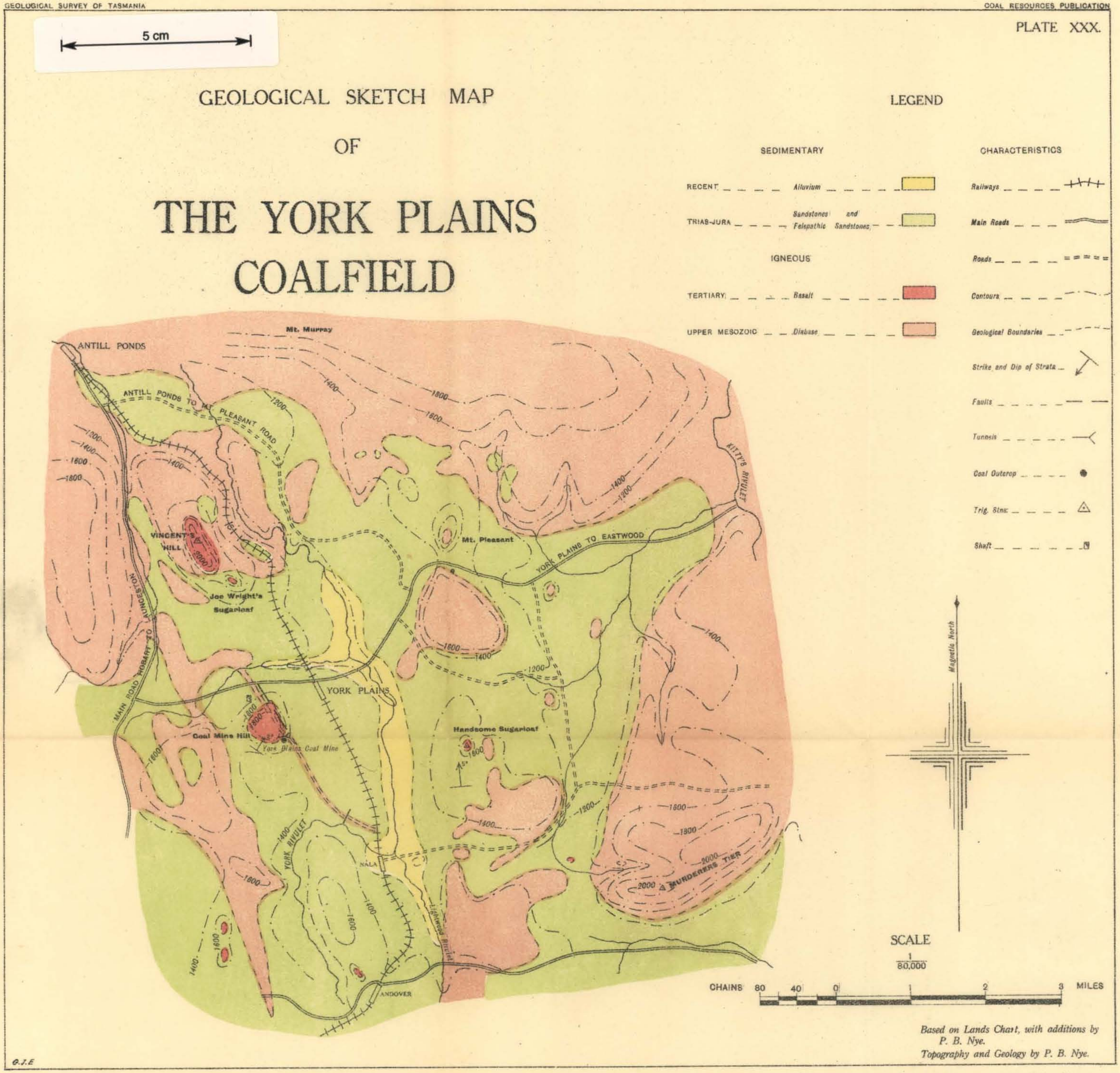
G.J.E

Geology by P. B. Nye.

Photo Algraphed by John Vail Government Printer Hobart Tasmania.

PLATE XXX.

GEOLOGICAL SKETCH MAP OF THE YORK PLAINS COALFIELD



Based on Lands Chart, with additions by P. B. Nye.
Topography and Geology by P. B. Nye.

Photo Algraphed by John Vail, Government Printer Hobart Tasmania.

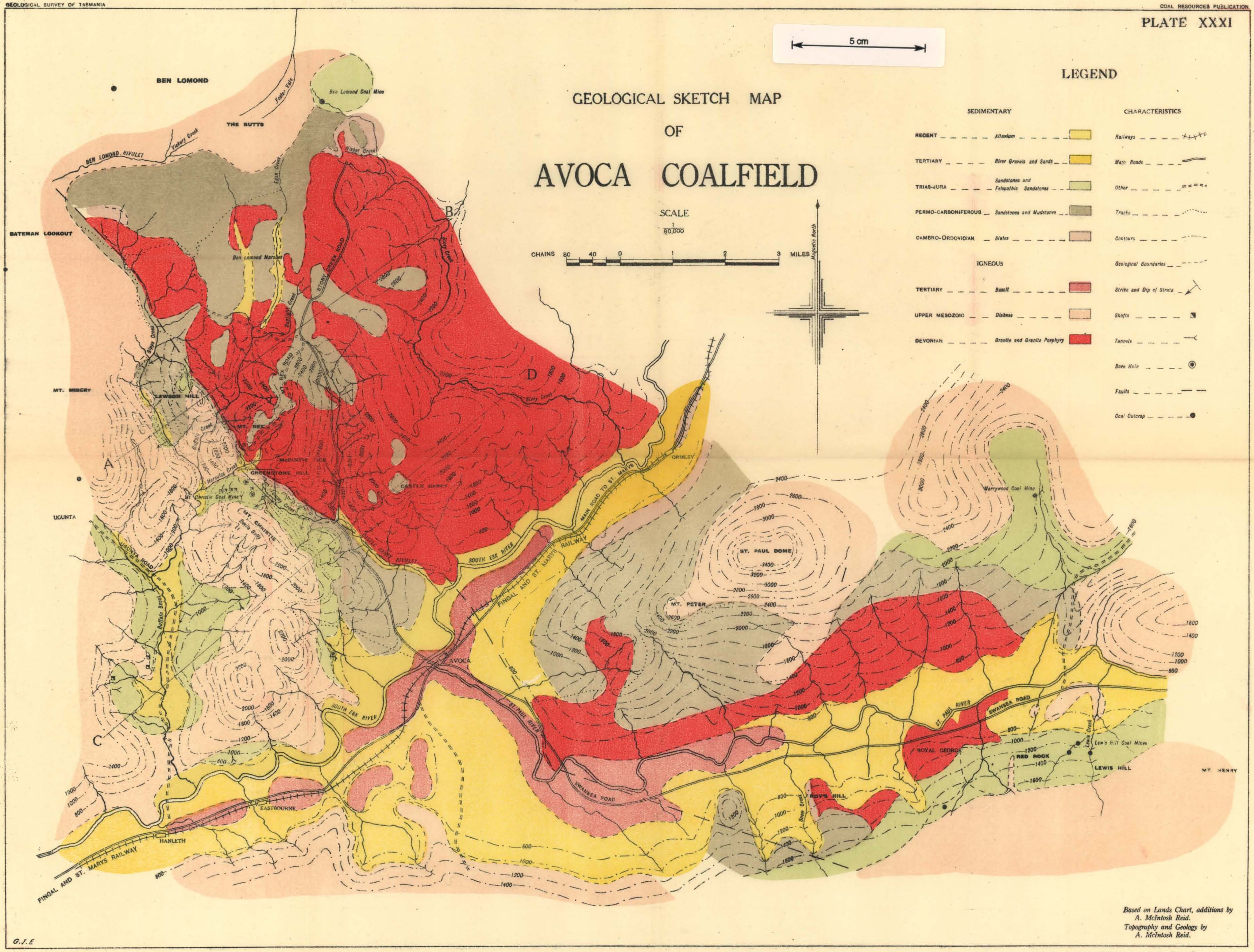
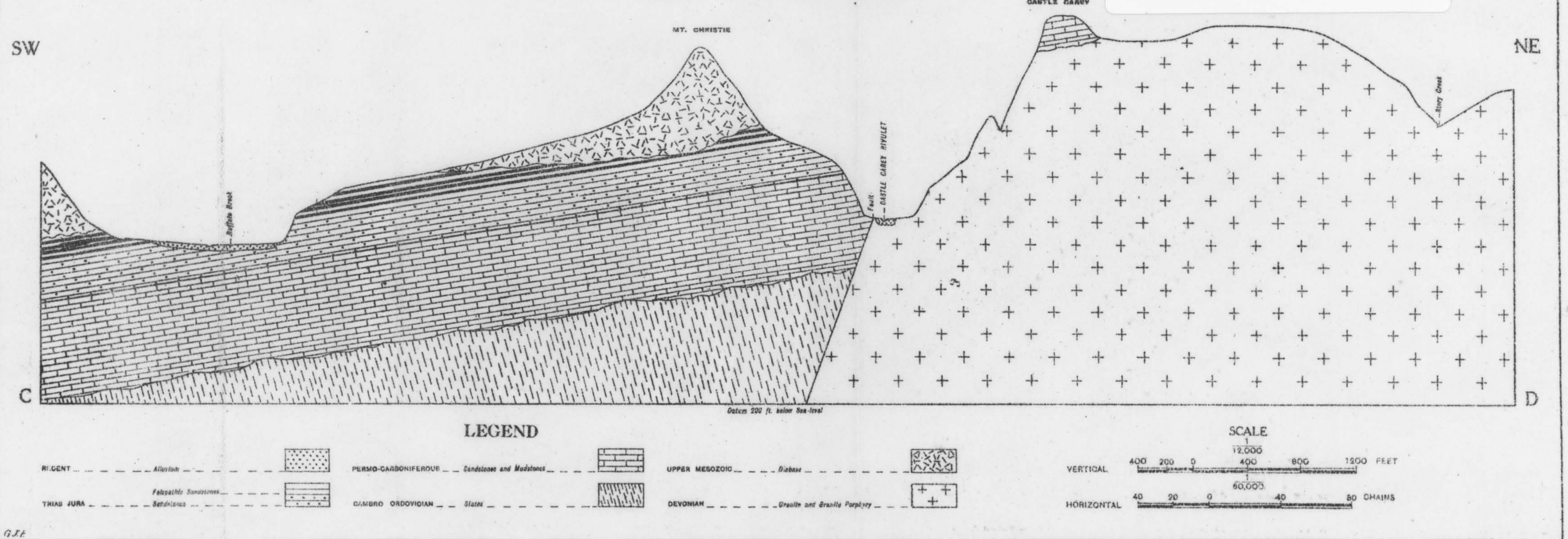


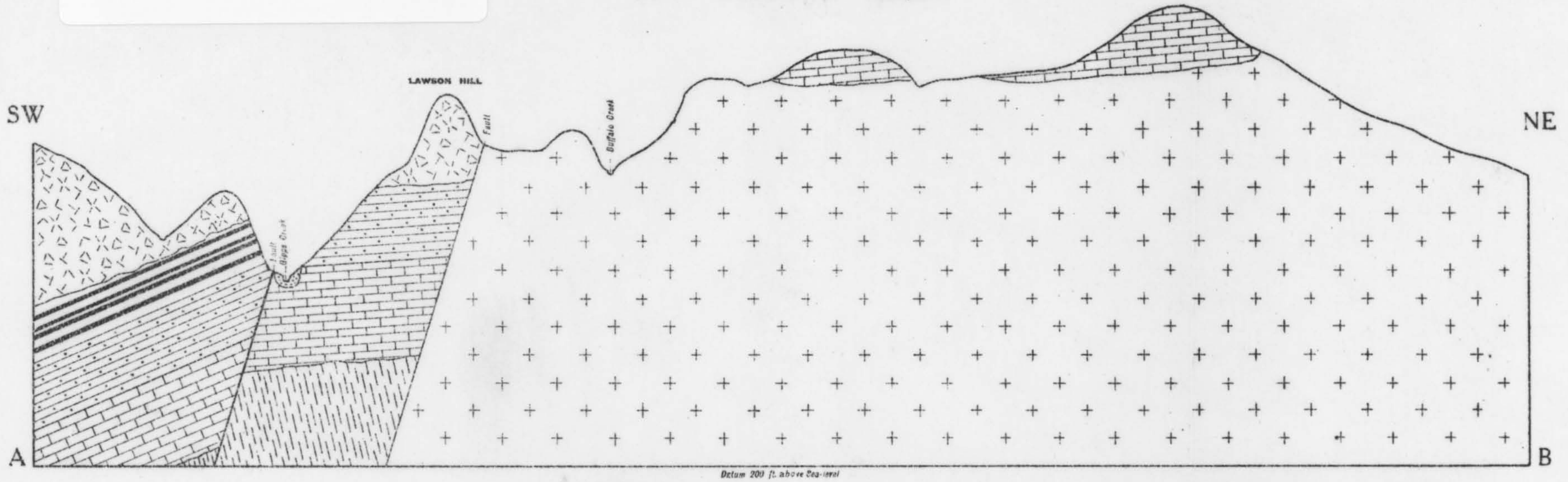
Photo Lithographed by John Vail Government Printer Hobart Tasmania.

PLATE XXXII.

GEOLOGICAL SKETCH SECTION OF BEN LOMOND AREA



GEOLOGICAL SKETCH SECTION OF BEN LOMOND AREA



LEGEND

RECENT — Alluvium

TRIAS-JURA — Felspathic Sandstones; Sandstones

PERMO-CARBONIFEROUS — Sandstones and Mudstones

CAMBRO ORDOVICIAN — Slates

UPPER MESOZOIC — Diabase

DEVONIAN — Granite and Granite Porphyry

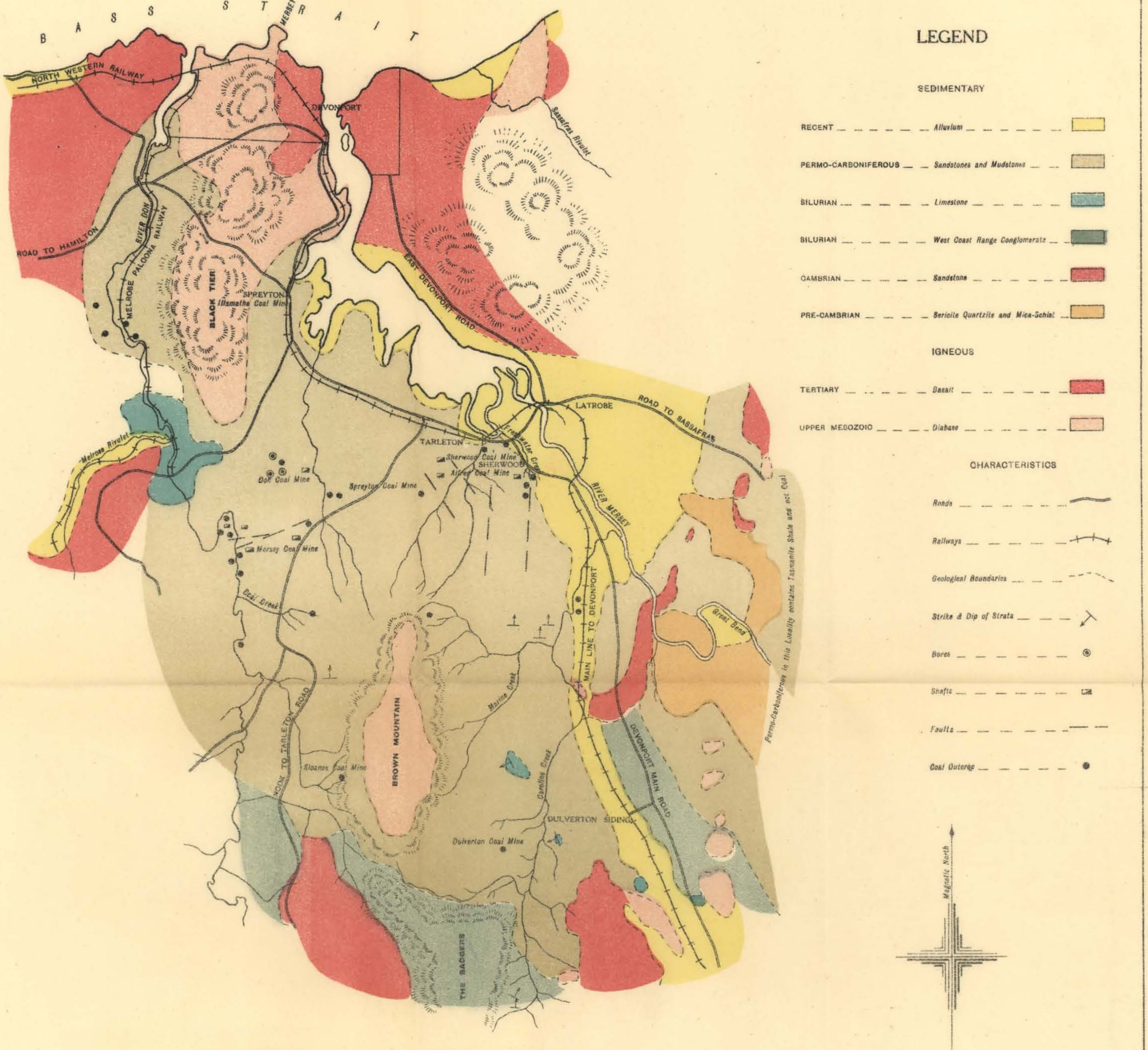
SCALE

VERTICAL $\frac{1}{12,000}$ FEET 400 200 0 400 800 1200 FT

HORIZONTAL $\frac{1}{60,000}$ CHAINS 40 20 0 40 80 CHS

Photo Algraphed by John Vail Government Printer Hobart Tasmania.

PLATE XXXIV.



GEOLOGICAL SKETCH MAP OF MERSEY COALFIELD

SCALE $\frac{1}{80,000}$

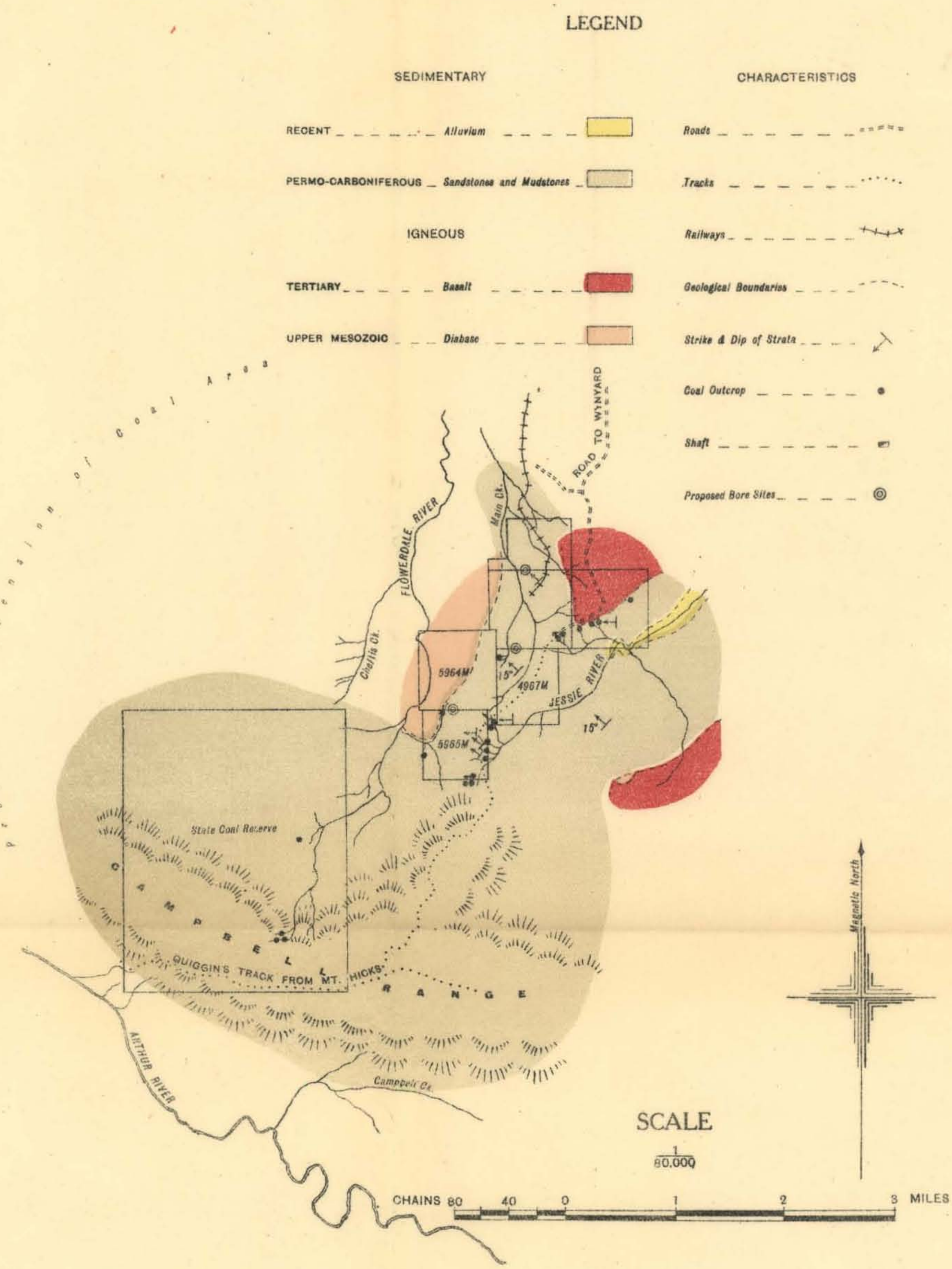
CHAINS 80 40 0 1 2 3 MILES

Based on Lands Chart.
Geology by W. H. Twelvetrees, Loftus Hills and A. McIntosh Reid.

G.J.E.

Photo Algraphed by John Vail Government Printer Hobart Tasmania

PLATE XXXV



GEOLOGICAL SKETCH MAP OF THE PREOLENNA COALFIELD

Based on Mines Chart, with additions by Loftus Hills.
Geology by Loftus Hills.

G.J.E.

Photo Algraphed by John Vail, Government Printer, Hobart, Tasmania.

PLATE XXXVI.

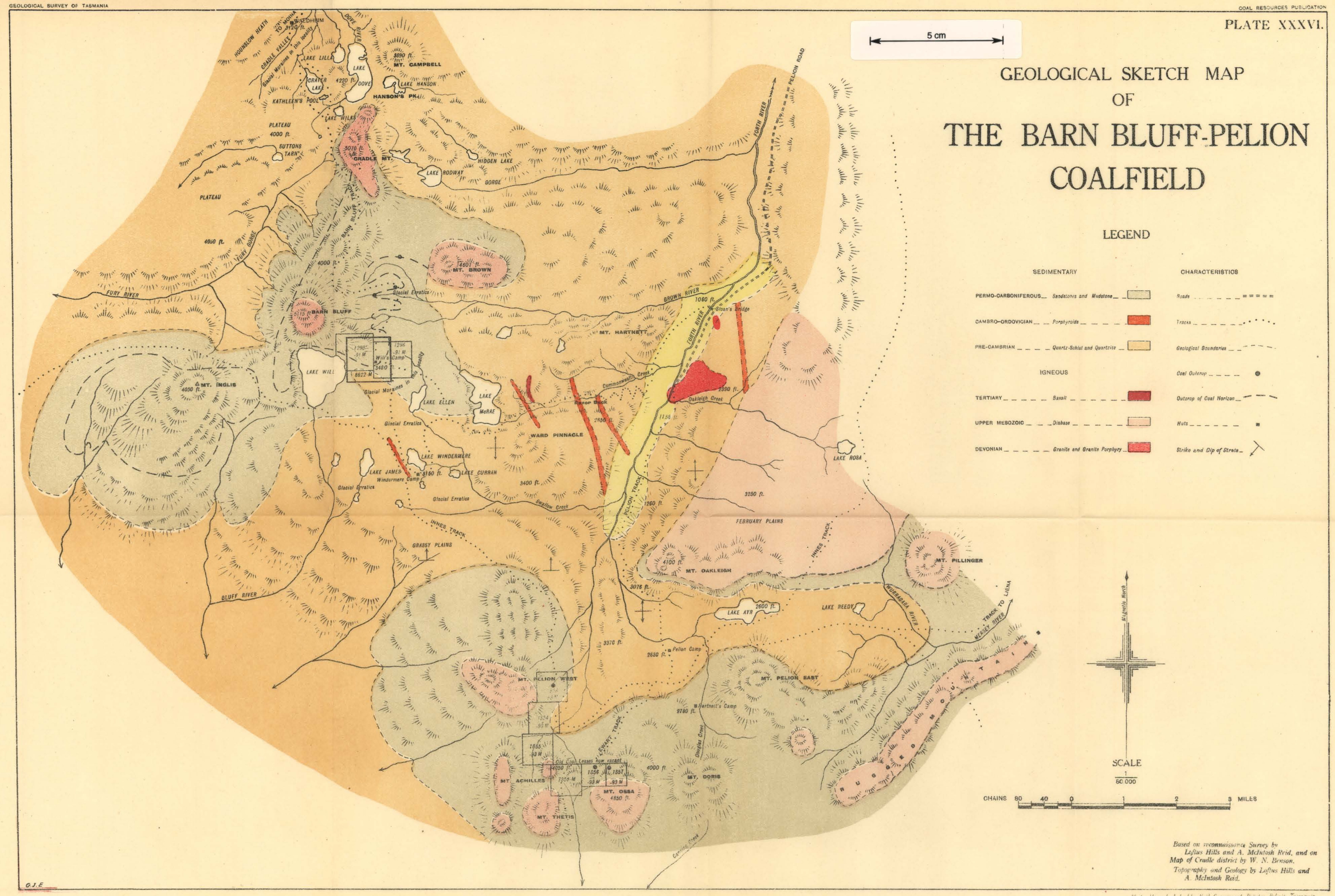


Photo Algraphed by John Vail, Government Printer, Hobart, Tasmania.