COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Report No. 8

GEOLOGICAL AND GEOPHYSICAL SURVEYS, ASHFORD COAL FIELD, NEW SOUTH WALES

PART 1 — GEOLOGY

By

H. B. OWEN and G. M. BURTON

PART 2 — GEOPHYSICAL SURVEY

By

L. W. WILLIAMS

Issued Under The Authority Of Senator the Hon. W. H. Spooner, M.M.,
Minister For National Development
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LIST OF REPORTS

1. Preliminary Report on the Geophysical Survey of the Collie Coal Basin-N.G. Chamberlain, 1948.
2. Observations on the Stratigraphy and Palaeontology of Devonian, Western Portion of Kimberley Division, Western Australia-Curt Teichert, 1949.
3. Preliminary Report on Geology and Coal Resources of Oaklands-Coorabin Coalfield, New South Wales-E. K. Sturmfels, 1950
4. Geology of the Nerrima Dome, Kimberley Division, Western Australia-D. J. Guppy, J. O. Cuthbert and A. W. Lindner, 1950
5. Observations of Terrestrial Magnetism at Heard, Kerguelen and Macquarie Island, 1947-1948. (Carried out in co-operation with the Australian National Research Expedition, 1947-1948). N. G. Chamberlain, 1952.
6. Geology of New Occidental, New Cobar and Chesney Mines, Cobar, New South Wales -C. J. Sullivan, 1951.
7. Mount Chalmers Copper and Gold Mine, Queensland-N. H. Fisher and H. B. Owen, 1952.
8. Geological and Geophysical Surveys, Ashford Coal Field, New South Wales-H. B. Owen and L. W. Williams.
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11. The Nelson Bore, South-Western Victoria; micro-palaeontology and stratigraphical succession-I. Crespin,
12. Stratigraphy and micro-palaeontology of the Marine Tertiary rocks between Adelaide and Aldinga, South Australia-I. Crespin,
13. Geology of Dampier Land-R. O. Brunnschweiller,
14. A Provisional Isogonic Map of Australia and New Guinea Showing Predicted Values for the Epoch 1955·5-F. W. Wood and I. B. Everingham, 1953
15. Progress Report on the Stratigraphy and Structure of the Carnarvon Basin, Western Australia; M. A. Condon.
16. Seismic Reflection Survey at Roma, Queensland; J. C. Dooley.
17. Mount Philp Iron Deposit; E. K. Carter and J. H. Brooks.

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Department Of National Development

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SUMMARY

In an area of northern New South Wales between Inverell and Texas a coal-bearing sequence of Lower Permian sediments has been geologically surveyed and tested in part. The beds are known as the Ashford Coal Measures and the area in which the Coal Measures occur is known to the New South Wales Department of Mines as the Ashford Coal Province.

The main known reserves of coal in the Province are in an area eight miles almost due north of Ashford in the vicinity of the Severn River, where an area of 150 acres was tested by core drilling and shown to contain "Indicated Reserves" of 4,860,000 long tons of coal.

The Ashford Seam is the only one of the known seams on the field that could be worked at present. It generally occurs within 80 feet of the base of the Coal Measures and has a true thickness of 6 to 51 feet. The dip of the coal averages about 26 degrees westward.

The coal has a medium-volatile bituminous ranking. Its calorific value places it amongst the best steam coals in Australia. Ash content is reasonably low. Its low volatile content (23 to 24 percent) makes it unsuitable for production of gas or cement.

The small quantity that has been mined was used mainly for making metallurgical coke, but tests on the samples from recent drill holes did not give very promising coking results. These drill samples, however, did not represent the average composition of the seam.

Local authorities intend to use Ashford coal for the generation of electricity, and subject to the limitations imposed by lengthy transport to small centres of population, the coal may find local use in light industries and mining.

INTRODUCTION

Coal was first discovered near Ashford in 1884 by John Macdonald, who noticed an exposure in the bed of a short gully tributary to the Severn River at a point 8 miles north of the village of Ashford. Later investigation revealed that the Coal Measures extend southwards from near Bonshaw, on the Queensland border, through the Ashford area to Arrawatta, forming a narrow discontinuous strip over 40 miles long in which coal seams are known north of the Ashford mine, at the colliery itself, and at Arrawatta (see Plate 1). The Coal Measures are bounded on the east by an unconformable junction with Carboniferous sediments and on the west by the Severn Fault, which probably dies out at Arthur's Seat, 14 miles south of the coal mine.

The coal seam discovered by John Macdonald was not exploited until the beginning of this century. A small colliery has been opened by means of an inclined tunnel driven on the base of the seam near the site of original discovery. Production from the mine has been small and intermittent and the mine was last worked in 1925.

This report records the results of investigations by officers of the Bureau of Mineral Resources, Geology and Geophysics, in the vicinity of Ashford and as far south as Inverell during a period from 1947 to 1950.

The earlier part of this work included a limited amount of scout boring for coal at Byron and at Arthur's Seat by the Australian Aluminium Production Commission under the geological supervision of the Bureau. Core drilling at Ashford Coal mine was recommended at this time (Owen, 1948) and was subsequently undertaken by the Bureau in conjunction with the Geological Survey of New South Wales in 1949.

Situation and Access.

Ashford, a village with a population of 600, is about 508 miles by road north from Sydney and about 22 miles south-west of the Queensland border at its nearest point. The village lies about midway between the railheads at Inverell, 35 miles south, and Texas in Queensland to the north.

The Ashford Coalfield, the area in which the Ashford mine is situated, lies eight miles north of Ashford and is reached by a poor gravel road. North of the mine the road, which is also a Travelling Stock Route, is a poor track and crosses the Severn River at a rough natural ford before connecting with the main Ashford-Texas road.

Topography.

The Coal Measures crop out in low, gently undulating and flat country flanked by low hills of Carboniferous sediments and granite intrusives. Few of these low hills rise more than 300 feet above the lowest neighbouring point; some of them are capped with basalt. Elevations above sea level range from about 1500 to 1800 feet.

The main drainage is to the north and includes the MacIntyre River which flows through Inverell, Byron, Arrawatta, and Wallangra. It joins the Dumaresq River above Boggabilla on the Queensland border and 59 miles north-west of Ashford. The Severn River, into which drain Nine Mile Creek from Arthur's Seat, and Frazer's Reedy and Myall Creeks from the low country about Ashford, forms one of the major tributaries of the MacIntyre River.

The Mandoe road along the northern boundary of the Parish of Myall is along a divide. North of it Spring Creek and other small rivers flow north-east to the Dumaresq River and not into the MacIntyre River.

Hard rock exposures other than granite are few, as most of the Ashford Coalfield is mantled by a cemented granite eluvium and by the old alluvial deposits of the Severn River and Myall Creek.

At Arthur's Seat almost the whole area occupied by Permian rocks is blanketed by Pleistocene lacustrine deposits with greatest thickness exceeding 35 feet.

At Arrawatta only a few exposures of the Coal Measures are visible. Any possible extension is hidden by the MacIntyre River and its flood plains and gravel banks.

Outline of Investigations.

Since the first surveys by T.W.E. David in 1884 (David, 1885) and E.F. Pittman in 1896 (Pittman, 1896), both officers of the New South Wales Department of Mines, the coalfield has been inspected frequently by other officers of the Department of Mines, the Joint Coal Board, and the Bureau of Mineral Resources.

F.N. Hanlon carried out the most recent survey for the Mines Department and reported on his work in 1947 (Hanlon, 1947 a).

In September, 1947, one of the writers (H.B.O.) visited the area on behalf of the Australian Aluminium Production Commission and, after examining the underground workings and the area in the immediate vicinity of the colliery, recommended that the western edge of the field should be tested by drilling.

In May and June 1948, a southerly extension of the Ashford field at Arthur's Seat was mapped and tested by percussion drilling (Owen, 1948).

In March, 1949, the Bureau, acting in conjunction with the New South Wales Department of Mines, began a diamond drilling programme which continued until May 1950.

The other writer (G.M.B.) went to the area in April 1949, to inspect and log the drill cores and to map the Coal Measures in as much detail as possible.

This geological mapping consisted of two parts :

(i) a series of east-west traverses north and south of the town of Ashford to ascertain whether the Coal Measures existed in that area;

(ii) detailed mapping, of the area near the old Ashford Colliery and northwards to Spring Creek together with brief reconnaissance north of Spring Creek.

These areas are in the County of Arrawatta and the Parishes of Ashford, McDonald, Myall, Hallam, Bonshaw, and Hetherington.

Brief visits were also made to Arthur's Seat, Arrawatta, and Byron.

From early June to September, 1949, members of the Geophysical section of t.. Bureau conducted a gravity survey of the Colliery area. Details of this work are given in Part II of this report.

During the course of the drilling programme three reports were issued by the Bureau (Williams, 1949; Owen, 1949; and Burton, 1950).

COAL PRODUCTION AND QUALITY

During the sixty-six years that this coal has been known less than 2,000 tons of coal have been mined, all from the one mine near the site of the original discovery in Coal Gully.

Earliest recorded production was 712 tons by the Frazer's Creek Mine Syndicate in 1901. The next production was in 1908, when under the name of the Ashford Coal Mine the colliery produced 855 tons in seven months. Most of the coal produced was coked in beehive ovens at the pithead and the resulting coke supplied to the smelters at the Silver Spur Mine near Texas. Another attempt at mining was made in 1925 but little coal was mined (Hanlon, 1947 a).

The mining leases (ML 14 and 15) in the immediate vicinity of Coal Gully are now held by the North-West County Council, which plans to begin coal mining, at first on a small scale and, later, on a larger scale as soon as conditions permit.

The district is by no means densely populated and the immediate demand for coal will not be great, but it is proposed to establish a 10,000 kVA generating station on the coal field by 1957. Such a plant would be able to supply part of the power requirements of Inverell (population 6,000) as well as of Texas and nearer communities.

If an alumina plant were established near Byron to use the large reserves of ferruginous bauxite in that locality, substantial quantities of coal would be required.

Provided markets are available for the coal produced, maximum coal recovery should be ensured by applying open-cut methods in certain areas, such as from DDH 7 to DDH 9.

The problem of marketing is particularly important when considering open-cut mining at Ashford. As the seam has an average dip of 26-27 degrees the overburden ratio increases rapidly down-dip and consequently the removal of overburden presents a major engineering problem which can be handled only by expensive and efficient earth-moving machinery. The use of such machinery, involving large capital expenditure, is only warranted if large rapid production is required.

The best available information on the quality of the coal in the Ashford Seam is afforded by analyses of samples taken underground. These necessarily represent the coal from a restricted area only but are more representative than the drill samples, which contained little or none of the softer coal.

At the old colliery the seam is approximately 33 feet thick. Of this the upper 10 feet consists of alternating plies of hard and soft coal with thin bands of splint coal and clay. The coal in this upper 10 feet contains about 15 percent ash. Immediately below is 19 feet 6 inches of mainly hard dull coal with thin bands of soft coal, the whole averaging 8 percent ash. The remaining 3 to 4 feet above a floor of banded dirty coal and shale contains 14 to 17 percent ash.

Strip samples representing a total seam thickness of 33 feet 4 inches, but not including splint and shale bands totalling 7½ inches and "brassy" bands totalling 1½ inches, were taken in the colliery by officers of the Joint Coal Board in January, 1950. The average composition of these samples and the results of an analysis of a bulk sample of 2275 pounds taken from the same place in 1945 for a boiler test at Newcastle Technical College are given below:

	J.C.B.	N.T.C.
Moisture	1.9 percent	1.12 percent
Volatile Matter	23.2 percent	23.80 percent
Fixed Carbon	64.0 percent	64.58 percent
Ash	10.9 percent	10.50 percent
B.Th.U's per pound	13,010	13,080 (dry)

The "Fuel Ratios" (the ratios of fixed carbon to volatile matter) for these analyses are 2.76 and 2.72 respectively, and fuel ratios for 33 other analyses of Ashford coal containing less than 15 percent ash range between 2.45 and 3.25, averaging 2.90. The coal ranks as a medium-volatile bituminous coal. (A.S.T.M., 1938).

The sulphur content determined in 31 samples averages 0.51 percent and ranges from 0.32 to 0.73 percent.

On the basis of composition alone the Ashford coal is an excellent steam coal, and there is evidence that it produced a satisfactory metallurgical coke, but it has the disadvantage of being friable and broken. It is probable that an excessive proportion of fine material will be produced when it is mined, necessitating special attention in the design of boiler grates.

GEOLOGY

General Geology.

The Permian Coal Measures rest with an almost right-angled unconformity upon a sequence of folded and faulted sedimentary rocks which are probably of Lower Carboniferous age. From the unconformable contact with the Carboniferous along their eastern margin the Permian beds dip westward between 20 and 40 degrees. The western boundary, parallel to the strike, is a faulted contact with granite which has been overthrust at a high angle from the west. The granite is intrusive into the Carboniferous rocks and inclusions of the latter occur along a narrow band in the granite close to the fault.

The stratigraphical units present in the Ashford Coal Provinces are:

(5) Quaternary and Tertiary: unconsolidated sediments.
(4) Tertiary: intrusive keratophyre.
(3) Permian: coal measures.
(2) Carboniferous (?): intrusive granite.
(1) Lower Carboniferous: sediments: quartzite, siltstone, claystone, chert, tuff.

Lower Carboniferous Sediments.

The oldest rocks in the immediate vicinity of the Coal Measures are white cherts, grey and green claystones, tuffs, and quartzites, which are attributed tentatively to the Lower Carboniferous (Hanlon, 1947 b). They are practically unfossiliferous; an examination of drill core from the claystone beds showed only very small traces of plant remains.

The Carboniferous beds are sharply folded, and repeated small-scale faulting is noticeable in many places. The strike of the beds is for the most part between 320° and 40° and dips range from horizontal to near vertical within a very short distance.

The claystones crop out as a series of alternating hard and soft beds. The hard members seem to owe their strength to surface deposition of limonite in particular beds; at depth the hardness is fairly uniform.

The unhardened claystone outcrops weather easily and cause the harder beds between them to disintegrate and collapse. The Coal Measures in the Ashford Province overlie these claystones, and it appears that the Permian beds were deposited on an eroded surface of moderate relief formed by differential erosion of hard and soft beds.

The thin-bedded claystones can be followed almost continuously from Inverell northwards to the Dumaresq River.

Hanlon (1947 b, 26) has suggested that the Carboniferous sequence in the Ashford Province may be divided into two main formations:

(a) composed mainly of massive tuffs with tuffaceous grits and sandstones, and

(b) composed mainly of thin bedded mudstones, shales and cherts. Observations made during the investigation of the coalfield give support to this suggestion.

Carboniferous (?) Granite.

A batholith of biotite granite, outcropping as low rough hills, lies immediately to the west of the Coal Measures, which have been brought against it by faulting. Near its intrusive contacts with carboniferous sediments the granite is fine-grained and rich in biotite, but at a short distance from the margins the rock has a coarse porphyritic texture. The roof of the batholith has been denuded only recently, and pendants of silicified Carboniferous claystone are common, particularly in the area between DDH 7 and the ford across the Severn River near the confluence with Myall Creek.

At Limestone, ten miles west of the coal-mine, Raggatt (1941) found Symplectophyllum mutatum in a limestone marmorized by the granite. This shows the limestone to be of Lower Burindi (Visean) age, and the granite to be younger; its exact age, however, cannot be established beyond doubt. It is probable, but not certain, that it is older than the Permian Coal Measures against which it is faulted.

Permian Coal Measures.

Permian terrestrial sediments stretch intermittently from south of Bonshaw to Arrawatta. 10 miles by road north of Inverell. Marine Permian beds crop out in an infaulted block

at Silverspur, 34 miles north of Ashford, across the Queensland border (Bryan and Jones, 1946).

The Permian terrestrial sediments consist of coarse-grained to fine-grained blue-grey breccia or conglomerate, sandstone, blue-grey grit, grey and black carbonaceous shale, and coal seams. The basal Permian beds generally consist of coarse conglomerate. Much of this conglomerate is made up of fresh angular fragments and boulders from the Carboniferous claystones, quartzites, and cherts, and can be regarded as a normal residual sharp-stone conglomerate rather than a breccia.

At localities north of Ashford the Coal Measures maintain a fairly constant strike of 15° east of magnetic north, with local changes of about 10° to either side. The dip is westward at angles between 20° and 40°, commonly between 25° and 30°. In the northern part of the Arthur's Seat area also, the Coal Measures dip westward at 20° to 30°, but near the southern margin the beds have been sharply folded and the strike swings from north to north-west and west.

David and Pittman (1899) investigated suggestions by Dunn (1898) that some of the conglomerates are glacial, and decided that there was no definite evidence in favour of such an origin; but on evidence discovered later David (1931) supported Dunn's original view. The present writers did not observe any evidence of glaciation and noted that the passage into carbonaceous sedimentation showed no evidence of any break in deposition.

The presence of conglomerate and grit beds throughout the whole Permian sequence indicates nearby country of fairly high relief throughout most of the period of sedimentation. Boreholes have revealed grit and conglomerate overlying the Ashford seam in some places, and in other places the coal passes upward into shale. The presence of coarse sediments in such a position indicates deposition under somewhat torrential conditions and suggests the possibility of wash-outs in the seam.

The exact age of the Ashford Seam in unknown. The prevalence of Gangamopteris associated with Glossopteris has led to its correlation with the Greta Seam; but in the absence of marine fossils it has been impossible in the past to correlate the Measures accurately with type sections of the Permian in the Hunter Valley.

Tertiary Dyke Rock.

Two dykes, tentatively ascribed to the Tertiary System, have intruded the Coal Measures near the southern end of the Arthur's Seat area. Somewhat weathered specimens of the dyke rock have been examined by W.B. Dallwitz, petrologist of this Bureau, who found them to consist mainly of an acid plagioclase with a lesser proportion of orthoclase and a very minor quantity of quartz and sericite. The rock is regarded as a keratophyre.

Tertiary and Quaternary Sediments.

Much of the area of Ashford Coalfield is covered with cemented granite wash and also river gravels deposited in old channels of the Severn. This cover ranges in thickness from 3 to nearly 40 feet.

At Arthur's Seat the low ground occupied by the Coal Measures is covered by lacustrine sediments consisting largely of sandy clay with a few thin lenticular pebble beds. The greatest known thickness of these sediments is 37 feet, which was intersected in No. 3 Bore.

Tectonics.

The sedimentary deposits of Ashford have been affected by several major movements.

As far as can be gathered the Carboniferous banded cherts and claystone were folded, possibly incompetently between more competent Carboniferous beds, during the Kanimblan Orogeny in epi-Burindi time (Browne, 1949). The granite was possibly injected in the closing stages of this orogeny.

The next movement brought about the folding of the Permian beds, and disruption by the Severn Fault and subsidiary faults. These probably coincide with the Hunter Bowen Orogeny of Middle to Late Permian time.

The Severn Fault is a major structural feature. It has been mapped fairly accurately over a distance of about eight miles and is known to continue to the south as far as Arthur's Seat, 20 miles south of the Spring Gully area. It has a throw of at least 800 feet in Portion 9, Parish of Myall, and at least 500 feet in the vicinity of DDH 1. The actual throw of the fault is believed to be about 1000 feet over the length that has been mapped. It is probable that the southerly extension of the Severn Fault or a parallel system in the vicinity of Inverell has provided a zone of weakness in which extensive faulting has taken place in late Tertiary time, particularly in the vicinity of the MacIntyre River.

Nowhere is the fault exposed to view. Howe ver, about 300 feet north of DDH 3 the position of the fault line has been determined within narrow limits by outcrops and a shallow pit. In this particular place a costean a few feet in depth and twelve feet in length would reveal the actual fault zone. Similar shallow costeaning would disclose the fault near DDH 6.

It seems likely that in the Spring Creek Area the Severn Fault bifurcates into the Severn Fault and the Spring Creek Fault. Both of these faults have the downthrow side on the east and have throws of more than six hundred feet.

The evidence for joining the Spring Creek Fault to the Severn Fault is weak. It is mainly dependent on lack of marked thermal metamorphism of the wedge of Carboniferous sediments existing between the granite and the Coal Measures on the boundary of Portions 11 and 12, Parish of Hallam. Unfortunately most of the adjoining area is covered with wash.

The Severn Fault was intersected by DDH 6, which passes from granite and inclusions of silicified Carboniferous sediments through the fault zone, at 69 to 78 feet from the surface, into unaltered grey shale with carbonaceous bands and blue-grey conglomerate, both typical of the Permian beds.

Although the dip of the fault is not known exactly, DDH 6 provides almost conclusive evidence that it is a reverse fault with a steep dip to the west. It is most unlikely that the bore would deviate appreciably in such a short depth, nor is it at all probable that the hole was drilled at an angle so far out of the vertical as to exceed the hade of a normal fault without its inclination being noticed and reported by the driller. The relationship of the fault line, as mapped, to the topography does not indicate the dip of the fault. South of DDH 1 the fault swings slightly to the east. If this swing is not due to a change of strike of the fault, it must be due to a lessening of a westerly dip, as it is greater than can be accounted for by topography alone. North of Myall Creek the fault has a similar swing to the east as it approaches the divide at the Mandoe road, and this also could indicate a lessening of dip on a reverse fault with thrust from the west.

At the northern end of the Arthur's Seat area the structural relations between the Coal Measures and the surrounding rocks appear to be identical with those near the Ashford colliery. The Permian beds, which dip west at about 20°, unconformably overlie Carboniferous tuff, quartzite, and siltstone, on the east, and are bounded on the west by highly silicified Carboniferous rocks intruded by granite. Undoubtedly this junction is a continuation of the Severn Fault. In the southern part of the area, which is shown in Plate 5, the Coal Measures extend westward across the faults in an area of confused dips within the core of a sharp syncline pitching to the north-north-west.

At Arrawatta a large fault probably separates granite on the north-west from the Coal Measures on the south-east. Other subsidiary faults probably occur in the Coal Measures near Ashford and are hidden beneath the heavy cover of alluvium and wash. These will be revealed only as the Coal Measures are developed and further tested.

The Jurassic sediments towards Wallangra, 10 miles west of Ashford, have been only gently warped and have not suffered any major movement, indicating relatively stable conditions in the immediate vicinity since soon after the close of Palaeozoic time.

Igneous Activity.

No igneous intrusion into the Coal Measures in the main area between Ashford and Bonshaw has been discovered, but at Arthur's Seat one of the writers (H.B.O.) has mapped acid dykes intruding the Coal Measures. A small area of coal-bearing sediments of Permian (?) age in the "Glenmore" property on the Bonshaw-Glen Innes Road is intruded near its southern end by basalt.

In the belt of green and grey mudstones about two miles north of Inverell intrusions of basalt are to be seen. Basalt flows of both early and late Tertiary age cover large areas between Inverell and Bonshaw (Owen, 1948, 1949). Hence it is possible that Tertiary intrusions of small extent may be found in concealed portions of the Coal Measures between Ashford and Bonshaw.

DESCRIPTIONS OF AREAS EXAMINED

The main areas in which the Permian terrestrial sediments are known to occur within the Ashford Province are :

1. The Ashford Coalfield, north of Ashford.
2. At Arthur's Seat, seven miles south of Ashford.
3. At Arrawatta, nine miles north of Inverell and 24 miles south of Ashford.

ASHFORD COALFIELD.

As the area north of Ashford is most likely to produce coal it has been drilled and mapped in more detail than the deposits in the other two localities. For the purpose of mapping, the Ashford area has been divided into four smaller areas shown on Plate 2, which from north to south are :

(i) Spring Creek area, covering Portions 11 and 12, Parish of Hallam, and the northern part of Portion 9, Parish of Myall.

(ii) Myall Creek area, covering the southern half of Portion 11, Parish of Myall, and a strip of land thence to the junction of Myall Creek and the Severn River.

(iii) Colliery area, covering the northern part of the Parish of McDonald from the Severn River to about two thousand feet south of the Ashford Coal Mine.

(iv) Sheepskin Gully area, extending for half a mile from the Colliery Area.

Spring Creek Area.

In this area the Permian sediments are 600 to 800 feet thick.

The continuation of the Coal Measures is not visible much north of Spring Creek. A heavy soil cover obscures the immediate northward continuation, and in the next northerly Portion a traverse of a creek gully and adjoining area failed to locate the Measures. A traverse was also made along the Atholwood Road just north of Bonshaw and in several creek beds in this area, but no sign was found of the Coal Measures, although they could be present beneath the heavy alluvial cover of part of this area.

Two good sections of the Coal Measures are visible in the two gullies in Portion 11, Parish of Hallam.

In Spring Creek gully the Coal Measures are duplicated by faulting. In this locality a seam that corresponds to the Ashford Seam has been prospected by two shafts, both of which are now inaccessible. The seam, judging from the "smut" in the creek banks, appears to be only about 8 feet thick including bands. However, the partial cover of wash and small slumps produced by the perishing of the coal outcrop make an accurate measurement impossible.

Reverse dips are found in the section along the other gully in this Portion, where there appears to be a small gentle north-pitching fold. No "smut" or seam is visible in this gully.

The eastern boundary of the Coal Measures, as mapped in Portion 11, is tentative. Some beds, believed to be Permian, have very similar lithology to the Carboniferous grits, and the apparent local absence of a marked angular unconformity renders sharp distinction between the rocks of the two systems very different.

In Portion 12, which adjoins Portion 11 to the south, very few Permian outcrops are visible and the boundaries are mostly interpolated.

In Portion 9, Parish of Myall, good exposures of the Permian beds include a carbonaceous bed from eight to twelve feet thick, which is thought to correspond to the Ashford Seam. Spring Creek Bore No. 1 was sunk to intersect it at about two hundred feet.

The following section was recorded from this hole:

To 237 feet:	Black shale and thin coal bands.
From 213 to 237 feet:	Shale with penny bands of coal.
From 237 to 239 feet:	Coal.
From 239 to 242 feet:	Shale.
From 242 to 245 feet:	Coal.
From 245 to 264 feet:	Hard Shale and thin coaly seams.

This hole was sunk with a percussion drill and was abandoned after collapse at 264 feet.

Myall Creek area.

West-dipping Permian beds die out against Carboniferous beds at what is probably a cross-fault near the southern boundary of Portion 9, Parish of Myall. South of this faulted block of Carboniferous beds, the presence of the Permian is indicated only by a slight change in soil colour and by the absence of granite and Carboniferous outcrops as far as the point where the track from Bonshaw to Severn River passes over Waterhole Creek. There, in a ridge beside the track, Permian conglomerate crops out. In Myall Creek near where it is joined by Waterhole Creek continuous alluvium covers an area between Carboniferous outcrops. This is the place where interpolation would indicate that the Permian sediments cross the creek. One weathered outcrop was inspected beneath water level in this creek: it appeared to be Permian shale but could be younger consolidated alluvium. In the absence of evidence to the contrary the extension of the Coal Measures has been drawn through this area between Carboniferous outcrops. Between this area and the Central area a heavy alluvial blanket covers an inferred thin belt of Permian.

Colliery area.

The most important of the four subdivisions is the Colliery area. Most of this area from Coal Gully northwards to the Severn River is covered with a Recent deposit of granite wash, and late Tertiary to Recent gravel. However, with drilling and geophysical assistance, it has been possible to map the sub-surface beneath the alluvial mantle with reasonable accuracy (See plate 3).

In this area the Coal Measures attain a maximum thickness of about 550 feet and dip to the west or west-north-west at an average of about 26°. The dips on the eastern side, there visible, are generally steeper (about 30° to 35°). Near DDH 5 the dip appears to be 20°.

At the western boundary the Coal Measures are abruptly truncated by the Severn Fault. As mentioned previously this faulted boundary is nowhere exposed, and the minor degree to which the Permian beds appear to be disturbed near the fault can be deduced only from the results of the drill holes. DDH 6, which intersected the fault at a very acute angle, probably about 10°, recovered no core for a depth of 9 feet in the fault zone, and then passed into apparently normal Permian shales and conglomerates with the usual range of dips between 22° and 31°; but no core was recovered from the Ashford Seam. This result suggests that the coal was more broken

than usual. The distance from the fault zone to the point where the drill entered the co.. eam is about 50 to 60 feet if the hade of the fault is about 10^{o}.

In DDH 6, and at points where pits were sunk through the alluvium, it was found that a narrow band of highly silicified Carboniferous rocks is interposed between the granite and the fault. The band is too narrow to show in Plate 3, although it probably widens to the north, where it is concealed beneath alluvium.

The sequence of the beds of the Coal Measures is set out below. The column here given refers to the immediate vicinity of the old colliery; further details will be found in the bore logs in Appendix II.

Thickness Feet	Description
26	Conglomerate;
7	Carbonaceous shale and thin coal seam;
13	Conglomerate, blue-grey;
9	Sandstone, coarse and fine, grey, bands of conglomerate;
16	Conglomerate, blue-grey;
23	Conglomerate, alternating with coarse and fine sandstone; dips 25^{o} to 35^{o};
4	Coal (4 ins.) and carbonaceous shale; dip 28^{o};
33	Carbonaceous sandstone, grey sandstone, alternating conglomerate and sandstone; dips 28^{o}- 35^{o};
6	Coal and carbonaceous shale (Bonshaw Seam);
20	Sandstone and conglomerate with thin (1 inch) coal seam; dip 32^{o};
5	Carbonaceous shale;
18	Sandstone and conglomerate, blue-grey;
8	Carbonaceous shale and coal bands; dip 30°;
24	Sandstone, fine, grey, with carbonaceous bands; dips 28° to 34°;
57	Sandstone, grey-green, coarse and fine, with conglomerate band; dips 25° to 30°;
17	Sandstone, dark grey, coarse, and fine conglomerate with carbonaceous bands; dips 27° to 43°;

Thickness Feet	Description
1	Carbonaceous shale;
33	Coal (Ashford Seam); dips 25° to 32°;
12	Carbonaceous shale with thin coal seams and sandstone and conglomerate bands; dip 20°;
49	Sandstone, coarse, with carbonaceous bands and conglomerate; dip 20°.
381	
	Unconformity.
?	Siltstone: Lower Carboniferous.

The Ashford Seam is the most important seam contained within the Coal Measures. It lies about 20 to 150 feet above the unconformity with the Lower Carboniferous bedrock and has been proved by drill-holes to range from 6 to 51 feet in true thickness. A longitudinal section and columnar sections of drill-holes (Plate 4) show the variations in thickness of the Ashford Seam. The thickness shown in the section is that of coal intersected by the borehole in each case and is not restricted to any arbitrary grade of coal chosen by reference to the analysis of bore samples, which, on account of low core recovery, must be regarded as insufficiently reliable.

The true seam thickness increases from 12 feet at DDH 5 (2,400 feet south-west of the old colliery) to 36½ feet at DDH 2, which is 1,200 feet north of the mine. Northwards from DDH 2 the seam dwindles to only 6 feet thick in a distance of 950 feet, and then increases to 30 feet of probably poor and broken coal at DDH 7 (4,600 feet north-north-east of the mine). At 1,200 feet north-west of DDH 7 the percussion bore DH10 cut only 8½ feet of coal and 4 feet of shaly coal or carbonaceous shale. The northernmost hole drilled, DDH 9, which is 1,150 feet north-west of DH 10 and approximately 6,000 feet north-west from the colliery, penetrated a true coal thickness of 51 feet, which confirms the low gravity value recorded at this site by earlier geophysical survey. However, the very broken and slickensided condition of the coal (only the top 6 feet yielded good core) suggests that the seam may have been thickened by overthrusting and impaction.

The coal has a dull, and in places a cindered, appearance; banding of durain and vitrain can be distinguished with difficulty. There is, however, no sign that the coal has been coked by igneous action.

At and north of the colliery the seam contains a number of half-inch to two-inch bands of shale spaced by a foot or two of clean coal. These bands increase to the south as the ridge in the Carboniferous basement is approached. The roof rock is commonly coarse sandstone or conglomerate, but shale immediately overlies the coal at DDH 3, 4, 6, 9, and 10. The coal passes downward into carbonaceous shale with successively thinner and more widely spaced seams of dirty coal. In the colliery a clay shale forms the floor of the seam, but this

also passes to carbonaceous shale. None of the diamond drill holes revealed an under-clay beneath the Ashford Seam.

The following description of the Ashford Seam as it is exposed in the colliery is taken from a report by S. Flowers (1950), District Mining Engineer, Joint Coal Board. The analyses are averages of seven, six, and two samples respectively.

TOP OF SEAM				MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	B Th U PER LB.
				%	%	%	%	%
0'0"	TO	3'0"	HARD COAL					
3'0"	TO	3'1"	"BRASSY" BAND ★					
3'1"	TO	5'1"	HARD COAL					
5'1"	TO	5'1½"	"BRASSY"BAND ★					
5'1½"	TO	6'1½"	SOFT BRIGHT COAL					
6'1½"	TO	6'2½"	SPLINT COAL ★					
6'2½"	TO	7'5½"	SOFT BRIGHT COAL	2.2	22.3	60.9	14.6	12,390
7'5½"	TO	8'3"	HARD COAL					
8'3"	TO	8'5"	DIRTY COAL					
8'5"	TO	9'3"	SOFT COAL					
9'3"	TO	9'3½"	MUDSTONE ★					
9'3½"	TO	10'2½"	SOFT COAL					
10'2½"	TO	10'4½"	SOOTY COAL					
10'4½"	TO	11'9½"	COAL					
11'9½"	TO	11'10"	MUDSTONE ★					
11'10"	TO	14'11½"	COAL					
14'11½"	TO	15'1"	SPLINT COAL ★					
15'1"	TO	16'10"	VERY HARD COAL	1.8	24.0	66.3	7.9	13,820
16'10"	TO	17'0"	SOFT COAL					
17'0"	TO	19'6"	HARD COAL					
19'6"	TO	19'8"	SOOTY COAL					
19'8"	TO	21'0"	MODERN HARD COAL					
21'0"	TO	29'10"	HARD COAL					
29'10"	TO	30'7"	SOFT BRIGHT COAL					
30'7"	TO	30'9"	MUDSTONE ★	1.6	22.0	59.9	16.5	12,325
30'9"	TO	33'9"	SOFT BRIGHT COAL					

★ BANDS EXCLUDED FROM SAMPLES

Thrusting and slickensiding of the coal is noticeable in the old mine. At the north-western end of the main heading the seam has been thickened by an overthrust from the north.

Similar disturbances to the coal seam may possibly have occurred at or near some of the points drilled, and the thickness of coal intersected in such bores may not be an accurate measure of the true thickness of the seam. Attention has already been drawn to DDH 9 in this regard. There is, however, no reason to believe that results at other holes are similarly affected.

Main reserves of coal in the Ashford Seam lie between DDH 6 and DDH 4, which is about 4,500 feet south of DDH 6.

In the Colliery area coal has been intersected in the drill holes at several levels above the Ashford Seam. The only important one of these is 130 to 170 feet above the Ashford Seam. It has been called the Bonshaw Seam, and from the drill core that has been recovered it would appear to be heavily banded and contain only a few feet of clean coal. Hence the Ashford Seam is the only economic seam in the Colliery area.

The Coal Measures are markedly reduced in thickness and consequently in width north of DDH 6 as they are followed northwards towards the Severn River. In this locality the river formerly cut a lateral terrace into the Coal Measures and left them covered with unconsolidated gravel.

Sheepskin Gully area.

Sheepskin Gully area adjoins the Colliery area on the south and appears to be partly separated from it by a ridge in the Carboniferous basement which offsets the eastern boundary of the Coal Measures.

The unconformable junction between Carboniferous and Permian is exposed in the gully. Numerous outcrops of Permian conglomerate were observed in the area, but generally exposures are poor and the greater part of the section is masked by alluvium, which forms a continuous blanket across the southern end of the area.

The basal conglomerates in this area are much coarser in texture than those occupying the corresponding position near the coal mine and presumably represent an accumulation of coarse sediment which did not extend north of the ridge dividing the areas.

The possibility that the supposed divide between two basins is a cross-fault is not entertained very seriously, but should not, perhaps, be entirely disregarded.

Shallow pits were sunk through the alluvium in the bed of Sheepskin Gully in a search for a continuation of the Ashford Seam, but they uncovered horizons that appear to be stratigraphically above the probable coal horizon.

A number of traverses were made across the likely extension of this area as far south as about two miles south of Ashford, but no Permian sedimentary beds were found in the areas not covered by wash and alluvium. Interpolation indicates that no appreciable body of the Coal Measures exists between a point about half a mile south of Sheepskin Gully and two miles south of Ashford.

A minor occurrence of Permian conglomerate is reported by Hanlon (1947b, p29) at a point three miles south of Ashford, but this outcrop has not been examined by the writers.

ARTHUR'S SEAT (See Plate 5).

In the Parish of Arthur's Seat, Permian rocks, consisting of alternating beds of shale, conglomerate, and sandstone with carbonaceous bands, occupy the flat floor of a valley which is about 2 miles long from north to south and ranges in width from 500 yards near the northern extremity to 1200 yards towards the south. The Permian beds for the most part are masked by a thick mantle of alluvium with a maximum known thickness of 37 feet, but are exposed in the stream channels and at a few places where harder beds crop out through the alluvium

The longer axis of the valley is parallel to and about 1 mile west of the main road between Ashford and Inverell. Access to the valley may be gained by an indistinct track which branches from the main road at a small creek-crossing 28 miles north of Inverell.

Near the northern end of the valley - which is better described as an elongated basin with the eastern rim of low hills breached by two narrow superimposed gorges - the Coal Measures and their contact with the older rocks in each flank of the valley are concealed by alluvium except for one good exposure of conglomerate and sandstone in a creek bed in Portion 55. On the north-west the Permian beds are bounded by silicified Carboniferous rocks which have been intruded by granite. This boundary presents a similar appearance to the western boundary of the Coal Measures at Ashford colliery, with the small difference that at Arthur's Seat a wider zone of Carboniferous chert and quartzite is interposed between the granite and the Coal Measures. This concealed boundary is considered to be a southward continuation of the Severn Fault. The straight and presumably faulted contact may be followed south into Portion 59, where the fault dies away in an area of confused dips and strikes and culminates in a sharp syncline pitching to the north-north-west.

Along the eastern boundary the Coal Measures unconformably overlie Carboniferous tuffs and siltstones. Towards the southern end of the eastern boundary the Permian beds swing sharply to the west and the dip steepens from about 20° west to 30° or 40° north.

Good exposures in the channel of Nine Mile Creek for 560 feet from the base of the Coal Measures across the strike represent a thickness of about 260 feet. The base of this section is occupied by a boulder conglomerate of sharp stones derived from silicified Carboniferous tuff and quartzite, and the remainder of the exposed section contains bands of grey and black carbonaceous shale intercalated with conglomerate and overlain by two narrowly separated beds of sandstone containing plant fragments. This pair of sandstone beds and one conglomerate horizon characterized by very angular cobbles serve as useful markers. No reliable outcrops stratigraphically above the sandstone beds were found and attempts to map the confused and reversed structures on the line of the western boundary fault were not pursued.

No coal outcrops were observed anywhere in the area and it was decided to test the concealed beds lying stratigraphically above the marker beds by percussion bores. Three bores were sunk in the positions shown on Plate 5. All bores penetrated grey shale with a few carbonaceous bands and minor intercalations of soft pebble-conglomerate similar to that at Ashford, but no coal was cut and the investigation of the area was abandoned.

Unexpected difficulties were encountered in drilling these holes: otherwise they would have been sunk to greater depths; but it is considered that the bore sections and natural outcrops together reveal a considerable thickness, totalling about 1,000 feet, of the less disturbed part of the Coal Measures, and that the possibility of a body of coal of economic importance remaining undiscovered is fairly remote.

ARRAWATTA.

A coal seam reported to be 10 ft. thick and dipping west at 55° to 60° is known to occur in the bed of MacIntyre River at Arrawatta, 10 miles by road north of Inverell (Booker, 1941). The coal seam is visible only in times of severe drought when the level in the water-hole in which it outcrops has fallen considerably, long after the river has ceased to run. The coal is overlain by conglomerate and sandy shale which form low river cliffs rising nearly vertically from the water.

To the west the Arrawatta Coal Measures terminate against granite along a boundary trending north similar to that at Ashford, and at Arthur's Seat.

BYRON.

It was reported in 1909 that coal or lignite had been found under basalt at Jessie's Gully, Parish of Byron, and that Permian rocks similar to members of the Ashford Coal Measures were exposed in the bank of the MacIntyre River near Byron town-site.

As the two sites mentioned are close to Parish's bauxite deposit, an examination of the area, supplemented by percussion boring, was undertaken by the Aluminium Commission in 1948.

Lignitic clay underlying weathered basalt was found in three bores sunk, thus confirming the reported discovery at Jessie's Gully in 1909, and it was demonstrated that the conglomerate exposed in the river at Byron, and associated clays, overlie laterite and consequently must be younger than early Tertiary.

Samples of the lignitic clay were submitted to Miss I. Crespin who identified fragments of diatoms and suggested that the age was probably lower Pliocene.

Boring and mapping at Byron in the vicinity of Lot 60 showed the following section above the Carboniferous bedrock:

	Depth from Surface feet	
Recent	0 - 2	Black Soil
Pliocene	2 - 8	Weathered basalt; black and grey clay.
	8 - 14	Sandy clay.
	14 - 20	Loosely cemented gravel with sand and clay.
	20 - 27	Lignitic clay.
	27 - 30	Finely banded lignitic clay.
	30 - 31.5	Compact grey clay.
	31.5 - 35+	Serpentinized basalt.
Middle to Lower Tertiary	?	Laterite (bauxite) passing to kaolinized and fresh basalt.
Carboniferous	?	Chert.

As soon as this section was established drilling was stopped and the investigation of the area abandoned.

DRILLING PROCEDURE

Two drilling programmes have been conducted on the coal deposits in the vicinity of the Severn River. The first of these was carried out in about 1944 by a Mr. White, who then held the mining rights. The second was carried out during 1949-50 by the Bureau of Mineral Resources, Geology and Geophysics.

The 1944 programme consisted of nine percussion holes sunk to locate the concealed outcrop of the Ashford Seam at a relatively shallow depth. Bore sites were selected by trial and error on four lines, A, B, C, and D, laid in a westerly direction from points just west of the surmised position of the unconformity. The southernmost line, A, was located at 2,400 feet south of the old mine, and line D, the most northerly, lay 1,500 feet north of the mine.

Coal was encountered in one hole of each line and a seam thickness of from 21 feet to 34 feet was reported.

This programme was not conducted under technical supervision and the results should be treated with reserve, owing to the difficulty of distinguishing between coal and carbonaceous shale in the fine cuttings recovered by the percussion method.

The programme carried out by the Bureau consisted of the drilling of fifteen holes. Of these, ten were drilled entirely by a diamond drill (DDH 1-6, and 7a-7d), three were started by a percussion drill and finished by the diamond drill (DDH 7, 8, and 9) and two holes were drilled entirely by the percussion drill (DH 10, and Spring Creek Hole No. 1).

The diamond-drilling programme was carried out by Messrs. J. MacD. Royle Pty. Ltd., under contract to the Department of Supply and Development. The contractors used a Sullivan drill with a 10 ft. core barrel and "NX" diamond bits (2-1/8 in. diameter core). The drilling rate was approximately 15 feet per day of one shift.

A hidden old river channel was encountered between DDH 6 and the Severn River. The uncemented gravel in this channel made diamond drilling impracticable and it was in this area that percussion drilling was used to start the holes, which were then completed by diamond drilling.

Core recovery from coal was extremely poor owing to the broken state and friable nature of the coal, which has been disturbed and crushed in places, as for example at the overthrust encountered in the colliery workings.

Much of the coal raised in the core barrel consisted of angular fragments, and whole pieces of cylindrical core with greater length than 2 or 3 inches were uncommon. The average core recovery was less than 50 percent, and in some bores much less. The coal core recovered from DDH 2 was only about 9 feet from a total length of 42 feet; DDH 6 yielded no coal core from a seam thickness of 7 feet; and in DDH 9, where the seam is much disturbed and probably thickened by overthrusting, the top 6 feet of a total of 59 feet of coal cored well, only shattered fragments of soft and slickensided coal were recovered from the next 20 feet, and no core at all was obtained from the remaining 33 feet.

Attempts to improve core recovery in coal were not successful. Different drilling speeds and a double-tube core barrel were tried with no appreciable improvement in core recovery.

All holes were vertical, and consequently intersected the coal seam at an angle of about 30°. The drill foreman was of opinion that angle drilling normal to the plane of the seam might have given better recovery.

All ten holes that entered the Coal Measures drilled through the Ashford Seam. DDH 1, 7, and 8 were carried through to the Carboniferous basement and indicated that no coal seam of importance lies beneath the Ashford Seam.

The two holes at Byron and three at Arthur's Seat were bored in 1947 by the Australian Aluminium Production Commission using two Goldfields percussion rigs drilling with drive pumps and without jars. For reasons beyond control in the field chisel bits could not be used, and although the drive pumps had been used with fair success to bore through thicknesses of a few feet of fresh basalt, they proved inadequate to deal with the hard - but relatively softer - shales at Arthur's Seat. Rapid wear of the cutting shoes is attributed to the abrasive action of quartz grains held in a tough argillaceous matrix.

COAL RESERVES

"Indicated Reserves" * of 4,860,000 tons have been established by the Bureau's drilling programme in the area between DDH 5 and the Severn River. A detailed statement of the location of these reserves appear in Table 1 below:

Table 1

Location of Indicated Coal Reserves

Central Area

Area between	Reserves † long tons
DDH 5 and DDH 4	150,000
DDH 4 and DDH 3	480,000
DDH 3 and DDH 1	660,000
DDH 1 and DDH 2	1,020,000
DDH 2 and DDH 6	590,000
DDH 6 and DDH 8	360,000
DDH 8 and DDH 7	380,000
DDH 7 and DH 10	280,000
DH 10 and DDH 9	470,000
DDH 9 and Severn River ‡	470,000
TOTAL	4,860,000

† Calculated on basis of 1,600 tons of coal per acre per foot.
‡ Assuming same average seam thickness as between DH 10 and DDH 9 and not allowing for erosion beneath old river gravels.

* *(FOOTNOTE): "Indicated Reserves" are reserves for which tonnage and grade are computed partly from specific measurements, samples, or production data, and partly from projection for reasonable distance on geological evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade to be established throughout.*

For the purpose of calculating reserves the Severn Fault has been regarded as vertical. If, however, the fault is overthrust from the west, then the angle of dip of the fault will have some bearing on the question of reserves. By studying Section H-J an approximation of the percentage increases in reserves for certain dips on the fault may be computed: these increases are shown in Table 2.

Table 2

Percentage increase in reserves for certain angles of dip of fault.

Westerly Dip of Fault	Percentage increase	Maximum Depth of Reserves below Surface
80 degrees	10	400 feet
71 degrees	20	450 feet
65 degrees	30	500 feet
56 degrees	50	550 feet

Thus if the fault dips at 56 degrees between DDH 1 and DDH 5 an additional 600,000 tons of coal lie in that section of the Coal Measures. The additional reserves postulated in this table are problematical and depend upon constancy of dip of the coal seam.

It is doubtful if additional reserves of coal exist in the Sheepskin Gully area. The results in DDH 5, the variation in sedimentation south of the probable ridge in the basement, and the absence of any outcrop of coal in this area, are not promising signs. On the other hand, none of these factors is strong enough to prove the absence of coal. In the circumstances it would be advisable eventually to diamond-drill the area. If this course is contemplated the first hole should be drilled on a site approximately 500 feet west of the Permian-Carboniferous contact where it is exposed in Sheepskin Gully.

Most of the area between the Severn River and Portion 9, Parish of Myall, is covered with a thick alluvial blanket. Little is known of the Coal Measures except that if they are present they occupy only a very narrow strip. Hence little coal could be expected from them.

From the results of the Spring Creek Bore No. 1 and observations made nearby and at Spring Creek the prospects of finding large economic reserves in this area are not good. However, the Spring Creek Bore No. 1 is about 1½ miles from Spring Creek and some of the concealed intervening Measures in the vicinity of the Mandoe Road may contain the seam in a workable thickness. Hence scout drilling along the eastern edge of these Measures to cut the coal at about sixty feet is worth considering.

RECOMMENDATIONS

The investigations of the Ashford Coalfield have now proved sufficient reserves of high-grade coal to permit development of the field on a moderate scale.

No attempt should be made to mine the coal by open-cut methods in the vicinity of the Severn River before sinking at least two shafts to examine the condition of the seam there,

and before drilling a grid of scout holes to prove continuity of its thickness. Some investigation of the probable movement of water from the river through the gravels to the future opencut would also be advisable.

If a suitable opportunity arises the gravity survey should be extended southwards into the Sheepskin Gully area for at least one mile or until the gravity profiles indicate the absence of coal.

The thinning of the Ashford Seam in the vicinity of DDH 6 is pronounced. In view of the fact that no core was recovered in this hole, any mining development in this area should be preceded by two diamond drill holes sunk to hit the Ashford Seam about 70 feet below the surface.

As the need for further reserves arises drilling could be carried out in the Sheepskin Gully and Spring Creek areas. The dip of the fault in the vicinity of Ashford DDH 3 will have a bearing on the coal reserves in the most important area. Therefore it is suggested that, if further diamond drilling is being done in the future, a vertical drill hole be sunk at a point measured 65 feet west from and at right angles to the Severn Fault near DDH 3. This would necessitate location of the actual fault-line by means of a short shallow costean. If this drill-hole does not intersect the fault-zone above 300 feet the increase in reserves due to the dip of the fault would be less than 12 percent. An alternative to this would be to sink an angle hole dipping east. To correct any appreciable error in this work such a hole should be checked by bore-hole survey.

At the moment insufficient is known about the Arrawatta occurrence to warrant drilling to find extensions of the Arrawatta Seam; but it is possible that local private boring for water may be done in the future. In view of the importance to Inverell of the discovery of workable coal in this area the logs of all bores sunk in the eastern part of the Parish of Champagne, the western side of the Parish of Burgundy, or the Parish of Bukkulla, should be kept carefully, and any carbonaceous material recovered from the holes should be sent to the Geological Survey for examination.

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PART II - GEOPHYSICAL SURVEY

by L.W. WILLIAMS

INTRODUCTION

The geophysical survey of the Ashford coalfield was part of an investigation carried out by the Bureau of Mineral Resources with a view to estimating the coal reserves of the field. In order to estimate the reserves it was necessary to determine the thickness of the seam - which was done by drilling - and the limits of the coal measures. Over a considerable part of the area, however, these limits could not be determined by geological mapping because the coal measures and other rocks were obscured by a thick mantle of alluvium. The geophysical survey was therefore conducted to outline the area occupied by the coal measures and to provide guidance in the selection of sites for drilling.

The gravity method was used because the coal measures are less dense than the neighbouring rocks and consequently the gravitational attraction over them is relatively low. The method has been used successfully for this purpose in other areas in Australia - for example, at Collie, Western Australia (Chamberlain, 1947). The area is one of low relief, is sparsely timbered, and can easily be traversed by motor vehicles. No difficulties were therefore experienced in carrying out the gravity observations.

The magnetic method was also tried as a means of delineating the geological contacts, but after being used on several traverses without giving useful results it was abandoned.

DDH 1 to 5 and the geological mapping of the southern part of the area were completed before the geophysical results had been analysed and the information so obtained provided a basis for the geophysical interpretation. The geophysical results, however, provided useful information on the approximate position of the geological contacts on the remainder of the area and also in the selection of sites for the subsequent drill holes (DDH 7 to 10).

The survey was carried out by the author, assisted by I.A. Bunbury, between early June and mid-September, 1949. An area 11,500 feet long and 2,000 feet wide was surveyed.

The assistance of members and staff of the North West County Council, which held a lease over portion of the area surveyed, is gratefully acknowledged.

GEOLOGY

The geology of the area is described in detail in Part 1 of this report and shown on Plate 3. Only those features which have a direct bearing on the geophysical results will be described here.

The Permian coal measures occur in a narrow belt limited on the east by Carboniferous rocks which underlie them unconformably. They dip at approximately 30° to the west, where they terminate against a fault. Along most of the length of the fault surveyed, the Permian rocks are in contact with granite, but in places they are in contact with Carboniferous rocks which form a

thin wedge between them and the granite. The dip of the fault is not known except at DDH 6, which was drilled after the geophysical work had begun. This hole, sunk vertically at 2800N:070W , started in granite near the fault contact and entered the coal measures at 70 feet below the surface, showing that the contact at this place probably has a very steep dip to the west and is a reverse fault. The geophysical results provide evidence that between 00 and 2000N the granite is overthrust at a much lower angle than at DDH 6.

GRAVITY SURVEY

Outline of Survey.

Gravity stations were established every 200 feet along traverses 400 feet apart and laid out approximately normal to the unconformable contact between the Carboniferous and Permian beds on the eastern side of the field. The gravimeter used was a Heiland type GSC2 capable of an accuracy of better than ±0.05 milligal, or ± one twenty-millionth part of the total gravitational force. This accuracy was necessary because the maximum anomaly over the coal measures was 0.7 milligal; the average anomaly was much smaller.

The observed gravity values were corrected for latitude and elevation; the country was sufficiently regular to make any correction for terrain unnecessary.

Determination of Elevation Correction Factor.

Difficulty was experienced in arriving at the best value for the elevation correction factor. Three methods were used in an attempt to determine this value :

(i) Densities of the various rock-types were determined by direct measurement, giving the following results -

Granite	-	2.60 gm/cc
Carboniferous	-	2.60 gm/cc
Permian	-	2.55 gm/cc

(ii) A density profile was observed on the Carboniferous rocks and gave a density of 2.60 gm/cc; a profile observed on the granite gave 2.80 gm/cc.

(iii) A graphical method was also used. The gravity value at each station, corrected for latitude and an approximate regional effect but not for elevation, was plotted against the elevation of the station. Except for observations made on the coal measures, all points were close to a straight line, the slope of which was taken as the elevation correction factor. This method gave a factor of 0.061, which corresponds to an average density of 2.59 gm/cc.

An elevation correction factor of 0.061 mgl./ft. was finally adopted as being the most probable value.

RESULTS AND INTERPRETATION

The observed gravity values, corrected for latitude and elevation (Bouguer anomalies), were used to compile a gravity-contour plan (Plate 6). The plan shows a series of gravity lows extending in a north-north-easterly direction throughout the area. The contour plan reveals also the presence of a marked regional effect for which allowance had to be made.

Regional Effect.

The presence of a large regional effect is apparent from a consideration of the variation of the gravity values over the granite on the western side and the Carboniferous rocks on the eastern side of the area; gravity values over the granite range from 6.2 milligals at the southern end of the area to 4.3 milligals at the northern end, and values over the Carboniferous rocks range from 6.4 milligals in the south to 5.0 milligals in the north.

That a linear regional correction is not applicable is evident when the spacing and trend of the contour lines over the granite and the Carboniferous rocks are considered; the spacing of the contours is not uniform and the contours do not follow a uniform direction. For example, over the granite the contours are closely spaced from 6.2 to 5.9 milligals; the spacing then increases considerably until the 5.4 contour is reached, decreases until 4.6, and then increases until 4.3 is reached. Lack of uniformity of spacing is also noticeable over the Carboniferous rocks. The variation in direction of the contours is illustrated by the 5.2 and 5.6 milligal contours. The 5.2 contour starts at approximately 3200N on the west and finishes at 6400N on the east, whereas the 5.6 contour starts and finishes at 2400N.

Since a linear correction could not be applied, the regional pattern was obtained by smoothing the gravity profiles (Plate 7). The profile of observed gravity was plotted for each traverse, and these profiles were smoothed by comparing them with curves calculated for known geological sections and by comparing successive profiles throughout the area.

Effect due to Coal.

The difference between the smoothed and observed profiles gave a residual anomaly made up of four areas of low gravity, as shown on the residual gravity contour plan (Plate 8). Of these four areas of low gravity, the most southerly is fairly large, the next two are smaller, and the most northerly is of intermediate size and has the steepest gradients in the area.

The residual anomaly was also plotted in the form of profiles (Plate 7). It can be seen that the gravity profiles in the southern part of the area differ in character from those in the north. In the south the profiles have a very steep gradient on the east near the Carboniferous-Permian contact and a lower gradient towards the west, whereas in the northern part of the area the gradient on the east is less steep and the profiles are therefore much more symmetrical.

As a guide in interpretation it was desirable to have some idea of the amount of anomaly that could be attributed to the presence of the coal seam. An indication of this amount was obtained in the following way. For a given dip and thickness of seam and given width between outcrop of coal and fault, the amount of coal, and consequently the amount of anomaly due to the coal, depends on the angle of dip of the fault that forms the Permian contact with the granite. For a section with the Coal Measures 800 feet wide at the surface and the fault vertical, the anomaly calculated for a 30-foot coal seam dipping at 30° is 0.45 milligal, assuming

a density contrast of 1.15 mg/cc. Hence it appears that most of the residual anomaly, which has a maximum value in the vicinity of DDH 1 of 0.55 milligal, is due to the coal seam and that the remainder of the anomaly is due to associated carbonaceous shale and other Permian sediments. It is therefore considered that the four areas of low gravity represent areas of thickening of the coal seam and that the very steep gravity gradient on the east, particularly in the southern part of the area, is caused by the coal's being covered by a thin layer of overburden and therefore terminating close to the surface. Subsequent testing has confirmed this interpretation.

Delineation of Geological Contacts.

By comparing profiles across the residual anomaly with curves calculated for known geological sections, it was possible to determine the approximate position of the Carboniferous-Permian contact on the east and of the granite-Permian contact on the west. An examination of curves calculated for assumed geological sections (Plate 9) shows that there is a sharp decrease in gravity as the section passes from Carboniferous to Permian rocks and also that this decrease begins above the Carboniferous-Permian contact. The observed profiles were smoothed so that the residual gravity value where the sharp decrease in gravity began was zero, and the zero residual gravity contour-line on the eastern side was taken to represent the Carboniferous-Permian contact. The position determined for the contact in this way agrees very well with the position of the contact where known from geological mapping.

The position of the granite-Permian contact occurs at a point of inflection of the calculated curves and it was possible to delineate this contact in the same way. However, in places other small gravity effects were present and these produced slight alterations in the shape of the profiles, so making it difficult to recognize the point of inflection; therefore the position determined for the contact at these places is probably not very reliable.

Evidence of Nature of Faulting.

Curves calculated for the three possible types of granite-Permian contact - normal, vertical, and reversed faulting - show that the gravity gradient at the western ends of the profiles depends on the angle of dip of the contact, the gradient being lowest where there is overthrusting of the granite. The manner in which the gravity contours open out to the west between traverses 00 and 2000N suggests that overthrusting of the granite has occurred in this part of the area; the contours give no such indication of overthrusting farther north. However, as stated earlier DDH 6 indicated that at 2800N the contact is a reversed fault which probably has a very steep westerly dip. It should be noted, however, that the gravity gradient would remain substantially the same for steep dips ranging from, say, 80° east to 80° west and that the flattening of the gradient between 00 and 2000N most probably corresponds to a dip comparable with or perhaps slightly less than that shown in the calculated section, i.e., 60° to the west.

TESTING

The results of the survey have been tested by the drilling programme which is described in detail in Part 1 of this report. The testing has shown that the geophysical predictions were substantially correct. The contact between the coal measures and granite was determined by DDH 6 and by the line of DDH 7, 7b, 7c, and 7d, which straddled the contact. Its position so fixed agrees well with the position predicted from results of the gravity survey.

It was shown that the gravity anomaly is due largely to the coal and that the containing measures produce only a minor effect. This conclusion was confirmed by the drilling results. DDH 1, 2, 3, 4, and 5, which had been drilled before the survey commenced, proved an average true thickness of 23 feet of coal in the Ashford Seam. The two northerly areas of low gravity were tested by DDH 7 and 9 which intersected, respectively, 30 feet and 51 feet of coal. DDH 6 and 10 are situated in areas where the gravity anomaly is weak and they showed corresponding small thicknesses of coal - 6 and 9 feet respectively.

The thickness of the coal seam revealed by DDH 8 - 20 feet - is not consistent with the very small anomaly on traverse 4000N and it seems likely that the drill penetrated either a small local thickening of the seam, or a place where the thickness was apparently greater due to repetition by faulting.

CONCLUSION

The object of the geophysical survey was to define the eastern and western boundaries of the coal measures and to trace their extension to the north under cover of alluvial deposits. This object was achieved with reasonable accuracy, and further evidence was obtained that overthrusting of the granite occurs in the southern part of the area. There appears to be scope for extensions of the survey both to the north and south of the area investigated.

Reference :

CHAMBERLAIN, N.G., 1947 - Geophysical Survey of the Collie Coal Basin. Bur. Min. Resour. Aust. - Rep. 1.

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APPENDIX I.

An effort has been made to bring together in this appendix as many as possible of the known analyses of Ashford coal. Thus the appendix records analyses of samples collected by officers of the Geological Survey of N.S.W. and the Joint Coal Board as well as the results of examination of bore samples obtained during the recent drilling campaign.

As diamond drill core recovery of coal was rarely more than 50 percent and generally about 40 percent, the analyses of core samples do not represent the composition of the entire seam. Most of the core recovered came from the highest and lowest few feet of the seam where the coal was hard, and relatively little of the softer central zone of the seam was recovered as core.

In the summary to this report it is mentioned that although most of the coal won from the Ashford colliery was used successfully for making metallurgical coke, tests of core samples of coal gave poor coking results. This apparent anomaly is explained in the following extracts quoted from "The Coke Industry of New South Wales" (Harper, 1916).

> "The following information was supplied by Mr. Edgar Hall, Manager of the Silver Spur Mining Co. N.L., Queensland.
>
> > *' Run of mine coal was used for coking - but the workings were confined to the soft seams of coal, which are high in ash. There are six beehive ovens, 12 feet in diameter and 7 feet 6 inches high inside, the weight of charge being 6 tons, the burning period 48 hours, and the output 2 tons per diem.*
> >
> > *The coke made was used in a 100-ton lead blast-furnace, bearing a heavy charge and tall column,and producing a high heat.'* "

Analyses distinguished by the letter J.C.B. or N.T.C. were carried out by the Joint Coal Board or the Newcastle Technical College. All other analyses have been made by the New South Wales Department of Mines. Analyses by the Joint Coal Board are of coal samples collected by officers of the Board.

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ASHFORD COALFIELD

COAL ANALYSES

LOCATION	YEAR & LABORATORY REFERENCE NO.	HYGROSCOPIC MOISTURE %	VOLATILE MATTER %	FIXED CARBON %	ASH %	COKE * NATURE	ASH COLOUR	SULPHUR %	B Th U /LB.	REMARKS
Arrawatta		4.02	10.14	70.80	15.04	Nn	Buff			Arrawatta Seam
Severn R.	1884	1.40	20.50	71.94	6.16			0.52		From a block of coal in river near Frasers Ck. H.S.
Shaft by Coal Gully, Ashford.										Probably the eastern air shaft of Ashford Colliery. Section (Pittman 1898).
A	1895/4362	0.65	22.15	71.65	5.55			0.48		(A) Hard Coal, slightly coked 2'6" Shale Band 0'2½" Hard Coal, slightly coked 0'6"
B	1895/4361	0.55	24.65	67.80	7.00			0.357		(B) Rather friable Coal 0'6" Band 0'1" Splint Coal 0'9" Shaly Coal 1'6"
C	1895/4360	0.75	23.25	68.90	7.10			0.357		(C) Splint Coal 1'5" Coal and Shales 0'9"
D	1895/4359	0.90	21.55	67.50	10.05			0.453		(D) Slickensided Anthracitic Coal 1'9"
										9'11½"
Stokes Seam Ashford. "Upper 2 feet"	1898/1928	0.91	17.18	69.08	12.83	Cm	Reddish tinge, granular	0.590	Cals. 12.43	
"Lower 2 feet"	1898/1929	1.28	11.44	33.10	54.18	Nn	Greyish tinge, granular	-	-	
Main Heading Ashford Colliery	1945/1514	1.7	22.6	65.9	9.8				13,360	Ashford Seam

LOCATION	YEAR AND REFERENCE NO.	HYGROSCOPIC MOISTURE %	VOLATILE MATTER %	FIXED CARBON %	ASH %	COKE * NATURE	ASH COLOUR	SULPHUR %	B Th U /LB.	REMARKS
Ashford Colliery (Bulk Sample)	1945/NTC	1.12	23.80	64.58	10.50				13,080*	* Dry Basis Ashford Seam
Ashford DDH 1.										
341' - 350'	1949/999	0.7	23.6	66.5	9.2	Cm	Pink	0.6	13,970	Ashford Seam
350' - 356'	1949/1000	0.7	23.5	66.5	9.3	Cw	Pink	0.5	13,970	Ashford Seam
356' - 357'	1949/1001	0.6	23.4	70.0	6.0	Cw	Pink	0.5	14,480	Ashford Seam
357' - 358'	1949/1002	0.6	23.0	66.1	10.3	Cw	Pink	0.6	13,830	Ashford Seam
358' - ?	1949/1003	0.6	22.5	68.9	8.0	Cw	Pink	0.6	14,160	Ashford Seam
3 ? - 370'6"	1949/1004	0.7	22.2	68.6	8.5	Cw	Pink	0.7	14,000	Ashford Seam
370'6" - 375'	1949/1005	0.7	18.5	47.2	33.6	Af	Pink	0.5	10,050	Ashford Seam
Ashford DDH 2.										
165' - 165'6"	1949/1414	1.0	19.8	57.5	21.7	Af	Pink		11,870	Bonshaw Seam
173'6" - 174'3"	1949/1415	0.9	25.2	58.3	15.6	Cm	Pink		12,770	Bonshaw Seam
308' - 312'	1949/1416	1.0	23.8	66.2	9.0	Cw	Buff		13,860	Ashford Seam
312' - 320'	1949/1417	0.9	24.5	66.6	8.0	Cm	Brown		14,070	Ashford Seam
320' - 333'8"	1949/1418	1.0	23.5	68.3	7.2	Cw	Pink		14,120	Ashford Seam
333'8" - 334'6"	1949/1419	1.1	24.2	69.7	5.0	Cm	Cream		14,450	Ashford Seam
334'6" - 340'6"	1949/1420	1.2	22.6	70.1	6.1	Cm	Buff		14,240	Ashford Seam
340'6" - 350'	1949/1421	1.2	20.7	67.0	11.1	Af	Pink		13,360	Ashford Seam
350' - 355'	1949/1422	1.2	19.6	47.3	31.9	Nn	Pink		9,830	Ashford Seam
355' - 357'	1949/1423	1.0	19.7	54.0	25.3	Aw	Pink		10,780	Ashford Seam
Ashford DDH 3.										
311' - 313'	1949/1622	0.8	24.8	65.2	9.2	Cw	Pink		13,710	Ashford Seam
313' - 315'	1949/1623	0.8	24.5	65.2	9.5	Cw	Pink		13,710	Ashford Seam
315' - 318'	1949/1624	0.9	23.3	69.5	6.3	Cw	Pink		14,270	Ashford Seam
318' - 320'	1949/1625	0.7	25.4	62.7	11.2	Cw	Pink		13,470	Ashford Seam
320' - 322'	1949/1626	0.7	24.6	60.5	14.2	Cw	Pink		13,020	Ashford Seam
322' - 323'8"	1949/1627	0.8	23.5	70.0	5.7	Cw	Pink		14,450	Ashford Seam
323'8" - 326'	1949/1628	0.7	23.2	69.3	6.8	Cw	Pink		14,340	Ashford Seam
326' - 328'	1949/1629	0.9	22.6	68.9	7.6	Cw	Pink		14,150	Ashford Seam
328' - 331'2"	1949/1630	1.1	17.5	31.4	50.0	Nn	Pink		14,150	Ashford Seam
Ashford DDH 4.										
218' - 222' (i) Top †	1949/2049	0.9	23.2	65.4	10.5	Cw	Pink		13,560	Ashford Seam
218' - 222' (ii)	1949/2050	0.9	24.2	66.3	8.6	Cw	Pink		13,820	Ashford Seam
218' - 222' (iii)	1949/2051	1.0	23.0	68.1	7.9	Cw	Pink		13,900	Ashford Seam
218' - 222' (iv) Base	1949/2052	1.1	21.9	66.1	10.9	Cw	Pink		13,440	Ashford Seam
227' - 229'	1949/2053	1.0	23.1	67.4	8.5	Cw	Pink		13,810	Ashford Seam

DDH 4, continued next page.

LOCATION	YEAR AND REFERENCE NO.	HYGROSCOPIC MOISTURE %	VOLATILE MATTER %	FIXED CARBON %	ASH %	COKE * NATURE	ASH COLOUR	SULPHUR %	B Th U /LB.	REMARKS
Ashford DDH 4. (Cont'd).										
229' - 237'	1949/2054	0.9	21.3	60.2	17.6	Cw	Pink		12,440	Ashford Seam
242'3" - 242'9"	1949/2055	0.9	20.6	63.9	14.6	Cw	Pink		12,920	Ashford Seam
Ashford DDH 5										
37' - 39'7"	1949/2056	1.8	24.7	63.2	10.3	Cw	Pink		13,240	Ashford Seam
39'7" - 50'	1949/2057	1.1	21.5	53.9	23.5	Cw	Pink		11,200	Ashford Seam
50' - 51'	1949/2058	1.2	19.6	42.8	36.4	Cw	Pink		9,150	Ashford Seam
Ashford DDH 6.	NO CORE RECOVERED FOR ANALYSIS.									
Ashford DDH 7.										
Coal.										
120'9" - 130'	1950/647	1.8	22.1	62.3	13.8	Af	Brown	0.5	12,710	Ashford Seam
130' - 134'	1950/648	1.8	20.7	54.7	22.8	Af	Brown	0.4	11,210	Ashford Seam
134' - 140'	1950/649	1.8	20.3	58.7	19.2	Af	Brown	0.4	11,710	Ashford Seam
140' - 143'	1950/650	1.4	18.7	48.9	31.0	Af	Pink	0.4	9,940	Ashford Seam
143' - 146'	1950/651	1.7	14.7	29.1	54.5	Nc	Pink			Ashford Seam
146' - 150'	1950/652	1.5	9.1	43.3	46.1	Nn	Pink			Ashford Seam
150' - 155'4"	1950/653	1.6	6.8	56.0	35.6	Nn	Pink			Ashford Seam
Cuttings.										
120'9" - 124'	1950/654	1.6	14.0	24.6	59.8	Nc	Pink			Ashford Seam
124' - 129'	1950/655	1.2	17.1	42.0	39.7	Af	Pink			Ashford Seam
129' - 135'	1950/656	1.2	21.6	45.8	31.4	Cm	Pink		10,110	Ashford Seam
135' - 138'	1950/657	1.2	23.2	50.8	24.8	Cm	Pink		11,080	Ashford Seam
138' - 142'	1950/658	1.3	18.1	34.3	46.3	Af	Pink			Ashford Seam
142' - 146'	1950/659	1.3	16.7	27.9	54.1	Aw	Pink			Ashford Seam
146' - 150'	1950/660	1.4	14.6	25.8	58.2	Aw	Pink			Ashford Seam
150' - 155'	1950/661	1.7	10.0	30.5	57.8	Nn	Pink			Ashford Seam
Ashford DDH 8.										
Coal.										
182'6" - 190'	1950/662	1.0	21.4	52.4	25.2	Af	Pink		11,070	
190' - 198'6"	1950/663	1.0	22.8	51.1	25.1	Cm	Pink		11,080	
206' - 207'	1950/664	1.3	8.1	37.3	53.3	Nn	Pink			
Cuttings										
182'6" - 185'	1950/665	1.1	15.6	24.1	59.2	Aw	Brown			
185' - 188'	1950/666	1.2	15.4	28.5	54.9	Aw	Pink			
188'-190'	1950/667	1.0	17.5	39.3	42.2	Af	Pink			
190' - 193'	1950/668	1.2	15.1	26.5	57.2	Aw	Pink			

DDH 8, continued next page.

LOCATION	YEAR AND REFERENCE NO.	HYGROSCOPIC MOISTURE %	VOLATILE MATTER %	FIXED CARBON %	ASH %	COKE * NATURE	ASH COLOUR	SULPHUR %	B Th U /LB.	REMARKS
Ashford DDH 8. (Cont'd).										
Cuttings Cont'd.										
193' - 196'	1950/669	1.0	17.5	38.1	43.4	Af	Pink			
196' - 198'6"	1950/670	1.1	16.9	34.8	47.2	Af	Pink			
199'9" - 203'	1950/671	1.1	15.7	37.6	45.6	Aw	Pink			
203' - 205'	1950/672	1.1	19.0	53.0	26.9	Af	Brown		10,780	
205' - 207'	1950/673	1.1	15.7	30.1	53.1	Aw	Brown			
Coal Froth.										
Various depths	1950/674	1.1	24.3	55.0	19.6	Cm	Brown		12,080	
Ashford DDH 9.										
Coal.										
65' - 69'	1950/675	1.9	14.3	46.2	37.6	Nn	Brown			Ashford Seam
69' - 71'	1950/676	1.1	23.2	51.5	24.2	Af	Brown		11,210	Ashford Seam
71' - 76'	1950/677	1.2	23.6	68.3	6.9	Af	Brown		14,070	Ashford Seam
76' - 80'	1950/678	1.2	21.1	55.0	22.7	Af	Brown		11,360	Ashford Seam
80' - 96'	1950/679	1.0	23.3	65.3	10.4	Cm	Brown		13,640	Ashford Seam
Cuttings.										
70' - 75'	1950/680	1.1	21.1	43.9	33.9	Af	Brown		9,540	Ashford Seam
75' - 80'	1950/681	1.1	23.3	35.4	45.0	Af	Brown			Ashford Seam
85' - 86'	1950/682	1.5	21.1	27.5	55.7	Aw	Brown			Ashford Seam
86' - 92'	1950/683	1.3	18.5	25.5	58.2	Nc	Brown			Ashford Seam
92' - 100'	1950/684	1.2	15.3	38.0	40.7	Af	Brown			Ashford Seam
100' - 106'	1950/685	1.4	15.0	26.2	57.4	Nc	Brown			Ashford Seam
106' - 114'	1950/686	1.4	11.7	15.9	71.0	Nn	Brown			Ashford Seam
114' - 122'	1950/687	1.1	18.9	34.8	45.2	Af	Brown			Ashford Seam
122' - 126'	1950/688	1.5	12.5	14.8	71.2	Nn	Brown			Ashford Seam
126' - 129'	1950/689	1.3	12.1	16.6	70.0	Nn	Brown			Ashford Seam
Ashford DH 10.										
Coal Borings.	1950/1390	1.7	16.6	32.6	49.1	Af	Brown			Ashford Seam
79' - 84'	1950/1391	1.7	18.4	42.3	37.6	Af	Brown			Ashford Seam
84' - 89'	1950/1392	2.0	12.7	16.9	68.4	Nn	Brown			Ashford Seam

LOCATION	YEAR AND REFERENCE NO.	HYGROSCOPIC MOISTURE %	VOLATILE MATTER %	FIXED CARBON %	ASH %	COKE * NATURE	ASH COLOUR	SULPHUR %	B Th U /LB.	REMARKS
Main Heading Ashford Colliery	Roof.									
0' - 3'	Ashford JCB8.	3.27	22.70	60.49	13.45	Aw	Brick Red	0.42	12,125	
3'1" - 5'1"	9.	1.92	21.87	64.07	12.14	Af	Pink	0.52	12,906	
5'1½" - 6'2½"	10.	1.65	22.55	60.38	15.42	Af	Pink	0.73	12,580	
6'2½" - 7'5½"	11.	1.70	22.45	62.05	13.80	Af	Pink	0.67	12,793	
7'5½ - 8'3"	12.	1.35	20.80	54.74	23.11	Cm	Light Pink	0.49	11,396	Samples were cut from an underground face which had been exposed for many, probably 40, years.
8'3" - 9'3"	13.	1.69	23.10	62.19	12.93	Cm	Pink	0.51	12,841	
9'3" - 10'4"	14.	2.03	21.70	59.50	16.77	Cw	Pink	0.52	12,125	
10'4" - 11'9"	15.	1.86	23.80	64.76	9.49	Cm	Dark Pink	0.63	13,509	
11'9" - 15'1"	16.	2.39	24.80	65.98	6.74	Cm	Brick Red	0.60	13,799	
15'1" - 17'	17.	1.91	24.23	65.17	8.69	Cm	Dark Pink	0.48	13,613	
17' - 19'8"	18.	1.51	26.09	65.36	7.04	Cs	Dark Pink	0.41	13,955	
19'8" - 21'	19.	1.52	26.80	66.26	5.42	Cs	Brick Red	0.32	14,380	
21' - 29'10"	20.	1.60	22.35	67.44	8.61	Cm	Brick Red	0.51	13,716	
29'10" - 30'7"	21.	1.40	23.24	61.20	14.16	Cs	Pink	0.44	12,848	
30'7" - 33'9"	22.	1.65	21.69	59.56	17.10	Af	Buff	0.55	12,195	
	Floor.									

* Explanation of coke symbols.

Nn	=	Non-agglomerating, non-coherent.
Nc	=	Non-agglomerating, coherent.
Aw	=	Weakly agglomerating.
Af	=	Firmly agglomerating.
Cw	=	Weak coking.
Cm	=	Medium coking.
Cs	=	Strong coking.

† DDH 4. Core samples from 218 to 222 feet were divided at the laboratory into four samples. The individual sample lengths are not known.

APPENDIX 11.

The following bore logs form a fairly complete record of bores sunk in search of coal in the Ashford Coal Province. It is probable that much private prospecting for coal, of which little or no record exists, has been carried out in the past; for example, a shaft, now inaccessible, was sunk at Arrawatta.

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SUMMARY OF

OF

ASHFORD PERCUSSION DRILLING

BY LEASE-HOLDER WHITE IN 1944.

Ph. McDonald, Co. Arrawatta.

Zero datum approx. 1300 feet. A.S.L.

HOLE	APPROX. R.L.	APPROX. LOCATION ON GRID LAID DOWN BY B.M.R.	THICKNESS OF COAL FEET	BASE OF COAL FEET	BASE OF HOLE FEET
A1	196'	165S)) 538W)	Nil	-	18½
A2	198'	1618S)) 622W)	Nil	-	25½
A3	201'	1570S)) 700W)	21	38	-
B1	213'	623S)) 360W)	Nil	-	30
B2	204'	640S)) 518W)	34	65	?
C1	195'	1383N)) 610E)	Nil	-	12
C2	202'	1432N)) 365E)	Nil	-	22
C3	204'	1440N)) 300E)	29	61	?
D1	198'	2198N)) 410E)	28	70	?

NO. 1. DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, APRIL, 1949.

Ph. McDonald, Co. Arrawatta.

Location (920N
(518W

R.L. of Bore Collar 219 feet.

Datum Level. - Approx. 1500 feet. A.S.L.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil and alluvium	12		12		Thin sandy soil over hard granite wash.
Conglomerate (?)	42	1	30	1	No core retained by driller for inspection.
Shale, grey with black bands	45	3	3	2	Plant remains, streaks of coal and limonite staining. Dips 30° - 40°.
Shale, black to light grey, and thin coal seams.	48	8	3	5	Lustrous coal 46' - 46'4". Limonite staining.
Sandstone, shale, and coarse grit.	50	7	1	11	Dip 25°.
Conglomerate, blue-grey	65	10	15	3	No core.
Sandstone, grey	66	4		6	
Sandstone, grey, and pebbles	68	5	2	1	Dip 30°.
Grit and sandstone	69	6	1	1	Dip 40° at base. Only 5" core recovered.
Conglomerate, grit, and sandstone	74	9	5	3	Poor core recovery between 73'3" and 74'9"
Sandstone, coarse, grey	76	0	1	3	Calcite veins
Conglomerate, blue-grey	84	3	8	3	Dip 30°. Some bands of shale and sandstone and green cherty pebbles in conglomerate.
Conglomerate, blue-grey with sandstone band 86'3" - 86'10"	94	11	10	8	Dips 25° to 35°.
Sandstone and grit	98	2	3	3	Dips 25° - 30°. Narrow band of conglomerate containing large particles coaly matter.

Log of No. 1 Diamond Drill Hole (Cont'd) :

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Conglomerate, blue-grey and blackish	103	3	5	1	Dip 27°. Carbonaceous banding 100'7" to 101'4"
Sandstone and grit	105	5	2	2	
Conglomerate and grit	106	9	1	4	
Sandstone, light grey	107	9	1	-	
Conglomerate, blue-grey, with greenish pebbles, alternating with thin bands of grit	119	5	11	8	Six inches core lost between 107'5" and 111'3"
Conglomerate and sandstone alternating.	122	0	2	7	Dips 31°, 32° and 35°.
COAL	122	4		4	
Shale, black, banded carbonaceous	126	2	3	10	Dip 28°. 3 feet of core lost between 122' and 127'2". Probably carbonaceous shale.
Sandstone, carbonaceous, and light grey banded sandstone	141	4	15	2	Dips 33° and 35°.
Conglomerate, grit and sandstone, alternating	163	6	22	2	Dips 32°, 28°, 30°.
COAL	169	2	1	9	BONSHAW SEAM. With thick shale band.
Shale, black, and black sandstone.	173	0	4	10	Dip 35°.
Sandstone and grit with thin bands fine conglomerate	191	3	18	3	Carbonaceous bands
COAL	191	4		1	Dip 32°.
Grit, blue-grey, and conglomerate	194		2	8	
Shale, black	200	3	6	3	Breccia from 196' to 197'1"
Sandstone, grey, blue-grey grit and fine conglomerate	215		14	9	Few shaly and carbonaceous bands.
Conglomerate, blue-grey	218	3	3	3	
Sandstone	220	11	2	8	
Shale, carbonaceous	230	5	9	6	One inch coal at 22'10". Dips 28° and 32°. 9 in. of core lost between 223'10" and 229'10".
Shale, very dark, banded.	230	8		3	
Sandstone, very fine, banded grey.	244	11	14	3	Dips from 28° to 34°. 30° at base.

Log of No. 1 Diamond Drill Hole (Cont'd) :

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Shale, coarse, black	246		1	1	See footnote *
Sandstone, grey, banded	252	10	6	10	Dips 27° to 42°. *
Shale, very dark	252	11	-	1	Dip 40°. *
Sandstone, grey, banded	294	5	41	6	*
Grit and sandstone, grey-green	304	1	9	8	Dips 30° and 25° *
Grit and sandstone, grey-green	307	11	3	2	Dip 30°.
Conglomerate, grey-green	308	8	-	9	
Grit and sandstone, grey-green	319	9	11	1	Dip 30°. *
Grit and sandstone, grey, with conglomerate bands	330	5	10	8	Dips 27° to 40°. *
Sandstone, dark grey, grit and fine conglomerate	340	4	9	11	Dips 35° to 43°. *
COAL and shale, carbonaceous	377	3	36	11	ASHFORD SEAM 341-375 feet. Core recovery 50%.
Shale, carbonaceous, with fine conglomerate and grit bands	390	8	13	5	Dips 15° to 20°.
Grit and conglomerate with bands of black shale	397		6	4	Dip 20°.
Grit and conglomerate, grey-green	401	9	4	9	*
Grit and conglomerate with frequent black shale bands	443	0	41	3	Dip 20°. Base of Permian
Mudstone, banded, with green and white cherts	450	6	7	3	Carboniferous

FOOTNOTE : Asterisk denotes interbedding of thin carbonaceous bands.

Evidence of slumping at 262'3"

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NO. 2 DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, MAY, 1949.

Ph. McDonald, Co. Arrawatta.

Location (1828N
(170W

R.L. of Bore Collar 220 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Mud, red	27		27		No Core
Mud, red, and carbonaceous matter	31	9	4	9	Dip 30°.
Shale, grey, thin banded, and red mudstone	36	4	4	7	Dips 20° and 22°.
Conglomerate, blue-grey	70		33	8	Dips 26° and 22°.
Sandstone, blue-grey	70	10		10	
Shale, light grey, banded	71	10	1		Dip 27°.
Grit, blue-grey, conglomerate and grey sandstone	76	8	4	2	Dip at base 26°.
Conglomerate, blue-grey	76	8		8	
COAL	77			4	Lustrous
Shale, black	107		30		Dip 23°.
Conglomerate alternating bands blue-grey and grey sandstone	164	10	57	10	Thin coaly bands at 145, 148, 151 feet. Dips measure 23°, 7°, 50°, 43°.
COAL. Thin bands, and black shale	177		12	2	Dips measures 31°, 28°, 31° and 28°. BONSHAW SEAM.
Shale, banded, light grey	183		6		Dips 36°, 42°.
Sandstone, grey	195	7	12	7	Dips 27°, 31°, 34°, 32°, and 32°.
Shale, banded	209		4	5	
Sandstone, grit, and conglomerate	220	6	20	6	Dips 36°, 40°, 40°, and 40°.
Shale, black	220	10		4	
COAL	221			2	Dip 35°.
Sandstone and shale, banded	227		6		
Grit and conglomerate	231	6	4	6	

Log of No. 2 Diamond Drill Hole (Cont'd) :

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Shale, black banded	248	3	16	9	Dips 42°, 32° and 42°.
Grit and conglomerate	307		58	9	Carbonaceous and sandy bands. Becomes progressively darker towards base. Dips 40°,43°,45°.
Grit, blackish-grey fine	308		1		
COAL	350		42		ASHFORD SEAM. Poor core recovery
COAL and black shale	357		7		Poor core recovery
Shale, black	363		6		Contains pebbles
Conglomerate, medium grey, black matrix.	366		3		

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NO. 3 DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, JUNE, 1949.

Ph. McDonald, Co. Arrawatta.

Location (50S
(758W

R.L. of Bore Collar 232 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET.	INCHES	
Soil	5		5		
Conglomerate, green-grey	25	1	20	1	Dips 21°, 28°.
Sandstone, grit, and conglomerate, green-grey	26	2	1	1	Dip 31°.
Shale, black and dark grey	32		5	10	Coaly seam at 32 feet
Conglomerate, green-grey	40	10	8	10	
Shale, black	41	8		10	Dip 40°.
Conglomerate, green-grey	50		8	4	
Sandstone, grit, and conglomerate, blue-grey	86	2	36	2	With carbonaceous bands at 66 & 68 feet. Dips 28° and 24°.
Sandstone, grey	88	6	2	4	Dip 20°.
Shale, grey and black, and fine grey sandstone	102		13	6	Dips 25°, 18°, 17°, and 24°.
Sandstone, grit, and conglomerate, dark grey and blue-grey	150		48		Carbonaceous bands at 111, 112, and 120 feet. Dips 31° and 32° at 142 feet.
Shale, banded, black and grey, with fine grey sandstone.	160		10		
Sandstone, grey with carbonaceous banding	163		3		Dips 22°, 30° and 40°.
Shale, banded, black and grey, with fine sandstone	168	10	5	10	Dips 37°, 32°, 20° and 48°.
Shale, brecciated, and black shale	169	10	1		Dip 31°.
Grit, blue-grey, sandstone and conglomerate	179	9	9	11	
Shale, carbonaceous	192	4	12	7	Slickensiding
Sandstone, grey-green	196	3	3	11	

Log of No. 3 Diamond Drill Hole (Cont'd) :

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Shale, black and grey	228	10	32	7	Dips at base 32° and 35°.
Sandstone, grey	235	4	6	6	Dips 30° and 18°.
Shale, black and grey	243	10	8	6	Dips 48° and 38°.
Sandstone, grey	246	5	2	7	With carbonaceous shale
Conglomerate, grey-green	251	4	4	11	
Sandstone, grey	256	6	5	2	Dip 32°.
Conglomerate	266		9	6	
Grit, dark grey	267		1		
Conglomerate, dark grey	278	3	11	3	
Shale, dark grey and black	287	4	9	1	Dips 28°, 29°, 30°, 34°.
Sandstone, grey	293	8	6	4	Dips 25° and 34°.
Shale, grey passing to black	310		16	4	Dips near base 20°, 20°, 10°, 31°, 31°.
COAL	331	8	21	8	ASHFORD SEAM Recovery about 50%
Shale, black with thin bands coal	349		17	4	
Shale interbedded with grey black conglomerate	357		8		
Conglomerate, grey-green	360		3		

Owing to loss of water, it was necessary to seal off this hole twice while in the coal seam.

NO. 4 DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, AUGUST, 1949.

Ph. McDonald, Co. Arrawatta.

Location (970S
(860W

R.L. of Drill Collar 223 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
No core	28		28		
Grit, sandstone, and conglomerate	63		35		
Shale, grey and black	65		2		Dip 27°.
Sandstone, grey	69		4		Dip 34°.
Shale, black	77	6	8	6	Dips 33°, 30°, 40°, 27°.
Grit, conglomerate, sandstone grey	108		30	6	Dip near top 23°.
Shale, grey and black	109	6	1	6	
Grit and shale alternating	119		9	6	Dip at 115 feet, 25°.
Sandstone and conglomerate	132	6	13	6	
Shale, black	147		14	6	Dips 29°, 28°, 33°.
Sandstone and conglomerate	167	6	20	6	Dips at 153-157 feet, 27°-28°.
Shale, grey	174		6	6	Dips 31°, 41°, 38°.
Sandstone and conglomerate, grey	175	6	1	6	
Shale, black and grey	218		42	6	
COAL	237		19		ASHFORD SEAM. First two feet mainly durain which cored well, below this fusain bands caused poor core recovery. Driller states clay band 222-227 feet but this unlikely. Thin shale band about 232 feet.
Shale and conglomerate in thin bands, black	238	3	1	3	Dip about 30° at 237'4"
Shale, black	242		3	9	
COAL	242	9	0	9	Durain

Log of No. 4 Diamond Drill Hole (Cont'd) :

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Shale, black	248		6	3	Thin bands of coal
Conglomerate, black	249		1		
Shale, black, with gritty bands	260		11		

Ground-water level - 87 feet.

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NO. 5 DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, OCTOBER, 1949.

Ph. McDonald, Co. Arrawatta.

Location (1550S
(750W

R.L. of Bore Collar 205 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
No core	11		11		
Shale, grey	20		9		Thin carbonaceous bands, 25°, 25°, 30°, 25°.
Conglomerate and sandstone	21		1		
Shale, grey	23		2		Carbonaceous bands, dip 26°.
Conglomerate, blue-grey	37		14		
COAL	51		14		ASHFORD SEAM. Coal weathered, showing limonite staining. Very poor recovery. Mainly durain. Slickensided. 37' - 39' contained shale bands.
Shale, black	54		3		
Conglomerate, blue-grey	61	8	7	8	
Shale, black	65		3	5	

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NO. 6 DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, OCTOBER, 1949

Ph. McDonald, Co. Arrawatta.

Location (2800N
(70W

R.L. of Bore Collar 208 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil	4		4		
No core	15		11		
Granite	27	9	12	9	Highly contaminated in part
Mudstone, etc.	69		41	3	Highly silicified. Carboniferous.
FAULT ZONE	78		9		Badly broken zone. No core recovered.
Shale, grey	84		6		With carbonaceous banding (Start of Permian)
Conglomerate, blue-grey	86		2		
Shale, grey	97		11		With carbonaceous sandstone and very thin coaly bands
Sandstone, blue-grey	100		3		Conglomerate bands
Shale, banded, grey	107		7		
Conglomerate, blue-grey	108	6	1	6	
Shale, banded, grey	126		17	6	With sandstone and carbonaceous shale bands. Dip 30°.
Sandstone, blue-grey	128	6	2	6	
Conglomerate, blue-grey	134		5	6	Few fine coaly bands. Dip 27°.
Sandstone and grit, blue-grey	146		12		Few conglomerate and coaly bands. Dip 29°.
Conglomerate, blue-grey	173		27		Few fine coal bands
Sandstone, grey	198		15		Carbonaceous bands. Very slight faulting and slumping. Dips 30°, 30°, 29°.
Conglomerate	215	6	17	6	Thick sandstone bands
Shale, grey	219		3	6	Banded with black shale. Dips 26°, 30°.

Log of No. 6 Diamond Drill Hole (Cont'd) :

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Conglomerate, blue-grey	220	6	1	6	
Shale, black	221	6	1		Black conglomerate bands
Conglomerate, blue-grey	237		15	6	Sandstone bands and little black shale. Dips 30°.
Shale, black	239		2		Very thin coaly bands
Conglomerate, blue-grey	240		1		
Shale, black	250		10		Dip 22°.
COAL	251		1		Top of split BONSHAW SEAM (?)
Shale, black	255		4		
Conglomerate	268		13		Occasional thin coaly bands
Shale, grey	276		8		
Conglomerate, dark blue-grey	285		9		
Shale, black, banded	298	6	13	6	Few fine coal bands near base. Dip 31°.
COAL	299			6	
Shale, black	317		18		Irregularly banded
COAL	318	6	1	6	Base of split BONSHAW SEAM (?).
Shale, black, banded	325		6	6	Irregularly banded
Grit and sandstone	335		10		Thick conglomerate bands
Shale, grey, banded	338		3		Banding streaked in part. Dip 30°.
Sandstone, grey	340		2		
Conglomerate and sandstone	346		6		At 341 feet little shale breccia
Shale, grey	347		1		Very irregularly streaked
Conglomerate, blue-grey	350		3		
Shale, black and grey	358		8		Dip 28°.
Conglomerate	373		15		
Shale, black	384	6	11	6	
Conglomerate with occasional very thin bands	389	6	5		

Log of No. 6 Diamond Drill Hole (Cont'd) :

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Shale, black carbonaceous	393	6	4		
Shale, grey, banded, and fine sandstone	397		3	6	Showing small faults
COAL	404		7		No core whatsoever obtained. ASHFORD SEAM.
Shale, black	405		1		
COAL	405	6		6	No core obtained
Shale, black	421		15	6	Pebbly bands increasing towards base.
Conglomerate, black	426		5		With some shale

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NO. 7a DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, DECEMBER, 1949.

Ph. McDonald, Co. Arrawatta.

Location (5200N
(800E

R.L. of Bore Collar 167.6 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil and granite wash	44		44		
Gravel	50		6		Hole abandoned owing to falling in of gravel and destruction of bits.

NO. 7b DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, DECEMBER, 1949.

Ph. McDonald, Co. Arrawatta.

Location (5165N
(415E

R.L. of Bore Collar 177 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil and granite wash	17		17		
Granite	18		1		Granite with Carboniferous chert

NO. 7c DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, DECEMBER, 1949

Ph. McDonald, Co. Arrawatta.

Location (5010N
(530E

R.L. of Bore Collar 176 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil and granite wash	29		29		
Chert	33		4		Contact phase highly contaminated by granite

NO. 7d DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, DECEMBER, 1949

Ph. McDonald, Co. Arrawatta.

Location (4970N
(610E

R.L. of Bore Collar 175 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil and granite wash	43		43		
Gravel	46		3		Hole abandoned while still in gravel.

NO. 7 DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, DECEMBER, 1949

Ph. McDonald, Co. Arrawatta.

Location (5200N
(800E

R.L. of Bore Collar 167.6 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil and granite wash	44		44		
Gravel	52		8		
Shale	65		13		Carbonaceous to 55 feet
Conglomerate and shale	80		15		
Conglomerate and sandstone	103		23		
Conglomerate	111		8		
Shale	119		8		
Conglomerate	120	9	1	9	
COAL	155		34	3	ASHFORD SEAM. Coal much slickensided. Shale bands below 143 feet.
Carbonaceous conglomerate	169	3	14	3	Angular and rounded pebbles, matrix more than 50% of rock.
Mudstone	172		2	9	Carboniferous basement

(Water level - 50 feet)

NO. 8 DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, JANUARY, 1950.

Ph. McDonald, Co. Arrawatta.

Location (4000N
(400E

R.L. of Bore Collar 186.1 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS	
	FEET	INCHES	FEET	INCHES		
Soil, granite wash and gravel	72		72			
Conglomerate, fine grey, passing to coarse grey sandstone with few pebbles	88		16			
Conglomerate	104		16		Sandy between 90 and 96 feet; narrow carbonaceous band at 96 feet	
Sandstone, coarse, with bands of conglomerate	118		14		Carbonaceous band at 118 feet	
Sandstone with sandy shale	134		16		Carbonaceous streaks between 120 and 128 feet	
Shale and sandy shale with carbonaceous streaks	137		3			
Sandstone	147		10			
Conglomerate	151		4			
Sandstone with bands of conglomerate	162		11			
Shale, sandy	178	8	16	8	Small nearly vertical faults	
Sandstone	181	6	2	10		
Conglomerate	182	6	1			
COAL	198	6	16			ASHFORD SEAM
Shale, crushed, with carbonaceous streaks and band of conglomerate	199	9	1	3		ASHFORD SEAM
COAL	207		7	3	Crushed friable coal, poor core recovery	ASHFORD SEAM
Shaly and carbonaceous conglomerate	207	6		6		

Log of No. 8 Diamond Drill Hole : (Cont'd)

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Conglomerate, becoming lighter in colour	226		18	6	
Mudstone	227		1		Carboniferous basement

(Water Level - 40 feet).

*** *** ***

NO. 9 DIAMOND DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, FEBRUARY, 1950.

Ph. McDonald, Co. Arrawatta.

Location (7590N
(1400E

R.L. of Bore Collar 136.7 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS	
	FEET	INCHES	FEET	INCHES		
Percussion hole - soil, gravel etc.	65		65			
Carbonaceous shale with soil	69		4		At 66 feet a 4-inch band of coal with veinlets of calcite. At 67 feet band of clay 3 in. thick. Dip 30°.	
Shale passing to coal with veinlets of calcite	70		1		Dip 30°.	
COAL	76		6		Good coring	ASHFORD SEAM
COAL	96		20		Very light friable shattered coal with slickensides. Poor recovery.	
COAL	129		33		No core recovery	
Shale soft brecciated carbonaceous	135	6	6	6	Poor core recovery	
Harder carbonaceous shale with soft bands	150		14	6	Dips 20° - 25°.	

*** *** ***

NO. 10 PERCUSSION DRILL HOLE

SUNK BY BUREAU OF MINERAL RESOURCES, MAY, 1950.

Ph. McDonald, Co. Arrawatta.

Location (6400N
(1103E

R.L. of Bore Collar 152 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Gravel and wash	44		44		
Shale	54		10		
Conglomerate	68		14		
Shale	74		6		
Carbonaceous Shale	79		5		
COAL	89		10		ASHFORD SEAM
Shale and mudstone	95		6		

*** *** ***

NO. 1 BORE, SPRING CK.

SUNK BY BUREAU OF MINERAL RESOURCES, FEBRUARY, 1950.

Ph. Myall, Co. Arrawatta.

Location Approx. 260 feet on Magnetic bearing 225° from N.E. corner of Portion 9. Parish of Myall.

R.L. of Bore Collar. Approx. 1800 feet A.S.L.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil	1		1		
Sandstone, hard fine	10		9		
Sandstone, hard and clay	30		20		
Shaly coal, weathered	33		3		
COAL, weathered	36		3		
Shale	94		58		
Conglomerate	122		28		
Shale	166		44		
Shale, carbonaceous	176		10		
Shale, carbonaceous	188		12		Streaks of coal.
Shale, hard	204		16		
Shale	213		9		
Shale	237		24		Penny bands of coal
COAL	239		2		ASHFORD SEAM
Shale	242		3		
COAL	245		3		
Shale, hard, with thin carbonaceous bands	264		19		Below 239 feet the coal and friable carbonaceous bands would not stand, and the hole was abandoned at 264 feet.

NO. 1 BORE, ARTHUR'S SEAT

SUNK BY AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION, MAY, 1948.

Portion 59, Ph. Arthur's Seat, Co. Arrawatta
Location : Refer to Plate 6.
R.L. at collar 1600 feet (assumed datum)
Datum level (No. 1 Bore) Approx. 1600 feet A.S.L.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Clay, grey sandy, and gravel	23	6	23	6	Sub-recent alluvium
Shale, grey and black carbonaceous	38	6	15	-	Thin conglomerate bands
Shale, black carbonaceous	41		2	6	
Conglomerate	47	6	6	6	
Shale	57	6	10	-	With carbonaceous seams
Shale, hard sandy	63		5	6	

*** *** ***

NO. 2 BORE, ARTHUR'S SEAT

SUNK BY AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION, MAY, 1948.

Portion 59, Ph. Arthur's Seat, Co. Arrawatta.
Location : Refer to Plate 6.
R.L. of Collar : 1617 feet

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Clay, grey and gravel	36	6	36	6	Sub-recent alluvium
Shale, grey	44		7	6	
Shale, grey	58		14		With carbonaceous seams
Conglomerate	59		1		
Shale, grey sandy	122		63		With few carbonaceous seams
Shale, hard grey	155		33		With few carbonaceous seams

NO. 3 BORE, ARTHUR'S SEAT

SUNK BY AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION, MAY, 1948.

Portion 59, Ph. Arthur's Seat, Co. Arrawatta.
Location : Refer to Plate 6.
R.L. of Collar : 1591 feet.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Clay, sandy	37		37		Sub-recent alluvium
Shale, carbonaceous	38		1		
Shale, soft grey	50		12		
Shale, grey	52	6	2	6	With carbonaceous seams
Conglomerate	53	6	1		
Shale	64		10	6	With carbonaceous seams
Shale, hard sandy	92		28		

NO. 1 BORE, BYRON.

SUNK BY AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION, APRIL, 1948.

Township of Byron, Co. Arrawatta.
Location : Portion 60.
R.L. of Collar : 1830 feet.
Datum Level Byron (No. 1 Bore) approx 1830 feet A.S.L.

DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil, black	1		1		
Basalt, weathered	8		7		Black and grey clay showing basaltic texture
Clay, sandy	14		6		
Gravel	20		6		With sand and clay
Lignitic clay	27		7		With diatoms
Clay, lignitic, finely bedded	30		3		
Clay grey	31	6	1	6	
Vesicular basalt, serpentinized	35		3	6	

NO. 2 BORE, BYRON

SUNK BY AUSTRALIAN ALUMINIUM PRODUCTION COMMISSION, APRIL, 1948.

Township of Byron, Co. Arrawatta.
Location : Portion 60.
R.L. of Collar : 1827 feet.

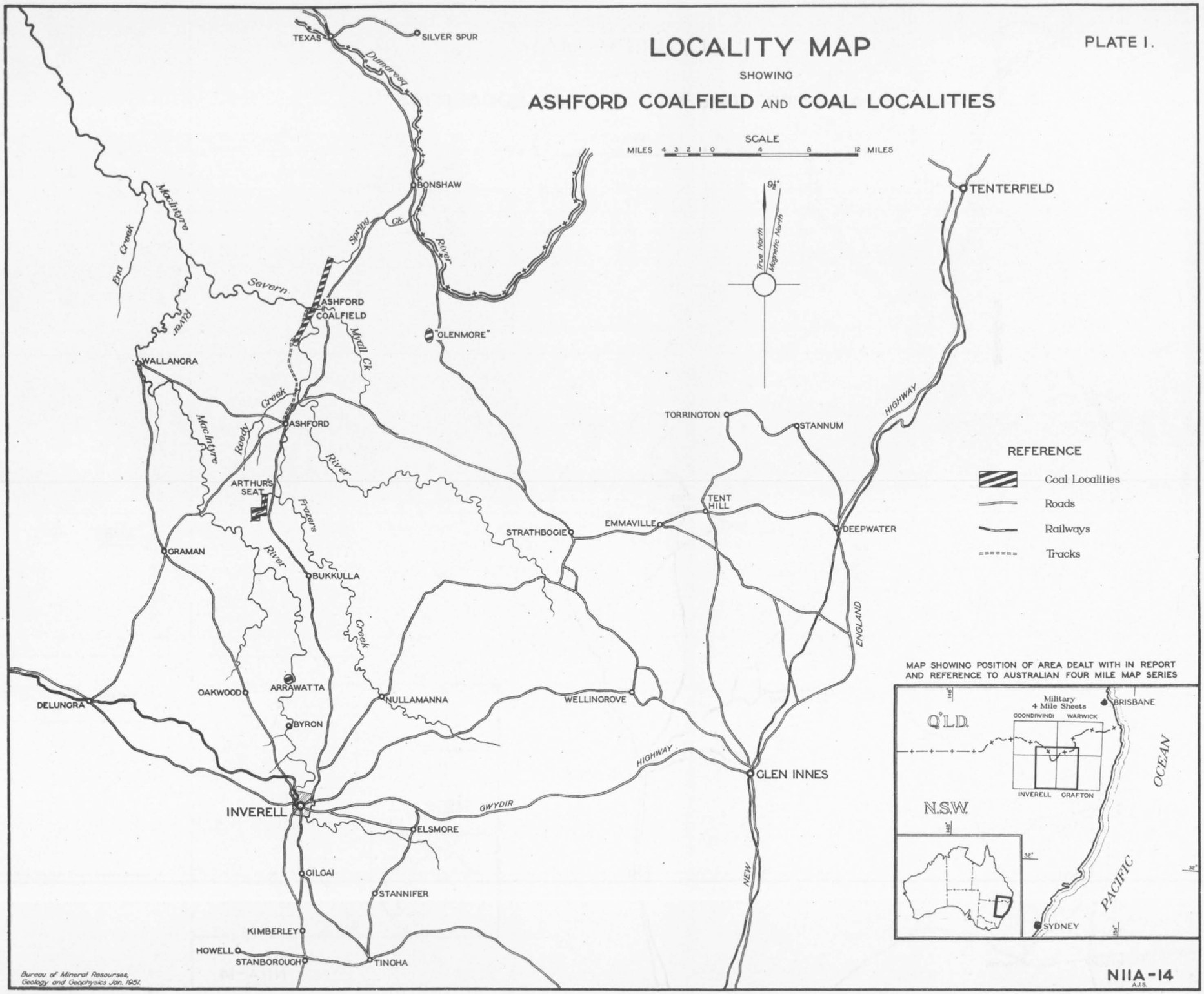
DESCRIPTION	BASE		THICKNESS		REMARKS
	FEET	INCHES	FEET	INCHES	
Soil, black	2		2		
Basalt, weathered	8		6		With black and grey clay
Clay, grey sandy	18		10		
Gravel	24		6		With sand and Clay
Vesicular basalt, serpentinized	27		3		

LOCALITY MAP

PLATE I.

SHOWING

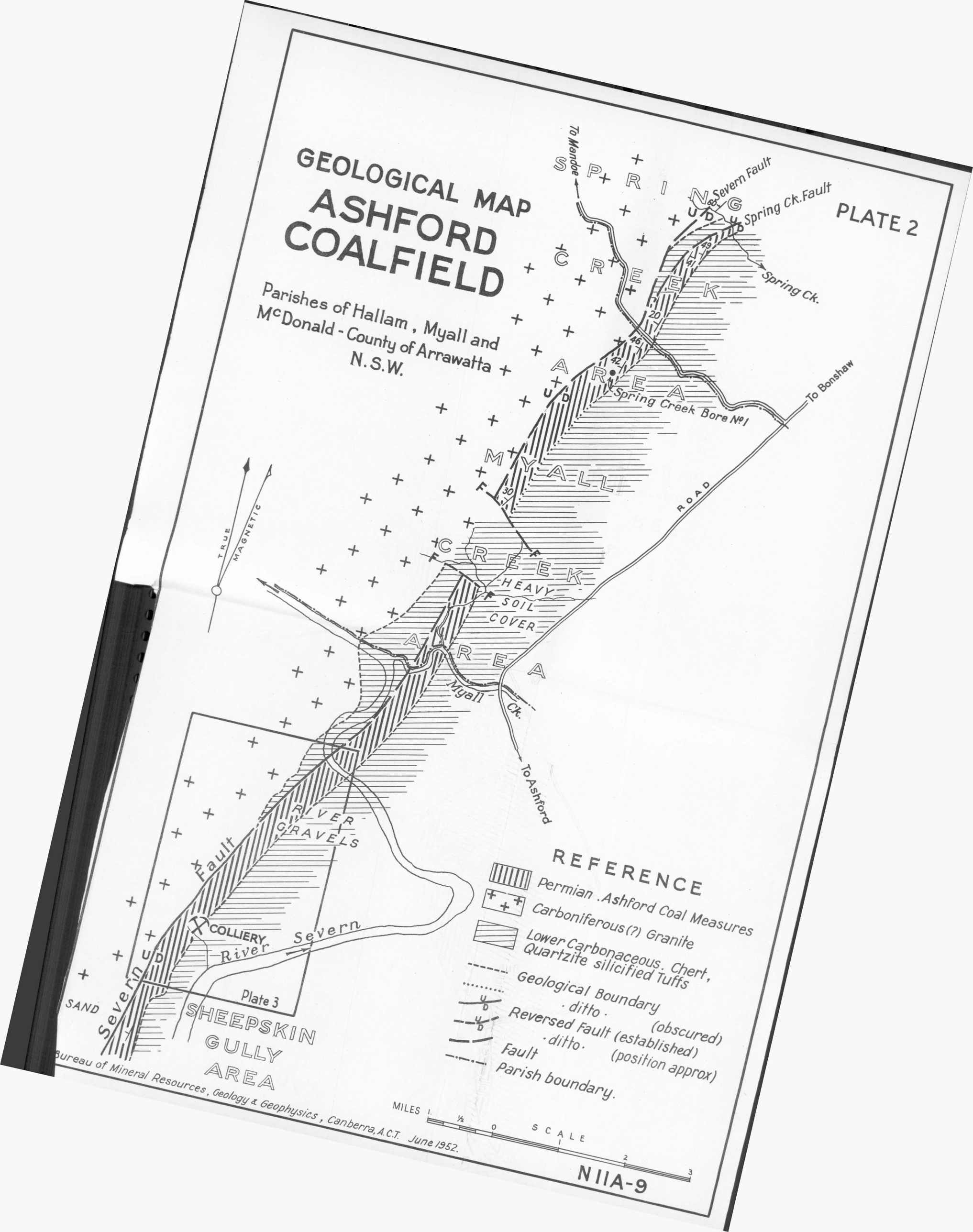
ASHFORD COALFIELD AND COAL LOCALITIES



GEOLOGICAL MAP
ASHFORD COALFIELD

Parishes of Hallam, Myall and McDonald - County of Arrawatta
N.S.W.

PLATE 2



Bureau of Mineral Resources, Geology & Geophysics, Canberra, A.C.T. June 1952.

N11A-9

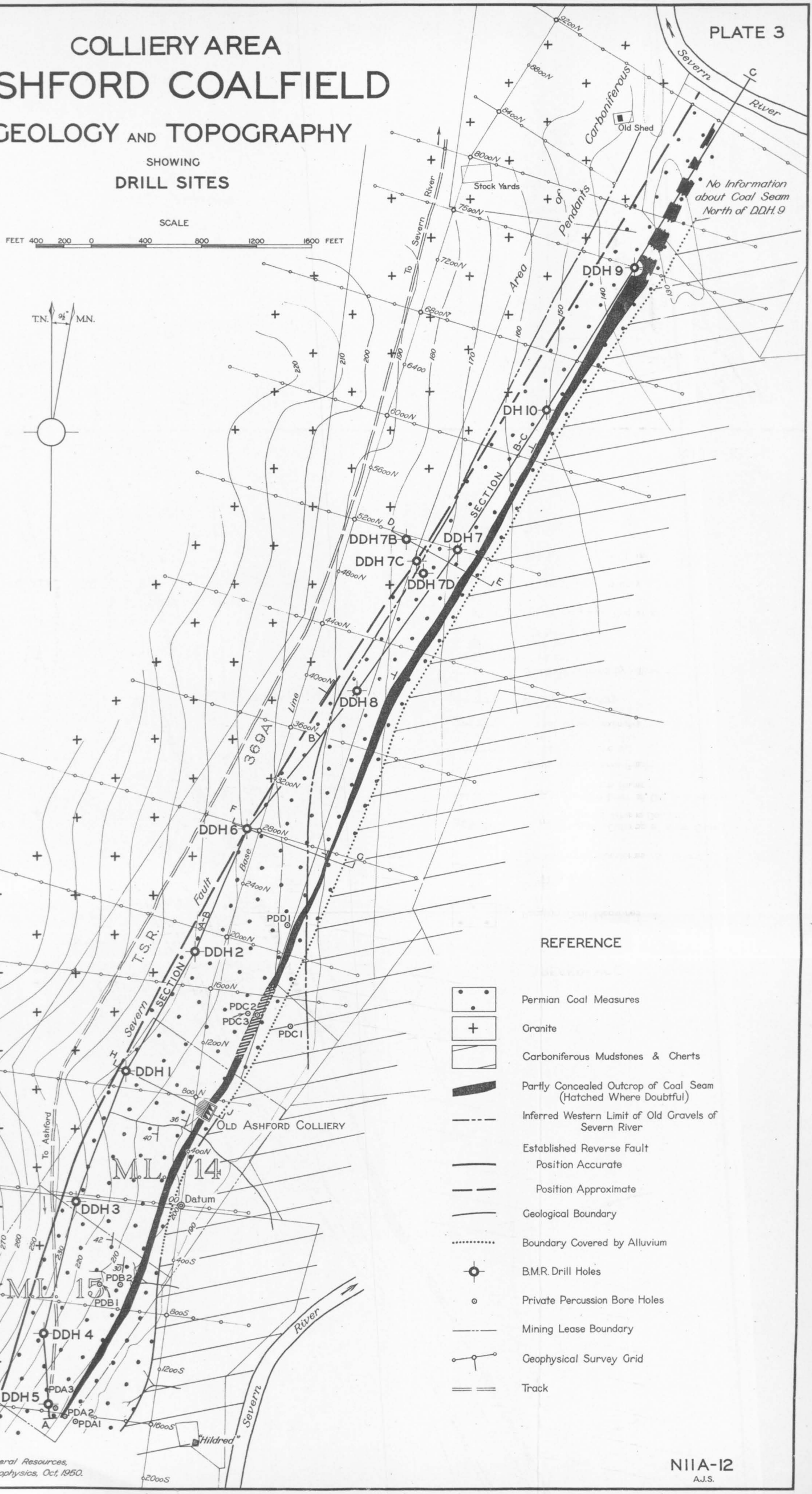
PLATE 3

COLLIERY AREA
ASHFORD COALFIELD
GEOLOGY AND TOPOGRAPHY
SHOWING
DRILL SITES

SCALE

FEET 400 200 0 400 800 1200 1600 FEET

T.N. 9½° M.N.



REFERENCE

- Permian Coal Measures
- Granite
- Carboniferous Mudstones & Cherts
- Partly Concealed Outcrop of Coal Seam (Hatched Where Doubtful)
- Inferred Western Limit of Old Gravels of Severn River
- Established Reverse Fault
  - Position Accurate
  - Position Approximate
- Geological Boundary
- Boundary Covered by Alluvium
- B.M.R. Drill Holes
- Private Percussion Bore Holes
- Mining Lease Boundary
- Geophysical Survey Grid
- Track

Bureau of Mineral Resources, Geology & Geophysics, Oct, 1950.

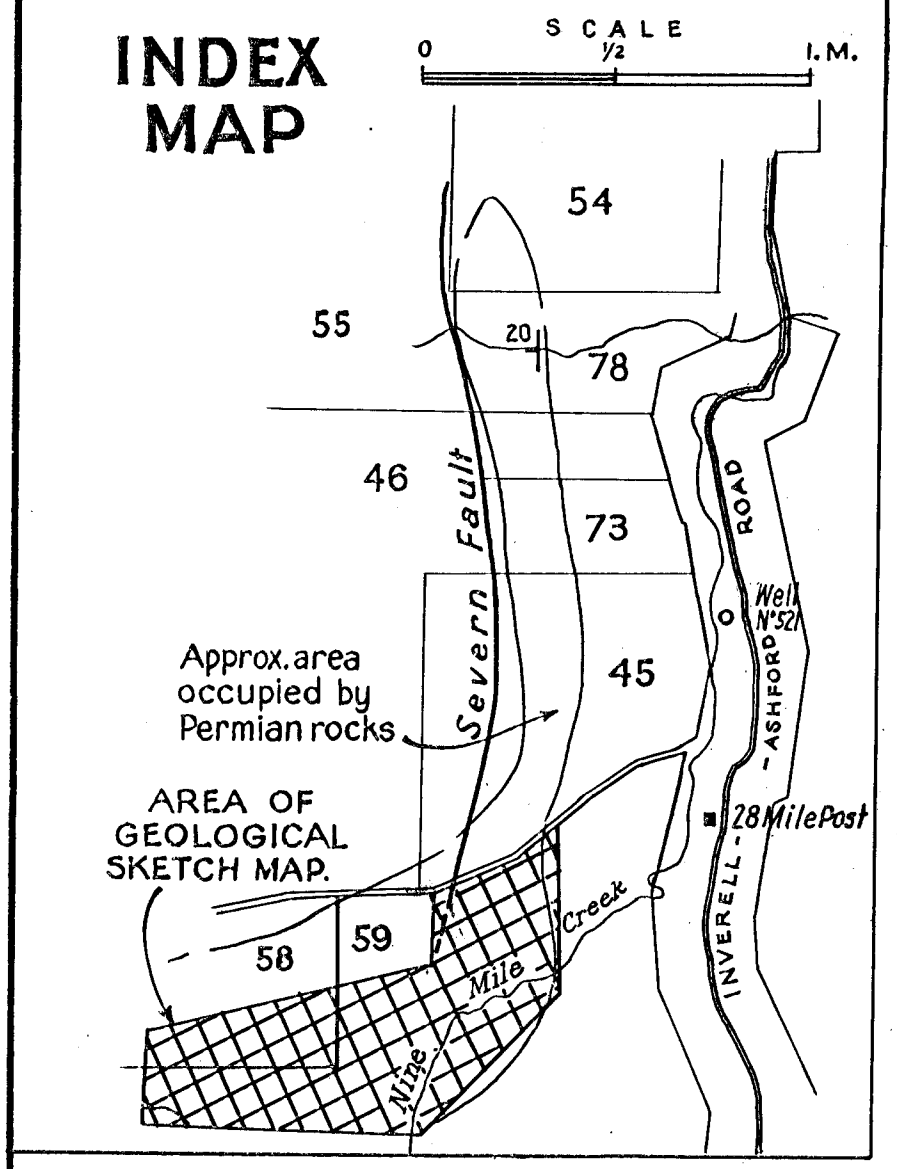
N11A-12
A.J.S.

PLATE 5.

GEOLOGICAL SKETCH MAP

PORTIONS 58 and 59
PARISH OF ARTHUR'S SEAT
COUNTY OF ARRAWATTA
N.S.W.

SCALE FEET 400 0 400 800



REFERENCE

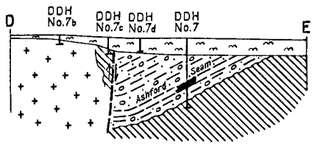
- RECENT: stream gravels.
- PERMIAN: sandstone, coarse felspathic grits.
- UNCONFORMITY
- PERMIAN: mainly concealed beneath Post-Tertiary alluvium.
  - shale, carbonaceous shale and coaly matter.
  - sandstone
  - cobble conglomerate and quartzite.
  - boulder conglomerate.
- UNCONFORMITY
- LOWER CARBONIFEROUS: tuff, chert, quartzite
- TERTIARY: Intrusive, Keratophyre
- F—F FAULT

Bureau of Mineral Resources, Geology & Geophysics - June 1952.

N11A-10

ASHFORD COALFIELD
COLLIERY AREA
LONGITUDINAL, TRANSVERSE AND COLUMNAR SECTIONS OF THE ASHFORD SEAM.

West East



SECTION D-E

Long. & Trans. Sections

200 100 0 200 400 600 800 FEET

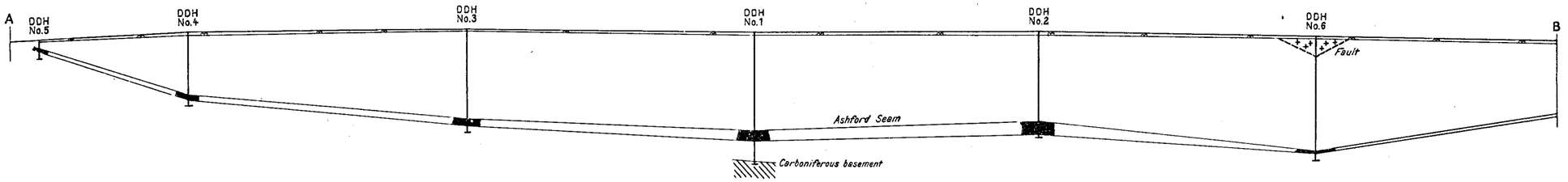
Columnar Sections

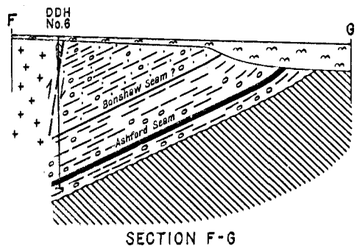
50 0 50 100 FEET

REFERENCE

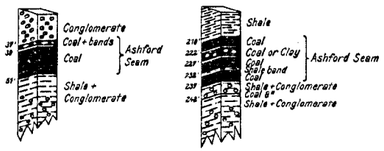
- Granite Wash and Alluvium
- PERMIAN: Shale, Sandstone and Conglomerate
- PERMIAN: Shale
- PERMIAN: Sandstone and Fine Grit
- PERMIAN: Conglomerate and Coarse Grit
- PERMIAN: Coal
- LOWER CARBONIFEROUS (?): Claystones and Cherts
- Granite
- Severn Fault (Dip unknown)

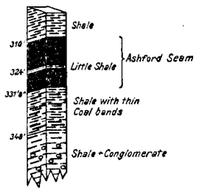
South North

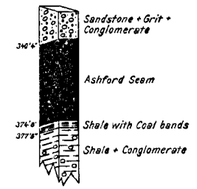


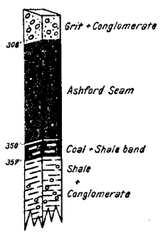


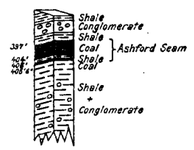
SECTION F-G



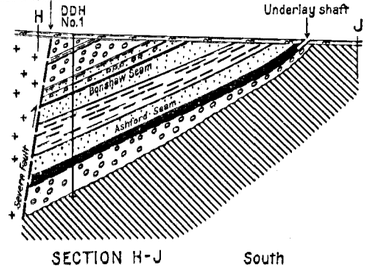






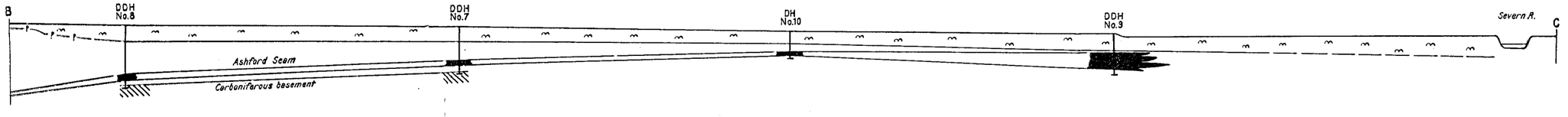


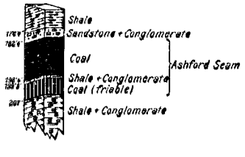
Possibly thin wedge of Carboniferous not more than 10 ft. wide on West side of contour.

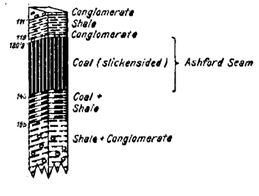


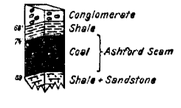
SECTION H-J

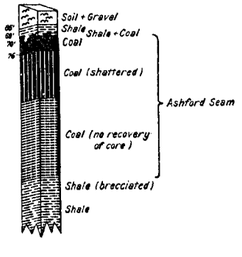
South North











Bureau of Mineral Resources, Geology and Geophysics, October 1956

N 11A-13
H.J.

PLATE 6

GEOPHYSICAL SURVEY AT ASHFORD N. S. W.

PLAN SHOWING

BOUGUER ANOMALIES

SCALE

400 200 0 400 800 1200 FEET

CONTOUR INTERVAL 0.1 MILLIGALS

LEGEND

Diamond Drill Hole

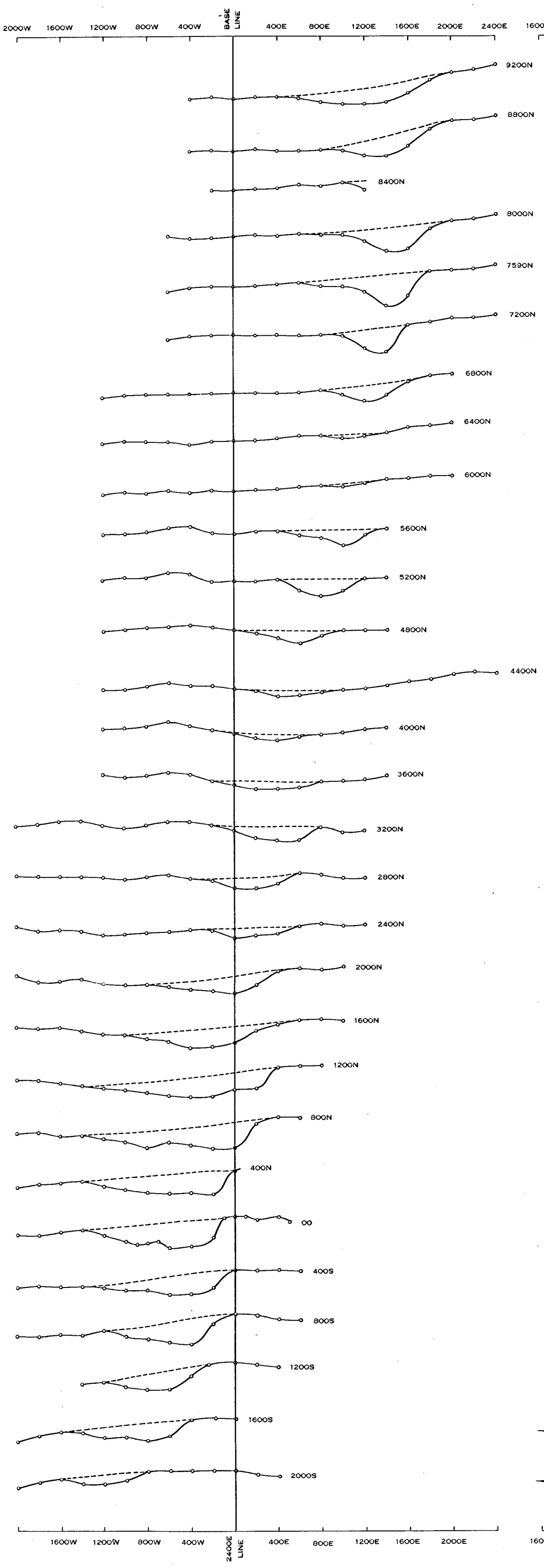
.....GEOPHYSICIST

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

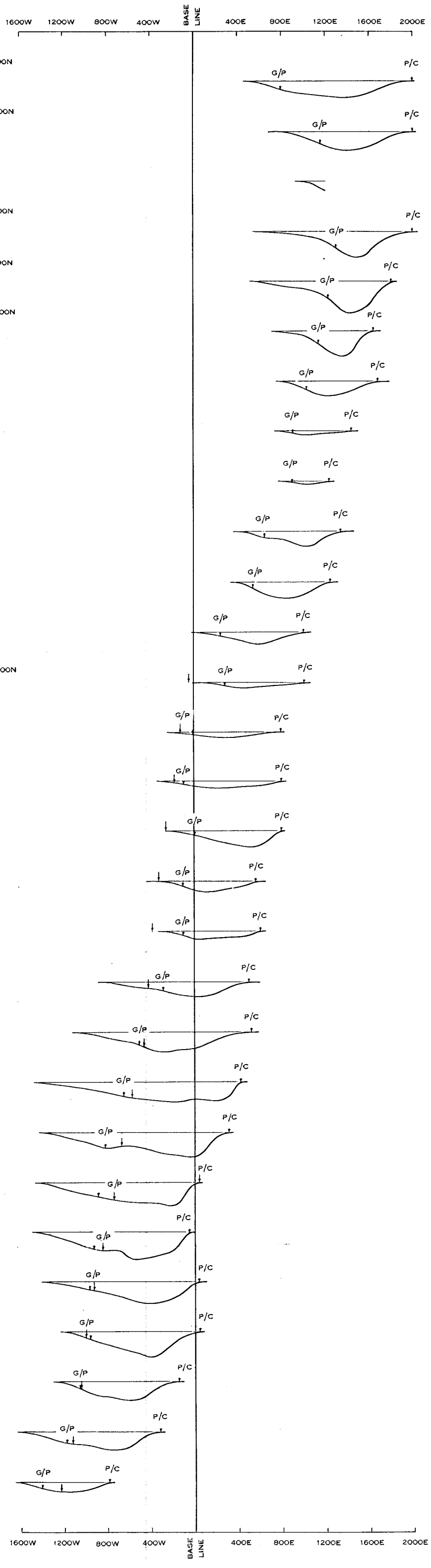
G 60-10

PLATE 7

BOUGUER ANOMALIES PROFILES AND SMOOTHING



RESIDUAL ANOMALIES



LEGEND

CONTACT BETWEEN GRANITE & PERMIAN ..... G/P

CONTACT BETWEEN PERMIAN & CARBONIFEROUS ..... P/C

CONTACTS FROM GEOLOGICAL MAPPING .....

CONTACTS FROM INSPECTION OF GEOPHYSICAL RESULTS .....

SCALES

HORIZONTAL 0 200 400 800 1200 1600 2000 FEET

VERTICAL 0 1 2 3 4 5 MILLIGALS

..... GEOPHYSICIST

GEOPHYSICAL SURVEY AT ASHFORD N.S.W.

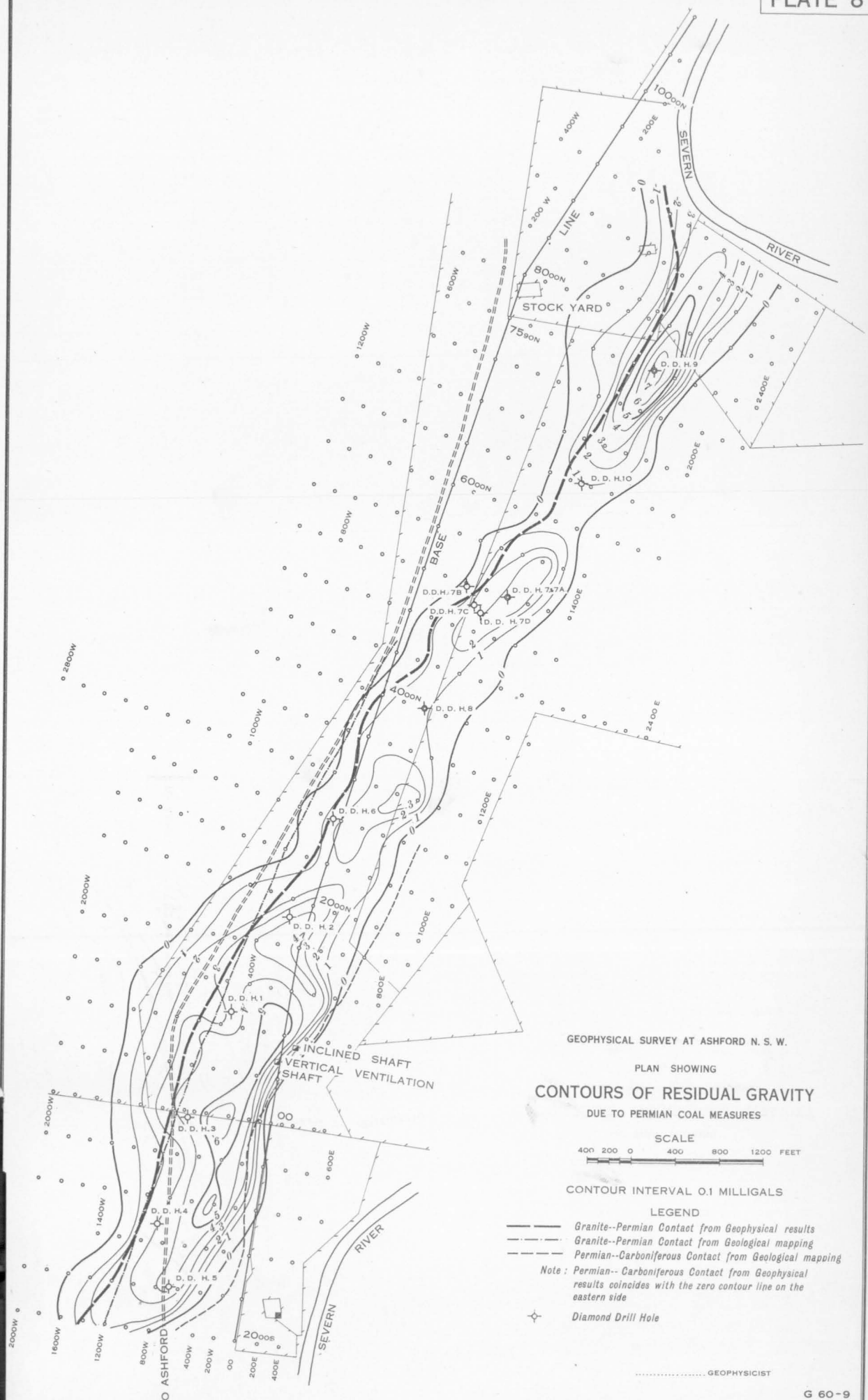
SECTION SHOWING

GRAVITY PROFILES OF BOUGUER ANOMALIES AND RESIDUAL ANOMALIES

DUE TO PERMIAN COAL MEASURES

GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS.

PLATE 8



GEOPHYSICAL SURVEY AT ASHFORD N. S. W.

PLAN SHOWING

CONTOURS OF RESIDUAL GRAVITY

DUE TO PERMIAN COAL MEASURES

SCALE

400 200 0 400 800 1200 FEET

CONTOUR INTERVAL 0.1 MILLIGALS

LEGEND

——— *Granite--Permian Contact from Geophysical results*

—·—·— *Granite--Permian Contact from Geological mapping*

– – – – *Permian--Carboniferous Contact from Geological mapping*

Note : Permian-- Carboniferous Contact from Geophysical results coincides with the zero contour line on the eastern side

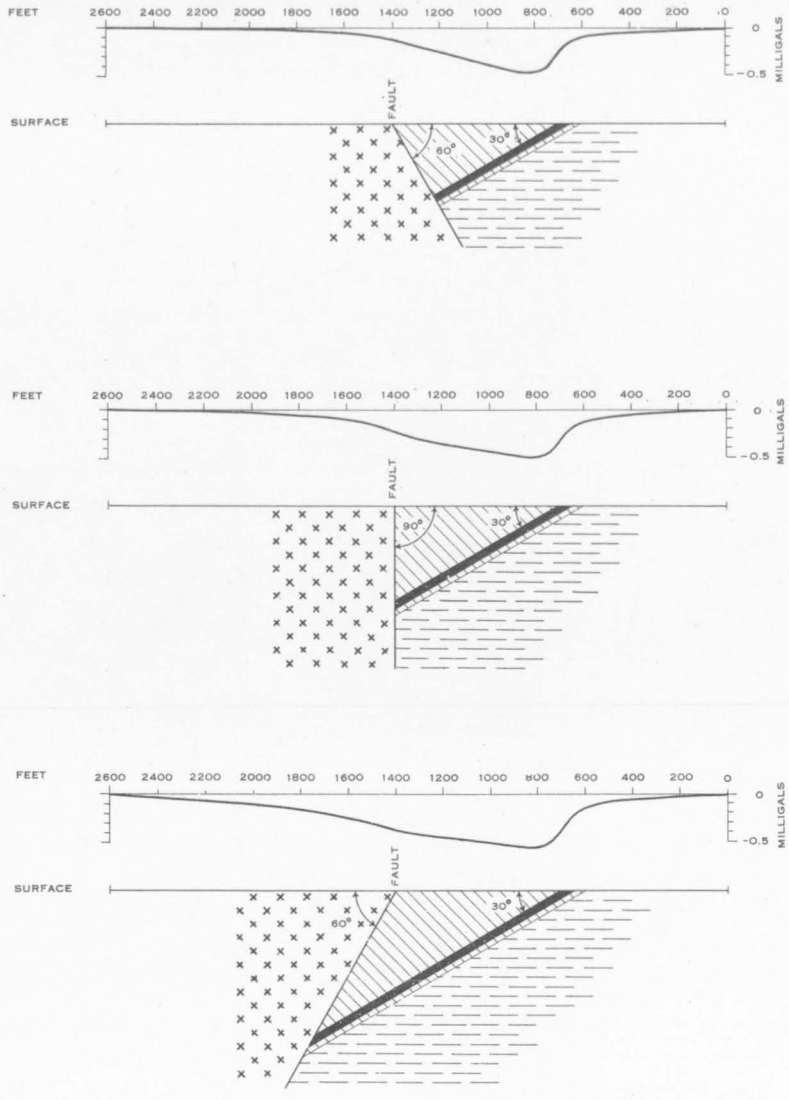
Diamond Drill Hole

.....GEOPHYSICIST

G 60-9

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

PLATE 9



LEGEND

		ASSUMED DENSITIES	
	Granite	*2.60*	*gm/cm³*
	Carboniferous	*2.60*	*gm/cm³*
	Permian	*2.55*	*gm/cm³*
	Coal	*1.45*	*gm/cm³*

GEOPHYSICAL SURVEY AT ASHFORD, N.S.W.

CALCULATED PROFILES OVER ASSUMED GEOLOGICAL SECTIONS

.....GEOPHYSICIST

G 60-8

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics