

1983/41. The Mt Nicholas coalfield

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Abstract

Coal was discovered in the Mt Nicholas area, north-west of St Marys, in the 1840's and has been mined almost continuously since 1886. The only currently operating mine on the Nicholas Range is the Blackwood Colliery owned by the Cornwall Coal Company N.L. which produces about 150 000 t of coal per year.

The coal seams occur in a fluvial sequence up to 400 m thick of dominantly lithic sandstone, siltstone, mudstone, claystone and rare tuff, which gradationally overlie a thin quartzose sandstone unit. These rocks are assigned to the Upper Parmeener Super-Group and are of Triassic age. A basalt of Triassic age occurs close to the base of the sequence. Underlying the fluvial sandstone sequence is a suite of marine sandstone, limestone, and mudstone assigned to the Lower Parmeener Super-Group and of Permian age. The marine sediments unconformably overlie a basement of folded quartzwacke (Mathinna Beds) and porphyry (St Marys Porphyry).

The coal-bearing sequence is capped with Jurassic dolerite, and the steep slopes of the Nicholas Range are heavily mantled in talus derived from the dolerite.

The coal seams have been correlated across the Mt Nicholas coalfield, although the area is faulted, and small faults caused mining difficulties in some of the now closed collieries.

The measured reserves of part of the Mt Nicholas coalfield are given as 44 million tonnes, and the total inferred reserve for the whole of the coalfield is about 100 million tonnes. The reserve is classed as a small inferred reserve.

LOCATION AND ACCESS

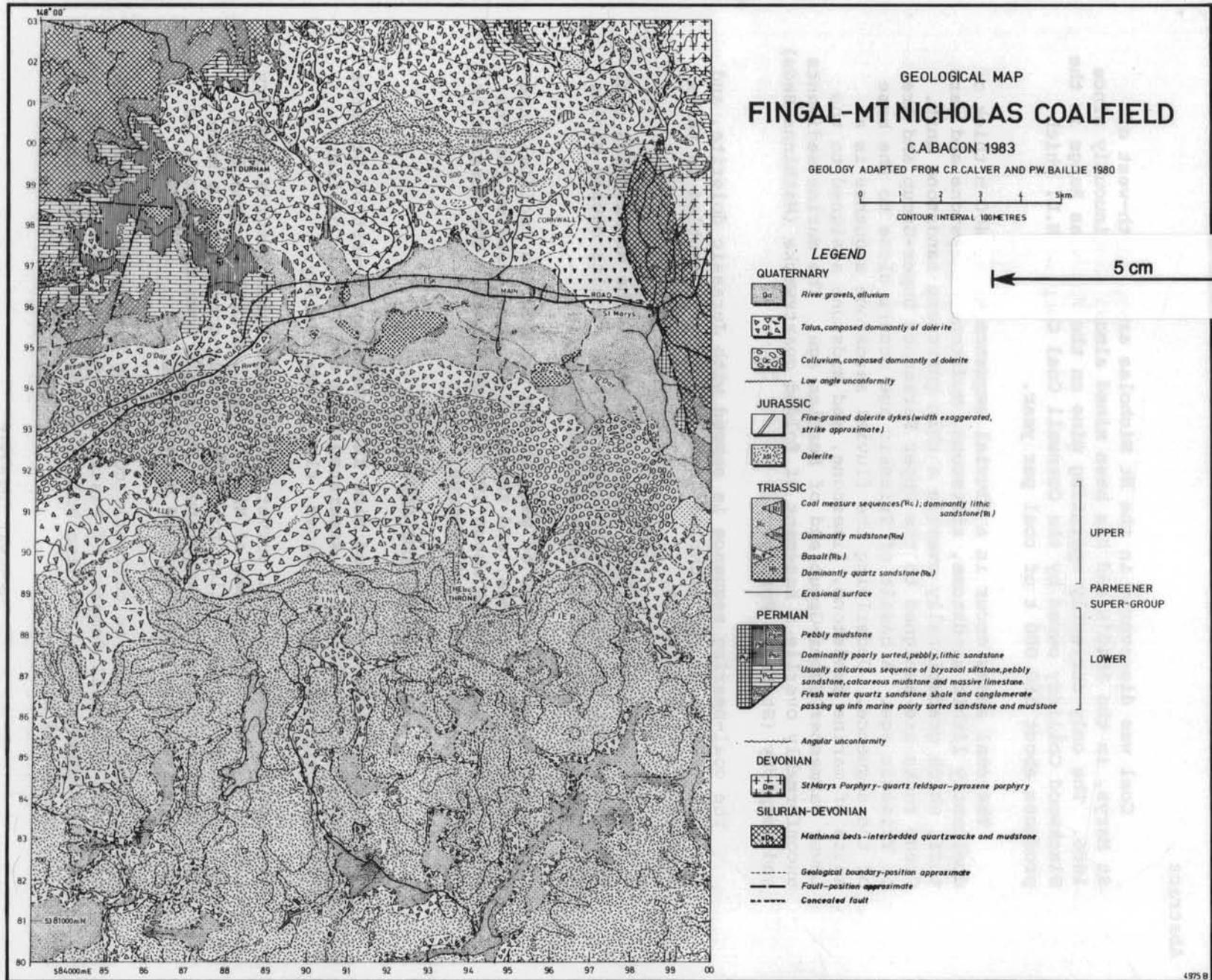
The Nicholas Range is located nine kilometres north-west of St Marys in north-eastern Tasmania, and is separated from the Fingal Coalfield (12 km to the south-west) by the broad, flat Fingal Valley.

The Nicholas Range is well traversed by roads which service forestry operations on the northern slopes of Mt Nicholas. A railway runs from St Marys through the Fingal Valley to Conara, where connection is made with the Launceston-Hobart railway line. The small town of Cornwall is situated four kilometres south-east of Mt Nicholas.

The Mt Nicholas area is currently covered by Exploration Licence 5/61, held by IMI and the Shell Company of Australia, and E.L. 50/82, held by the Cornwall Coal Company N.L., who also hold a Mining Lease covering the area around the Blackwood Mine.

GENERAL GEOLOGY

The regional geology of the area is discussed by Threader (1968) and details of mapping in the area are given in Baillie and Calver (1980). The geology of the area is shown in Figure 1. Earlier reports on the area were made by Milligan (1849), Gould (1861), Thureau (1883a), Twelvetrees (1902), and Hills *et al.* (1922). The results of a gravity survey of the east coast



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coalfields (including Mt Nicholas) are given in Leaman and Richardson, (1981). The following outline of the geology of the Mt Nicholas area is summarised from Baillie and Calver (1980).

The oldest rocks in the St Marys area are folded quartzwackes of the Silurian Mathinna Beds, which have been intruded by the Devonian St Marys Porphyry. These rocks form the basement upon which the flat-lying Parmeener Super-Group sediments were unconformably deposited.

The Parmeener Super-Group has been divided into a lower, dominantly glaciomarine sequence and an upper, dominantly freshwater sequence.

Three informal formations have been recognised in the Lower Parmeener Super-Group on Mt Nicholas. The lowest formation consists mainly of poorly sorted sandstone with some pebbly siltstone and mudstone, is poorly fossiliferous, and probably has a maximum thickness of about 40 m. The overlying formation is a calcareous sequence of bryozoal siltstone, pebbly sandstone, calcareous mudstone and massive limestone and is often richly fossiliferous. This sequence is about 20 m thick. The uppermost formation is a massive limestone sequence up to 50 m thick which consists dominantly of poorly-sorted pebbly mudstone.

The three formations contain dropstones of quartz, clasts from the Mathinna Beds, minor granite and rare schist, and are considered to be of glaciomarine origin.

The glaciomarine sequence on the south-west slopes of Mt Durham [EP875979] is overlain by quartz sandstone. Elsewhere, the glaciomarine sequence is overlain by massive, well-sorted, medium to coarse-grained lithic sandstone, except for a small area east of Cornwall [EP953983] where the Lower Parmeener Super-Group sediments are overlain by a Triassic basalt. The basalt has been dated at 233 ±5 m.y. (Calver and Castleden, 1981).

The fluvial sandstone sequence contains minor interbedded mudstone, siltstone, claystone and coal seams, some of which have been extensively mined.

Jurassic dolerite has intruded the Parmeener Super-Group sediments and now forms the capping of Mt Durham [EQ887000], the Nicholas Range [EQ912003], and South Sister [EQ976012]. Dolerite talus thickly mantles the slopes of the range.

COAL SEAM GEOLOGY

A diagrammatic representation of the coal seam stratigraphy on Mt Nicholas is shown in Figure 2.

There are three intervals in the stratigraphic sequence which contain coal seams. The Shell Company of Australia has called these intervals the upper, middle, and lower groups of seams. The correlation of the seams worked at the various mines and details of the mining methods employed are given in Tables 1 and 2.

The upper group of seams are of poor quality coal interbedded with claystone and mudstone. As many as eight seams occur in this interval, although most are better described as richly carbonaceous mudstone rather than coal. Only one of these seams, the U8 or Rileys, has ever been worked, being mined at the Mt Nicholas Colliery.

DIAGRAMMATIC STRATIGRAPHY, MT NICHOLAS (NOT TO SCALE)

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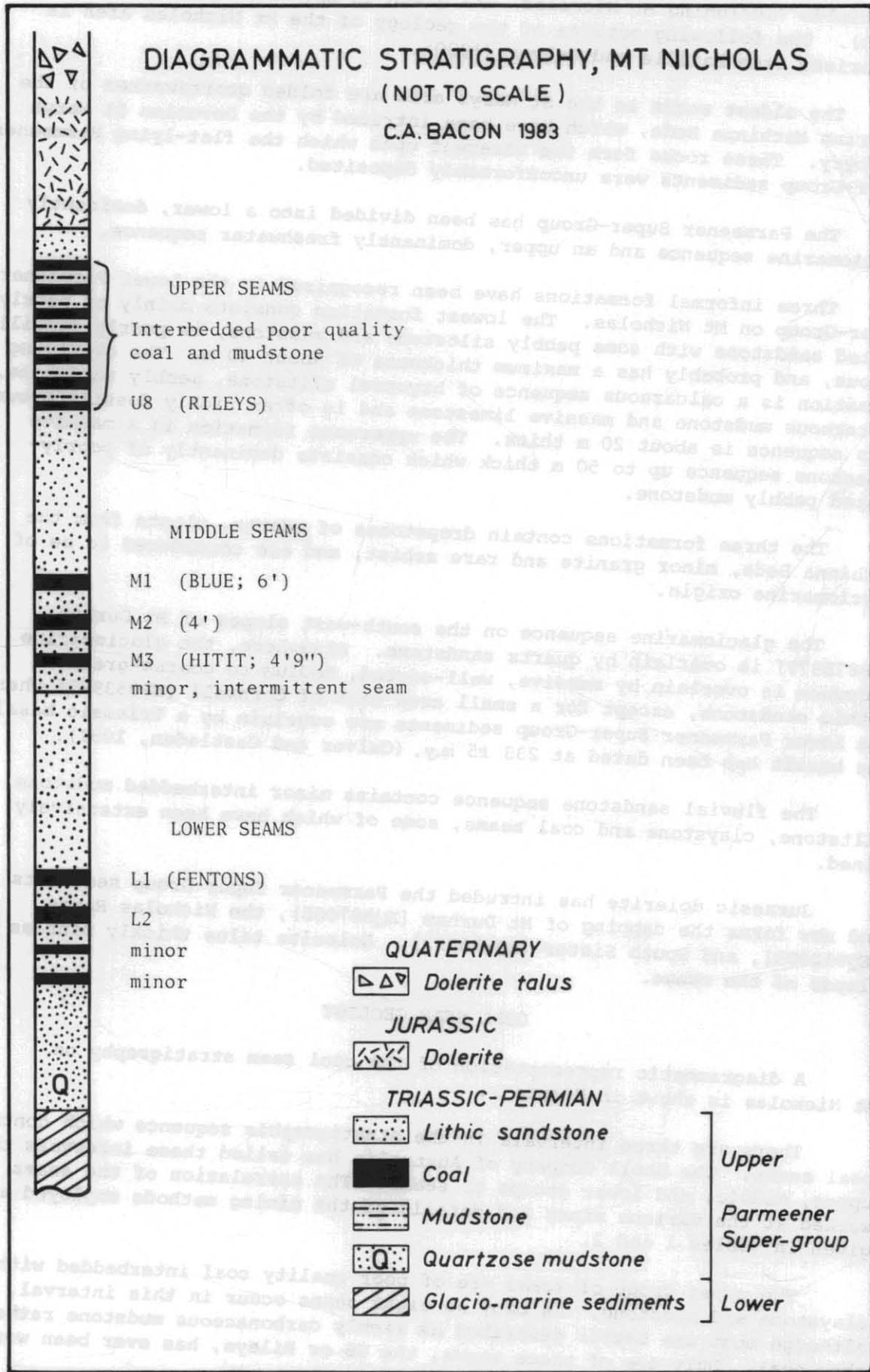


Figure 2.

Table 1. COAL SEAMS ON MT NICHOLAS

Drilling				Mines						
Shell		Department of Mines		Cornwall Coal Co.						
Mt Nicholas	Harefield	Dalmayne	Fingal Tier	Mt Nicholas	Blackwood	Cornwall	Mt Nicholas	Cardiff	Jubilee	Silkstone
			A							
		DA	B							
			C							
		DB	D							
			E							
U8		DC	*F	Rileys						
M1		DDu	*Gu	Blue Upper	Blue	Blue	6'			
M2		DD1	*G1	Blue Lower			4'			
M3				Cornwall		Hitit	4'9"	Cardiff(?)	Jubilee(?)	
Minor				Cullenswood						
L1	DE))	Fenton		Fenton	8'			No name given
))							
L2	E2))Ha,Hb	Millbrook						
Minor	E3))	Malahide						
Minor	DF))	Webber Falls						

* F = Duncan seam
 Gu = East Fingal seam, Upper Split
 G1 = East Fingal seam, Lower Split

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Table 2. MINING METHODS, MT NICHOLAS

	Mining Methods Employed		Years of operation	Total Production (t)
	Bord and Pillar	Short or step long wall		
Mt Nicholas	✓	✓	1888-1958	1 748 609
Cornwall	✓	Minor before 1922	1886-1964	4 053 104
Jubilee	✓	x	1897-1958	675 784
Cardiff	✓	x	1901-1914, 1966	1 000
Silkstone	✓	x	1920, 1950-1951	1 000
Blackwood	✓	x	1981-present	593 538

The middle group of seams usually comprises three seams; the M1 (6', Blue); the M2 (4'); and the M3 (4'9", Hitit). The M1 and M2 seams coalesce in some areas. A small seam of coal is intermittently found below the M3 seam.

The M1 and M2 seams appear to be part of the East Fingal Seam, which can be traced from Fingal Tier to the Douglas River. The M3 seam is confined to the Mt Nicholas area.

The lower seam group usually contains four seams. The upper two seams (L1, L2) often come together to form one seam, or are separated by only a few centimetres. The L1 seam, and in parts the combined (L1, L2) seam, is known as the eight foot or Fentons seam. Two smaller seams persist below the L1 and L2, but these have never been worked. This lower group of seams may be correlated with the H seam interval at Fingal Tier, which usually contains four or more small seams which frequently lens out or split and rejoin.

PREVIOUS MINING HISTORY

The earliest recorded mention of coal in the Mt Nicholas area is by Milligan (1849). Gould (1861) wrote on the east coast coalfields, and in 1861 coal from Mt Nicholas was tested by the Launceston Gas Works. Further tests on the coal were carried out in 1862 on the steamships 'Monarch' and 'Tasmania' (Falconer, 1862). Prospecting activities continued for many years and Mt Nicholas coal was tested as a fuel on both the Tasmanian Main Line and Launceston and Western Railways (Grant, 1883; Thureau, 1883b; Lord, 1883). Development work had started at both the Mt Nicholas and Cornwall Mines by 1885. The St Marys-Conara (then Corners) railway was opened in June 1886, the same year that production started at the Cornwall Colliery. Activities at the Mt Nicholas Mine were briefly suspended, the mine opening in 1888. Industrial troubles affected both mines in 1889 and again in 1900-1901.

The Jubilee Mine opened in 1897, with an initial production of 25 t for the year. The Cardiff Mine, adjacent to the Jubilee, opened in 1901 and closed in 1914. Prospecting in the Silkstone area of Mt Nicholas began in 1920, but no mine was ever established.

The Cornwall Coal Company purchased the Mt Nicholas Mine in 1937 from the Mt Nicholas Coal Company Pty Ltd and closed down the workings, but re-opened them in 1941. Interest was renewed in the Silkstone area in the early 1950s, but no mine eventuated.

The Jubilee Mine closed in 1958, after having had difficulty with faulted seam conditions and water accumulation for most of the mine life. The Mt Nicholas Mine closed in the same year, and the Cornwall Mine closed in 1964. Small scale mining activities resumed at the Cardiff Mine in 1966, but these soon ceased.

The latest and now only working mine on the Nicholas Range is the Blackwood, owned by the Cornwall Coal Company N.L., and which started production in 1981. The positions of the various mines on Mt Nicholas are shown in Figure 3.

Cornwall Mine

Mining at the Cornwall Mine, owned by the Cornwall Coal Company N.L., started in 1886, with 11 511 t of coal being produced in the first year. Preliminary exploratory prospecting work had been in progress since the late 1840s. The first recorded industrial trouble was in 1899, followed by a ten week strike in 1900.

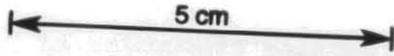
In 1902 one of the main consumers of the coal, the Tasmania Company at Beaconsfield withdrew their contract for Mt Nicholas coal, preferring instead to use imported Newcastle coal. The Cornwall Coal Company then secured a market on the mainland for their product, but this market was lost due to another miners' strike in June 1902. By 1906 production was 22 089 t for the year with 61 men employed. By 1910 two seams were being worked, the Blue (M1) seam which was worked by longwall methods, and the Hitit (M3) seam which was mined by the bord and pillar system. In 1911 work started on the No. 1 and No. 3 tunnels of the Blue (M1) seam and on the No. 4 tunnel of the Hitit (M3) seam. Most development work was concentrated on the Hitit seam (M3) from 1914, as the workings on the Blue (M1) seam struck a major fault. Of the 1918 production of 27 330 t of coal from 72 employees, only 500 t were from the Blue (M1) seam. By 1931 the mine employed 130 men and produced 70 900 t of coal for the year. The workings stretched for 2.4 km. Roof trouble was a problem for the entire life of the mine. Work resumed on the Blue (M1) seam in 1937. Industrial trouble in 1937 and 1938 caused a slight drop in production.

By 1943 production was 83 000 t from 133 employees and an arc wall coal cutting machine was installed. In 1946 the right hand side of the workings were abandoned due to excessive floor heave and the collapse of some of the airways. Water sprays were installed on the arc wall coal cutter at the face and storage bins erected in 1948.

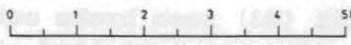
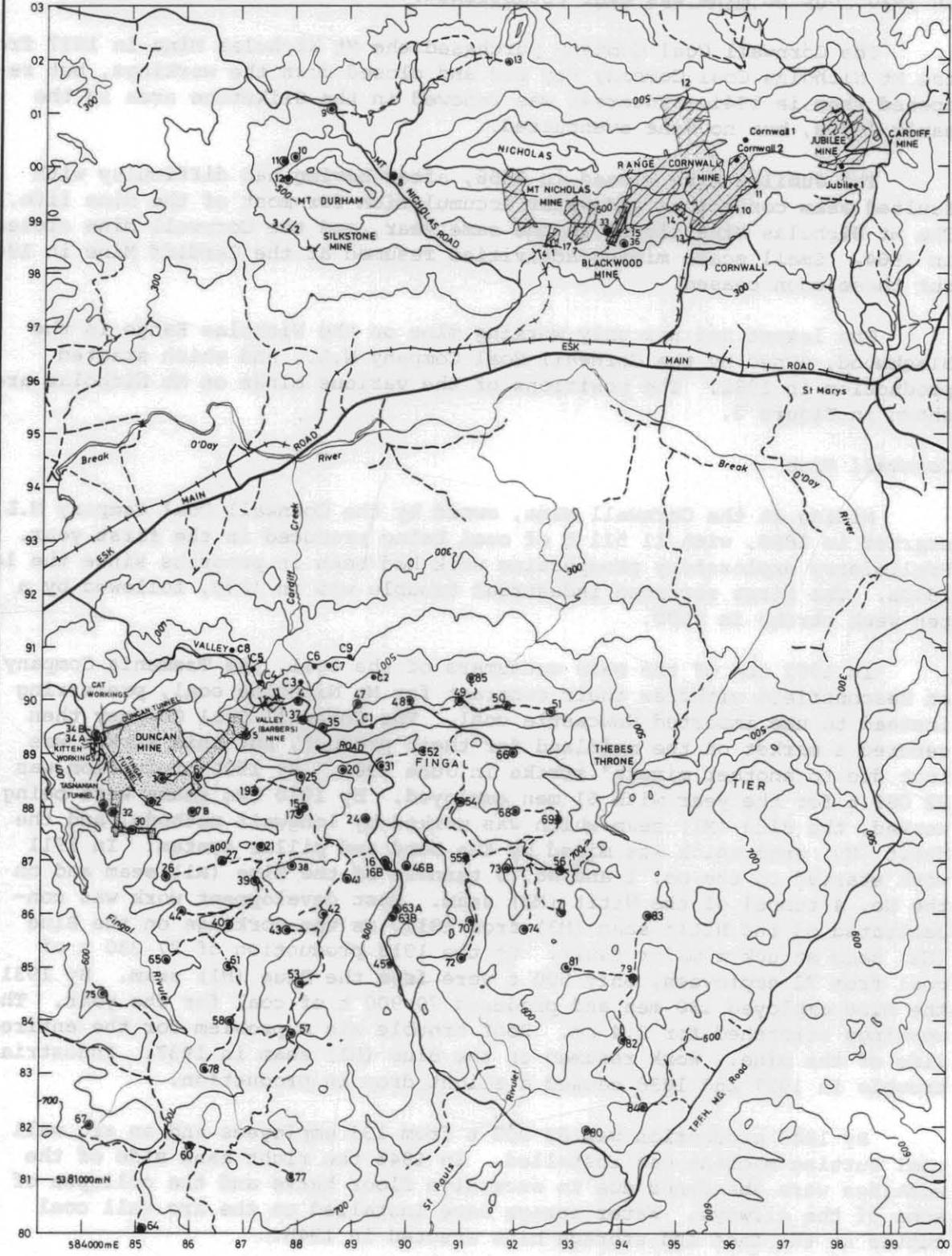
Workings in the Hitit (M3) seam broke out to the northern flank of Mt Nicholas in 1950, and a fan was installed at this point. A continuous miner was imported from the United States in the same year. Output in 1950 was 101 710 t from 131 employees.

Reduced demand for coal in 1953 caused production to drop to 88 147 t,

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MINE AND DRILL HOLE LOCATIONS, FINGAL TIER-MT. NICHOLAS



- 12 ● D.O.M. Drilling
- C8 ● H.E.C. Drilling
- Jubilee 1 ● Company Drilling
- adit
- ▭ mine area

DEPARTMENT OF MINES, TASMANIA

GEOLOGIST: C. A. BACON

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Figure 3.

with some of this being stockpiled. The continuous miner was unable to work to capacity due to the faulted nature of the seam. A fire in part of the workings of the Hitit (M3) seam in 1955 caused the arc wall machine to be lost; entrances were sealed and development continued east of the fire-affected workings. Production in 1959 was 119 791 t, dropping to 92 503 t from 123 employees in 1961.

New ground between the Cornwall and Mt Nicholas faults was opened up in 1963, and in 1964 the mine finally ceased production. Men and machines were transferred to the Duncan Mine at Fingal.

Three seams were worked at the Cornwall Colliery; the Blue (M1), Hitit (M3), and Fenton (L1). Only minor work was done on the Fenton (L1) seam in the early days of the mine life. The most extensive workings were on the Hitit (M3) seam.

Total production from this mine was 4 053 104 t.

Mt Nicholas Mine

Coal from the Mt Nicholas Mine area was examined by Sir H.T. de la Beche in 1861, tested by the Launceston Gas Works in 1862 and also tested on the steamships 'Tasmania' and 'Monarch' in 1862. Both the T.M.L.R. and L. & W.R. made some steaming tests of Mt Nicholas coal in 1883. These samples appear to have come from prospecting activities, with the first commercial mining starting in 1888. Mine development commenced in 1885, was postponed in 1886, and finally recommenced in late 1887 prior to mining proper starting in 1888.

Industrial trouble erupted at the mine in 1889 and again in 1900. Production slowly increased to 25 462 t in 1906 from 70 employees. In 1909 the company began prospecting behind the Killymoon Estate and found a one metre thick seam with an ash content (of a spot sample) of 8.5%.

By 1911 the longwall face was 500 m long and the mine ventilation had been improved. Production in 1913 was 31 397 t from 65 employees. Faulting of the longwall seam caused mine difficulties in 1916, as did a strike by the miners from 3 November to 4 December of the same year. The 6' (M1) seam was opened up in 1917, and in 1918 a lower seam, the 4' (M2) was also opened up. By 1919 driving on the 4' (M2) seam had stopped and a drift driven from this seam up to the 6' (M1) seam encountered old workings. A main heading was put through these workings into solid coal. In 1920 a drift was driven down from the No. 3 tunnel in the M1 seam to the 4' (M2) seam and in 1921 a new 'Sirocco' ventilation plant was installed. Production for that year was 25 325 t from 84 employees. By 1922 most of the production was from the 6' (M1) seam, which was worked from two tunnels by the longwall method.

Hills et al. (1922) noted that the "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 in for over half a mile and coal from 100 acres has already been won". Most of this early mining was by the longwall method, although by 1922 a modified version of this mining method, the step longwall, was being used.

In 1923 operations were confined to the No. 1 and 3 tunnels of the 6' (M1) seam, and in 1924 the No. 1 tunnel, which gave access to the long-wall part of the mine, was closed. By 1925 all mining was done by the bord and pillar method. Production rose to 38 610 t in 1929 from 91 employees, but declined in 1931 when 184 days were worked out of a possible 270 due

to there being no market for the coal. A large fault was encountered in 1933 and development in the western part of the mine was restricted, with the eastern part of the mine having trouble with a poor roof. By 1935 seam conditions had deteriorated further and attention was directed to the 4'9" (M3) seam.

Development continued on the 4'9" (M3) seam, with most of the 1937 production of 22 579 t (85 employees) coming from this seam. At the end of 1937 the Mt Nicholas Coal Company Pty Ltd sold out to the Cornwall Coal Company N.L., which withdrew all equipment from the mine and suspended mining operations.

Production began again in 1941 (16 982 t), increasing to 22 138 t (35 employees) in 1945. In 1946 some hand mining was done in seams above and below the previous workings, Rileys (U8) and the 8' (L1) seams.

In 1947 new headings were advanced into the 4' (M1) and 6' (M2) seams and by 1949 work had been done on the 8' (L1, L2) seam. Work on the lower (L1) seam was abandoned in 1950 and faulting hindered work in the M2 seam. By 1954 coal was being won from the 4'9" (L3) seam by machine and by hand from the 6' (L1) seam. A fault caused the 6' (L1) seam to be downthrown almost in line with the 4'9" (L3) workings. The 6' (L1) seam workings were abandoned in 1957 due to the coal being "dirty", with many mudstone and claystone bands. The mine finally closed in 1958, leaving workings on a total of 5 seams; Rileys (U8), 6' (M1), 4' (M2), 4'9" (M3), and the 8' (L1).

A total of 1 748 609 t of coal were extracted during mining operations.

Jubilee Mine

The Jubilee Mine commenced small scale production in 1897. By 1901 the workings consisted of one tunnel 50 m long (Twelvetrees, 1902). Work by the Jubilee Company continued until 1902, by which time 2 455 t of coal had been mined, and work then ceased. Hills et al. (1922) state that there was no apparent reason for the operations to have stopped.

The Jubilee Coal Mining Company, formed in 1920, engaged in prospecting works and by 1922 had driven one tunnel 120 m with cross cuts to the left and right (Hills et al., 1922). By 1924 the daily output was 40 t and an aerial ropeway 3.6 km long had been completed to a railway siding near St Marys. Production increased steadily to 18 064 t in 1928 and 18 584 t in 1929, largely from the No. 5 Heading. In 1933 a "major upthrow" of the Jubilee seam was reached, and the seam was opened up from another tunnel (No. 2). Production in 1934 was 13 798 t from 50 employees. In 1935, 56 t of the 14 807 t mined by 43 employees were from the old Cardiff Workings. Water accumulating in the mine continued to be a problem because of inefficient pumps.

From 1937-1939 effort was directed at mine development and production of coal came largely from the pulling of pillars in the old Cardiff Mine. An electric coal cutter was acquired in 1943, when production was 24 115 t from 47 employees, but the cutter did not function satisfactorily due to faulted seam conditions and water problems.

The faulting and water problems plagued mine development and finally caused the mine to close. Faulting retarded development of the main heading in 1949, and in 1950 a large landslide washed away part of the haulage lines. A contract system of mining was started in 1950 in order to increase coal production. Production increased as a result of this move from

502.7 t/man/year in 1952 to 590.2 t/man/year in 1953. Large roof falls occurred in the eastern section of the mine in 1954. In 1955 work began on exposing part of the seam for open-cut operations. This idea failed as removal of the dolerite talus was too difficult and expensive. As a result of roof falls, which almost blocked the return airway in 1958, the ventilation at the mine suffered and in 1960 operations were finally suspended after the mine was worked for one month of the year.

Cardiff Mine

In 1901 the Coronation Coal Syndicate started prospecting activities which led to the opening of the Cardiff Mine. The production in 1901 was 695 t with three men being employed. Production dropped to 100 t in 1914 and thereafter work was intermittent. Mr H. Aulich bought the mine in 1916 and in 1917 produced 125 t of coal. Hills et al. (1922) noted that production at the "old Cardiff Workings" ceased due to the workings hitting the Gould Fault. The mine was worked in 1966 on a weekend basis for six months, with 76 t being produced.

Silkstone

The area known as the Silkstone Mine has never produced any great quantity of coal, although periodic prospecting has been carried out since the 1920s. In 1920, a pre-existing small pit (mine) was leased to Messrs Meredith and Whittle, who obtained a bulk sample of the coal, but did little development work. Hills et al. (1922) reported that the Silkstone workings comprised three tunnels of a prospecting nature on one seam; one tunnel 76 m long on a lower seam (probably L2) and a few prospecting adits on an upper seam (probably L1). No coal appears to have been mined apart from the 140 t removed in 1920 until work recommenced in 1950. Elliston (1951) reported that seven tonnes of coal were being produced per day from one adit; a second adit on a lower seam was accessible but was not in use. Production ceased in 1951 after 620 t had been mined. The mine ceased operating mainly because of problems of water accumulating in the adit.

Blackwood Mine

This mine, owned by the Cornwall Coal Company N.L., opened in 1980. Preliminary prospecting of the Blue (M1) seam began in 1979, and in 1980 adits were driven in on the Blue (M1) seam and the Hitit (M3) seam (33 m stratigraphically below the Blue (M1) seam). The Hitit (M3) seam adit intersected old Cornwall Mine workings, but the Blue (M1) seam tunnel development work continued and by 1981 three portals to the new mine were established. Surface infrastructure such as offices, shower room, stores, coal bins etc. were also built. Production for 1981-82 was 130 385 t of coal.

COAL QUALITY

Analyses of coal from mines and outcrops on Mt Nicholas are given in Appendices 2 and 3.

Typical analyses for some seams are listed below:

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	NICHOLAS 6' (M1)*	CORNWALL Hitit (M3)+	CORNWALL run of mine°
Moisture (%)	4.1	3.8	3.73
Ash (%)	19.4	19.9	27.90
VCM (%)	31.2	25.8	23.20
Fixed carbon (%)	45.3	52.5	45.17
Total sulphur (%)	0.41	0.31	0.44
Specific energy (MJ/kg)	25.1	24.3	21.5

- * spot sample from Main Heading of 6' Seam, Mt Nicholas Colliery, 1947.
+ basal 1.49 m of Hitit seam, eastern workings, Cornwall Colliery, 1971.
° run of mine slack coal (smaller than 50 x 25 mm), Cornwall Colliery, 1946.

RECENT EXPLORATION

Prospecting activities have been present on Mt Nicholas since the 1840s, and mining of coal has been almost continuous since 1886. The management of the two larger mines have drilled numerous holes around the mines during the course of mining activity. Most of these holes were never fully documented and logs are unavailable. Logs of two holes drilled by the Government in 1888 at Harefield and on the Killymoon Estate are given in Hills *et al.* (1922). The logs of two holes drilled near the Cornwall Colliery (Cornwall 1 and 2) in 1957 and one hole drilled near the Jubilee Colliery (Jubilee 1) in 1959 are given in Threader (1968).

The Department of Mines began drilling on Mt Nicholas in 1969, and six holes were drilled between 1969 and 1972. The positions of these holes are shown on Figure 2. Two additional holes were drilled in 1978 between the old Mt Nicholas and Cornwall Mines, in the area in which the Blackwood Colliery was eventually opened. Details of coal intersections and analyses from Department of Mines drilling and mine sampling are given in Appendices 2 and 3.

The Nicholas Range area is currently covered by Exploration Licence 5/61 held by Industrial and Mining Investigations who have a joint venture agreement with the Shell Company of Australia, and E.L. 50/82 held by the Cornwall Coal Company N.L. The area around the Blackwood Colliery is held under a Mining Lease by the Cornwall Coal Company.

The Shell Company of Australia have been actively exploring E.L. 5/61 since 1979. Production from the Blackwood Colliery, owned by the Cornwall Coal Company N.L., started in 1981.

POTENTIAL FOR FUTURE EXPLORATION

The Mt Nicholas Coalfield is probably the most promising area in the State for future coal mining operations. In a portion of the Nicholas Range area within E.L. 5/61 the Shell Company of Australia Ltd have, after three years of exploration, measured a reserve of 44 million tonnes of coal, of which an estimated 22 million tonnes would be recoverable.

Total inferred *in situ* coal reserves for the whole of the Nicholas Range are likely to be in the order of 100 million tonnes, therefore the reserve would be classed as a small inferred reserve according to Australian Standard AS-2519-1982.

Estimates on the tonnage of coal recoverable are dependent on economic

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factors, mining conditions, and market trends and are not able to be calculated on the information available.

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[31 August 1983]

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APPENDIX 1

AMG references of boreholes and adits in the Mt Nicholas Coalfield

Department of Mines 1969-1978 drilling

<i>Hole</i>	<i>Easting (m)</i>	<i>Northing (m)</i>	<i>Elevation (m)</i>
DDH 8	589 793	5 399 660	560.5
9	588 701	5 401 002	450.2
10	588 995	5 400 162	527.9
11	587 821	5 400 073	500.2
12	587 816	5 399 779	574.9
13	591 967	5 401 970	536.4
33	593 770	5 398 700	509.3
36	594 048	5 398 509	436.2

Department of Mines 1957-1959 drilling

Cornwall 1	596 328	5 400 593	624.8
2	596 125	5 400 132	624.5
Jubilee 1	598 100	5 399 900	505.0

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Appendix 1 (continued)

ADITS IN THE MT NICHOLAS COALFIELD

Adit No. (see fig. 2)	Easting (m)	Northing (m)	Elevation (m asl)	
			roof	floor
<i>Mt Nicholas-Cornwall</i>				
1	592 565	5 398 390	350.2	348.4
2	592 585	5 398 435	-	
3	592 590	5 398 515	-	
4	592 615	5 398 505		
5	592 655	5 398 495		
6(?)	592 670	5 398 475	Caved in	
7	593 075	5 398 540	-	402.3
8	595 180	5 398 965	431.6	429.8
9	595 305	5 398 865	441.0	-
10	596 080	5 399 190	-	457.7
11	596 465	5 399 590	481.9	479.7
12	595 160	5 401 340	499.2	497.7
13	595 150	5 398 635		
14	595 030	5 398 995	427.2	425.5
15	594 055	5 398 570	-	434.3
16	593 040	5 398 670	-	-
17	593 065	5 398 630	431.3	428.9
18	593 110	5 398 580		
19	592 375	5 398 635		
20	592 440	5 398 680		
<i>Jubilee & Cardiff</i>				
?	598 700	5 400 370		
?	598 675	5 400 335	Approx. position from plan of coal workings	
18	598 240	5 399 955	505.5	504.3
19	598 045	5 399 895	509.6	507.6
20	598 025	5 399 895	509.8	507.7
?	597 990	5 399 860	-	507.8
			(water coming out of hillside)	
Cardiff Adit	598 760	5 400 385		

APPENDIX 2

Coal intersections and analyses from drilling on Mt Nicholas

DDH	Sample no.	From (m)	To (m)	Thickness (m)	Seam name	Moisture (%)	VCM (%)	Fixed carbon (%)	Ash (%)	Sulphur (%)	Specific energy (MJ/kg)	Description
Cornwall° 1		18.13	18.74	0.61								Poor quality coal
		19.04	19.96	0.92								Coal with one mudstone band
		24.22	26.66	2.44								Coal and mudstone, interbedded
		104.69	105.61	0.92	+Blue (M1)							Coal and mudstone, interbedded
		107.59	107.84	0.25	minor							Coal
		115.05	115.90	0.85	Hitit (M3)							Coal
		118.26	119.17	0.91								Coal
		123.13	123.89	0.76	minor							Coal
		158.80	159.71	0.91	Fenton (L1)							Coal and mudstone, interbedded
		164.13	165.81	1.68	(L2)							Coal and mudstone, interbedded
	171.29	172.21	0.92	minor							Coal and mudstone, interbedded	
	179.52	181.05	1.53	minor								
Cornwall° 2	3A	41.73	42.35	0.62		3.8	17.0	29.5	49.7			Coal
	4	42.35	43.69	0.34		3.6	20.5	40.6	35.3			Coal
	6	46.24	47.39	1.15		4.3	21.5	37.0	37.2			Coal interbedded with mudstone

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Appendix 2 (continued)

DDH	Sample no.	From (m)	To (m)	Thickness (m)	Seam name	Moisture (%)	VCM (%)	Fixed carbon (%)	Ash (%)	Sulphur (%)	Specific energy (MJ/kg)	Description	
Cornwall 2 (contd.)	21A	123.80	124.66	0.86	*Blue (M1,M2)	3.3	21.7	34.2	40.8			Coal	
	21B	124.79	125.38	0.59		3.6	22.8	30.2	43.4			Coal	
	25A	133.80	134.20	0.40		3.8	12.0	16.7	67.5			Coal and shale	
	26A	134.20	135.06	0.86	Hitit (M3)	3.3	24.3	46.9	25.5	0.24	22.9	Coal	
	27	135.22	137.16	1.94		3.6	22.8	46.9	26.7	0.24	22.1	Coal	
	28	140.74	141.73	0.99	minor	3.9	20.2	30.9	45.0			Coal interbedded with mudstone	
	29	176.47	177.52	1.05	Fenton (L1)	3.9	19.4	36.1	40.6			Coal	
	30	182.37	184.27	1.90	(L2)	4.9	18.4	39.3	37.4			Coal interbedded with claystone and mudstone	
	31	189.07	189.78	0.71	minor	3.4	21.9	43.1	31.6	0.24	20.2	Coal interbedded with mudstone	
	32	194.20	194.86	0.66	minor	4.1	19.2	27.5	49.2			Coal	
	33	196.35	197.08	0.73	minor	3.3	20.5	34.0	42.2			Coal	
	DOM 8	-	23.32	23.62	0.30	M1							
		-	26.92	27.31	0.39	M2							
1		124.05	125.88	1.83	L1	4.88		23.9	44.0			Coal, hard, stony	
2		126.87	129.16	2.29	L2	5.87		37.8	32.6			Coal with mudstone band	
3		150.57	152.40	1.83	minor	6.77		0.6	80.7			Carbonaceous mudstone	
4		152.70	153.42	0.71	minor	6.83		26.7	48.0			Dull coal	
	5	156.16	157.84	1.68	minor	4.72		14.5	64.6			Dull coal	

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Appendix 2 (continued)

DDH	Sample no.	From (m)	To (m)	Thickness (m)	Seam name	Moisture (%)	VCM (%)	Fixed carbon (%)	Ash (%)	Sulphur (%)	Specific energy (MJ/kg)	Description	
DOM 8 (contd.)	6	161.39	162.76	1.37	minor	4.38		9.3	71.7			Dull coal	
DOM 9		22.20	23.83	1.63	L1							Dull coal inter-bedded with mudstone	
DOM 10		Abandoned in scree at 43.28 m											Hard, stony coal
DOM 11		66.98	68.12	1.14	L1							Coal	
DOM 12		54.79	55.32	0.51								Dull coal	
		88.19	89.03	0.84								Dull coal inter-bedded with mudstone	
		123.95	125.55	1.45								Dull coal	
		149.25	150.85	1.52	L1							Dull coal	
DOM 13		68.89	69.24	0.35	M1								
		73.84	74.79	0.95	M2								
	1	85.50	87.68	2.18	M3	5.5	35.3		18.0		27.1		
	2	162.65	164.70	1.70	L1	5.7	22.4	47.4	30.2				
	3	165.10	166.65	1.20	L1	5.4	17.1	40.5	42.1				
	4	180.80	181.80	0.90	minor	5.6	29.2	52.4	18.4				
DOM 33		16.04	16.59	0.50	minor							Dull coal	
	1	43.27	44.20	0.93	M1	7.2	17.6	40.9	41.5			Dull coal inter-bedded with mudstone	
	2	44.44	45.19	0.75	M1	5.7	24.2	49.1	26.7			'as above'	
	3	45.25	46.29	1.04	M1	5.5	28.9	49.9	21.2			'as above'	
	4	46.39	46.65	0.26	M1	5.4	30.1	50.1	19.8			'as above'	

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Appendix 2 (continued)

DDH	Sample no.	From (m)	To (m)	Thickness (m)	Seam name	Moisture (%)	VCM (%)	Fixed carbon (%)	Ash (%)	Sulphur (%)	Specific energy (MJ/kg)	Description
DOM 33	5	46.65	47.20	0.55	M1	4.7	30.6	48.3	21.1			Dull coal inter-bedded with mudstone
	6	47.20	47.78	0.58	M1	5.2	34.1	57.4	14.5			'as above'
	7	47.89	48.48	0.59	M1	4.6	29.5	42.2	28.3			'as above'
Composite	1-7	43.27	48.48		M1	7.0	30.00	52.7	17.3			Heavy liquid separated at 1.6 t/m ³ ; mass yield 80.3%
DOM 33	8	54.35	55.41	1.06	M2	4.5	25.8	49.0	25.2			Dull coal
	9	55.66	56.20	0.54	M2	4.7	31.1	55.4	13.3			Dull coal
	10	56.20	56.98	0.78	M2	4.9	28.2	53.5	18.3			Dull coal
Composite	8-10	54.35	56.98		M2	6.1	29.7	55.5	14.8			Heavy liquid separated at 1.6 t/m ³ ; mass yield 87.8%
DOM 33	11	73.44	74.30	0.86	M3	5.1	24.0	53.3	22.7			Dull coal
	12	74.42	75.46	1.04	M3	4.5	23.4	48.6	28.0			Dull coal
	13	75.46	76.46	1.00	M3	5.4	27.4	53.3	19.3			Dull coal
Composite	11-13	73.44	76.46	3.02	M3	5.4	27.8	57.2	15.0			Heavy liquid separated at 1.6 t/m ³ ; mass yield 82.2%
		119.29	120.69	1.30	L1							Dull coal
		122.98	124.00	2.02	L2							Dull coal
		131.96	132.97	1.01	minor							Dull coal
		142.16	143.76	1.60	minor							Dull coal
DOM 36	1	25.04	25.21	0.17	L1		14.4	32.2	53.4		1.70	Dull coal
	2	25.21	25.43	0.22	L1		21.0	51.8	27.2		1.45	Dull coal
	3	25.43	25.56	0.23	L1		23.1	59.2	17.7		1.33	Dull coal
	4	25.56	25.80	0.24	L1		24.6	59.1	16.3		1.28	Dull coal
	5	25.80	25.96	0.16	L1		21.7	56.4	21.9		1.32	Dull coal
	6	25.96	26.14	0.18	L1		23.3	55.4	21.3		1.34	Dull coal
	7	26.14	26.28	0.14	L1		25.6	58.6	15.8		1.32	Dull coal
	8	26.28	26.59	0.31	L1		24.8	52.7	22.5		1.37	Dull coal
	9	26.61	26.70	0.11	L1		20.5	40.8	38.7		1.57	Dull coal

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Appendix 2 (continued)

DDH	Sample no.	From (m)	To (m)	Thickness (m)	Seam name	Moisture (%)	VCM (%)	Fixed carbon (%)	Ash (%)	Sulphur (%)	Specific energy (MJ/kg)	Description	
DOM 36 (contd.)	10	26.70	26.82	0.12	L1		23.8	55.4	20.8		1.44	Dull coal	
	11	26.82	27.03	0.21	L1		24.0	65.4	13.5		1.29	Dull coal	
	12	27.05	27.12	0.07	L1		21.5	46.7	31.8		1.52	Dull coal	
	13	27.13	27.41	0.28	L1		21.7	46.8	31.5		1.55	Dull coal	
	14	27.41	27.66	0.25	L1		26.9	59.2	13.9		1.31	Dull coal	
	15	27.67	27.76	0.09	L1		23.9	43.3	32.8		1.35	Dull coal	
	16	27.76	28.01	0.25	L1		27.2	58.2	14.6		1.30	Dull coal	
	17	28.01	28.13	0.12			25.6	52.1	22.3		1.35	Dull coal	
	18	28.13	28.30	0.17			27.4	55.6	17.0		1.29	Dull coal	
	19	28.30	28.60	0.30	L1		25.8	55.3	18.9		1.34	Dull coal	
	20	28.60	28.75	0.15	L1		27.0	50.7	22.3		1.38	Dull coal	
			32.30	32.92	0.62	L2							Dull coal
			44.14	44.72	0.58	minor							Dull coal
		48.02	48.86	0.84	minor							Dull coal	

+ M2 seam not present

* M1 and M2 seams combined

° modified from Threader (1968)

41-20

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APPENDIX 3

Coal quality data, Mt Nicholas mines

The following data is adapted from Hills *et al.* (1922). These analyses would be from spot samples, not whole seam sections.

Reg. number	CARDIFF			JUBILEE		CORNWALL				MT NICHOLAS			
	319	320	322	323	325	382	383	629	630	384	385	627	628
Moisture at 105°C	3.20	4.30	3.88	5.00	3.92	3.72	3.00	3.80	3.98	4.00	4.20	4.54	4.88
Volatile matter (%)	28.98	27.08	26.70	22.18	28.52	23.16	24.80	21.74	22.48	27.78	26.64	27.52	26.82
Fixed carbon (%)	48.90	51.42	50.51	50.51	47.46	56.76	55.75	54.38	55.22	46.01	45.96	50.04	47.68
Ash (%)	18.92	17.20	18.91	22.31	20.10	16.36	16.45	20.18	18.32	21.81	23.20	17.90	20.62
Sulphur (%)	0.56	0.47	0.60	0.40	0.60	0.41	0.38	0.36	0.36	0.44	0.40	0.45	0.48
Hydrogen (%)			4.46		4.50			4.02					4.46
Carbon (%)			55.03		55.69			58.63					50.59
Oxygen (%)			19.77		17.78			15.66					22.75
Nitrogen (%)			1.23		1.33			0.15					1.10
Specific energy (MJ/kg)			22.9		22.4			23.2					22.6
S.G. (g/cc)			1.37		1.47			1.43					1.52

41-21

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Appendix 3 (continued)

The following analyses of the Blue (M1) and Hitit (M3) seams as worked at the Cornwall Mine are taken from Threader (1968).

CORNWALL MINE

Blue seam (M1), eastern workings

Sample	Thickness (m)	Moisture (%)	Volatile matter (%)	Fixed carbon (%)	Ash (%)	Total sulphur (%)	Specific energy (MJ/kg)	Description
C1	0.25	4.0	23.3	50.2	22.5	0.20	23.3	Coal
A4	0.15	3.6	-	-	79.9	-	-	Brown stone with 0.01 m coal
A3	0.65	3.3	26.4	51.3	19.0	0.38	24.5	Coal
A2	0.41	3.1	-	-	58.6	-	-	0.05 m coal and stone 0.05 m coal 0.15 m grey stone 0.10 m coal 0.06 m grey stone
A1	1.00	3.4	25.2	49.1	22.3	0.46	23.3	0.68 m coal 0.05 m stone with 0.01 m coal 0.27 m coal
	<u>2.47</u>							Shale floor

Blue seam (M1), eastern workings

B3	0.65	3.7	25.7	50.4	20.2	0.25	24.5	Coal with mudstone roof
B2	0.29	3.8	-	-	61.2	-	-	0.06 m coal and shale 0.08 m coal 0.09 m sandstone 0.05 m coal 0.01 m stone
B1	<u>1.06</u>	3.9	26.2	50.5	19.4	0.36	24.3	
	<u>2.00</u>							Shale floor

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Appendix 3 (continued)

Hitit seam (M3), eastern section

Sample	Thickness (m)	Moisture (%)	Volatile matter (%)	Fixed carbon (%)	Ash (%)	Total sulphur (%)	Specific energy (MJ/kg)	Description
E1	0.76	3.3	25.8	43.3	27.6	0.29	21.4	Coal with sandstone roof
D3	0.20	3.0	-	-	69.3	-	-	Coal and mudstone bands
D2	0.25	3.4	25.2	39.4	32.0	0.25	19.9	0.02 m coal 0.01 m penny band 0.15 m coal 0.01 m stone 0.06 m coal
D1	<u>1.49</u> <u>2.69</u>	3.8	23.8	52.5	19.9	0.31	24.3	Coal Mudstone floor
<i>Hitit seam (M3), gully section</i>								
F2	0.38	2.7	22.9	36.7	37.7	0.20	18.4	0.030 m coal 0.02 m stone 0.06 m coal
F1	1.70	2.9	26.7	47.0	23.4	0.28	23.1	0.37 m coal 0.09 m stone with 0.06 m coal bands 1.12 m coal 0.06 m dull coal
	<u>2.08</u>							

41-23

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Appendix 3 (continued)

Hitit seam (M3), gully section

Sample	Thickness (m)	Moisture (%)	Volatile matter (%)	Fixed carbon (%)	Ash (%)	Total sulphur (%)	Specific energy (MJ/kg)	Description
H1	0.81	4.1	25.6	55.0	15.3	0.32	25.8	Coal with 0.02 m stone band; above Hitit
G2	0.39	3.5	22.6	38.4	35.5	0.28	18.8	0.31 m coal 0.02 m stone
G1	1.78	3.2	26.3	46.2	24.3	0.28	22.7	0.06 m stony coal 0.64 m coal 0.02 m stone 0.30 m coal 0.01 m penny band 0.06 m coal 0.01 m stone 0.57 m coal 0.15 m stony coal
	<u>2.98</u>							Mudstone floor

Split seam from Hitit (M3), gully section

J1	1.17	4.2	26.6	48.9	20.3	0.33	24.2	Coal with mudstone roof
J2	0.46	3.8	-	-	78.0	-	-	Stone with a few coal bands
J3	0.51	3.7	31.3	51.4	13.8	0.33	26.5	0.41 m coal 0.01 m stone 0.09 m coal 0.08 m fawn shale, not sampled
J4	0.53	4.1	25.4	52.4	18.1	0.24	25.0	0.17 m coal 0.02 m stone band 0.34 m coal
	<u>2.75</u>							Mudstone floor

41-24

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Appendix 3 (continued)

The following seam section descriptions were measured and samples collected for analysis by V.M. Threader in 1971.

Seam	Location	Thickness of ply (m)	Cumulative thickness (m)	Description	Proximate Analysis			
					Moisture (%)	Ash (%)	VCM (%)	FC (%)
<i>CORNWALL MINE</i>								
Hitit (M3)	In creek near gully section	0.06	0.06	Coal	3.7	23.3	24.5	48.5
		0.04	0.10	Band				
		0.46	0.56	Coal				
		0.15	0.71	Bright coal and mudstone, interbedded				
		0.97	1.68	Mudstone				
		0.02	1.70	Band				
		0.46	2.16	Coal				
				Mudstone (floor)				
18" (minor)	In creek; 33.55 m below adit in gully section	0.025	0.02	Mudstone (roof)	6.8	16.1	27.7	49.4
		0.05	0.07	Band				
		0.025	0.10	Coal				
		0.28	0.38	Band				
		0.05	0.43	Coal				
		0.02	0.45	Mudstone (floor)				
Fenton (L1)	In creek; 3.3 m below 18" section	0.25	0.25	Grey mudstone (roof)	3.1	37.4	21.8	37.7
		0.01	0.26	Black shale				
		0.21	0.47	Clay				
		0.09	0.56	Coal				
		0.28	0.84	Claystone				
		0.04	0.88	Coal				
				Claystone				

41-25

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Appendix 3 (continued)

Seam	Location	Thickness of ply (m)	Cumulative thickness (m)	Description	Proximate Analysis			
					Moisture (%)	Ash (%)	VCM (%)	FC (%)
<i>CORNWALL MINE (continued)</i>								
Fenton (L1)		0.38	1.26	Coal)	3.6	20.0	25.3	51.1
		0.01	1.27	Shaly band)				
		0.28	1.55	Coal)				
		0.03	1.58	Shaly band)				
		0.10	1.68	Coal)				
				Sandstone (floor)	3.9	8.4	35.8	51.9
Hitit (M3)	East adit	0.18	0.18	Coal)	7.4	25.4	25.3	41.9
		0.02	0.20	Band)				
		0.21	0.41	Coal)				
		0.19	0.60	Mudstone)				
		0.20	0.80	Coal)				
		0.22	0.82	Band)				
		1.04	1.86	Coal)				
Base of seam in water								
<i>MT NICHOLAS MINE</i>								
Nicholas 6' (M1)	Top adit	0.18	0.18	Coal)	4.8	34.2	20.4	40.6
		0.05	0.23	Dirt band with shaly coal above)				
		0.63	0.86	and below coal with three)				
				vitreous bands)				
		0.11	0.97	Dirt band)				
		0.22	1.19	Coal)				
		0.04	1.23	Dirt band)				
		0.02	1.25	Coal)				
0.01	1.26	Dirt band)						

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Appendix 3 (continued)

Seam	Location	Thickness of ply (m)	Cumulative thickness (m)	Description	Proximate Analysis			
					Moisture (%)	Ash (%)	VCM (%)	FC (%)
<i>MT NICHOLAS MINE (continued)</i>								
Nicholas 6' (M1)		0.77	2.03	Coal with numerous thin vitreous bands	3.9	20.2	28.3	47.6
		0.05	2.08	Dirt band				
		0.23	2.31	Coal with vitreous bands	4.3	16.3	33.3	45.7
		0.03	2.34	Dirt band				
		0.45	2.79	Coal with numerous vitreous bands	3.4	23.3	28.4	44.8
		0.33	3.12	Mudstone				
		0.89	4.01	Coal	4.2	26.1	26.5	43.2
				Sandstone (roof)				
Nicholas 4' (M2)	At end of railway line	0.71	0.71	Coal	4.9	33.0	20.2	41.9
		0.05	0.76	Band				
		0.26	1.02	Coal	3.7	39.1	22.2	35.0
		0.30	1.32	Band				
		0.15	1.47	Coal)				
		0.02	1.49	Band)	4.6	23.6	22.4	49.4
		1.66	3.15	Coal)				
				Shaly mudstone (floor)				
Nicholas 4'9" (M3)		0.15	0.15	Coal	5.0	34.8	19.3	40.9
		0.05	0.20	Stone band				
		0.54	0.74	Coal with vitreous bands	4.8	20.6	21.9	52.8
		0.01	0.75	Stone band				
		0.04	0.79	Coal	Not sampled			
		0.05	0.84	Stone band				
		0.16	1.22	Coal)				
		0.01	1.23	Stone band)	4.1	27.4	25.4	43.1
		0.93	2.16	Coal)				

41-27

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Appendix 3 (continued)

Seam	Location	Thickness of ply (m)	Cumulative thickness (m)	Description	Proximate Analysis			
					Moisture (%)	Ash (%)	VCM (%)	FC (%)
<i>CARDIFF MINE (Open Cut)</i>								
				Mudstone (roof)				
		0.13	0.13	Weathered shaly coal				
		0.02	0.15	Stone band				
		0.23	0.38	Weathered shaly coal				
		0.33	0.71	Coal				
		0.05	0.76	Stone band				
		0.23	0.99	Coal				
		0.10	1.09	Carbonaceous shale				
		1.63	2.72	Mudstone				
		0.51	3.23	Shaly coal				
		0.02	3.25	Stone band				
		0.99	4.24	Coal				
		0.02	4.26	Stone band				
		0.10	4.36	Coal				
		0.15	4.51	Black shale with clay bands				
		0.46	4.97	Coal				
		0.01	4.98	Stone band				
		0.49	5.47	Coal				
				Floor of seam in water				
<i>SILKSTONE MINE</i>								
Silkstone		0.41	0.41	Shaly coal		53		
Seam (L1)		0.02	0.43	Band				
		0.09	0.52	Coal)				
		0.01	0.53	Band)				
		0.84	1.37	Friable coal)		26.6		
		0.03	1.40	Band)				
		0.17	1.57	Shaly coal)				

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Appendix 3 (continued)

Seam	Location	Thickness of ply (m)	Cumulative thickness (m)	Description	Proximate Analysis					
					Moisture (%)	Ash (%)	VCM (%)	FC (%)		
Silkstone Seam (L1)		0.03	1.60	Band						
		0.05	1.65	Coal						
		0.03	1.68	Band						
		0.17	1.85	Coal	30.3					
		0.03	1.88	Band						
		0.02	1.90	Coal						
		0.02	1.92	Band						
		0.19	2.11	Coal	20.8					
		0.03	2.13	Band						
		0.63	2.76	Coal	16.4					
		0.01	2.79	Band						
		(L2)	3.3 m lower than Silk- stone Seam	0.40	0.40	Friable coal)				
				0.01	0.41	Band)	44.9			
0.29	0.70			Coal)						
0.01	0.71			Band						
0.18	0.89			Coal	38.0					
0.07	0.96			Band						
0.08	1.04			Coal	21.7					
0.05	1.09			Band						

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