Leigh Creek Coalfield

South Australia 1951

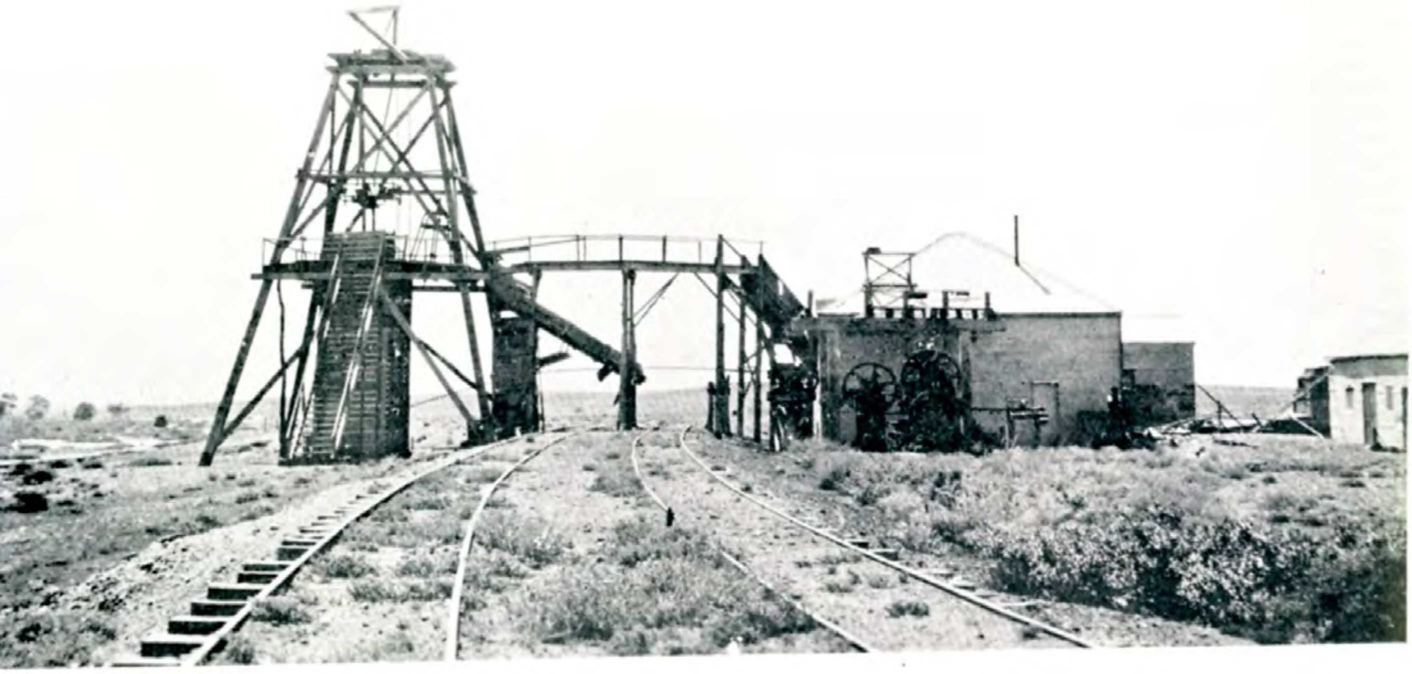
J. W. REDIN

The Leigh Creek Coalfield

Electricity Trust of South Australia

MAY 1951.

Printed by K. M. Stevenson, Government Printer, Adelaide



Headworks, Leigh Creek Colliery, 1894.

Leigh Creek Township from Top of 9W Dragline.

INTRODUCTION

Of South Australia's meagre coal deposits, the only field that has warranted extensive working has been the Leigh Creek coalfield. The discovery of Leigh Creek coal dates back to 1888, when excavation made for a surface water catchment disclosed coal-bearing rocks. However, due to its geographical location—some 380 miles north of Adelaide—it was not until 1943, when, due to the efforts of the Premier of South Australia, the Hon. Thomas Playford, the field was opened and worked on a large scale. The initial work was carried out by the Engineering and Water Supply Department until 1948, when the administration of the field was transferred to the Electricity Trust of South Australia, and the Trust takes this opportunity of paying a tribute to the excellent pioneering and developmental work carried out under the direction of the Engineering and Water Supply Department. Subsequent shortages of New South Wales coal, coupled with its deterioration of quality and increased price, have resulted in greater quantities of Leigh Creek coal being used, and today the importance to South Australia of the Leigh Creek coalfield is fully recognized.

HISTORICAL.

In 1888, coal-bearing shale was discovered during the sinking of a railway dam about half a mile S.W. of the present Copley siding. Early in 1889, H. Y. L. Brown, the Government Geologist, made an examination of the area and compiled a sketch map showing the extent of the Mesozoic coal-bearing shales, a map, which, although now modified by more detailed information, is remarkably accurate.

In 1890, shaft sinking and drilling was undertaken near the northern margin of the main basin where outcrops of carbonaceous shale were exposed. The shaft was abandoned after striking water at 75ft. and the test continued by drilling. The first bore on the field was thus drilled near the No. 1 shaft just north of the present Telford open cut. It was drilled to 330ft. and cut what is now known to be a lower coal seam between 135ft. and 137ft. The drill was then moved to a site about 1¼ miles west-south-west of the No. 1 shaft. Boring was carried to a total depth of 2,101ft. and penetrated the main seam 47ft. 10in. in thickness between 1,496ft. 8in. and 1,544ft. 6in.

This discovery led the Leigh Creek Mining Company in 1892 to sink a new shaft, now known as the "Old Main Shaft" at a site approximately 500yds. W.S.W. of No. 1 shaft. The main seam, 45ft. in thickness, was encountered between 240ft. and 285ft. Some 200 tons of coal was raised from the shaft and sent away chiefly for experimental purposes. Subsequently the leases expired and the area was withdrawn from the operation of the Mining Act. Between 1910 and 1919 four more bores were sunk by the Government, but none disclosed coal shallower than that in the Old Main Shaft.

In August, 1941, the current search for shallow coal began, and although the initial few bores were failures, the main seam was eventually located over an extensive area within opencast range and systematic grid drilling was begun to define what is now the Telford open cut. Concurrently, a new shaft was sunk and 640 tons of coal raised for experimental purposes. Later, the drills were moved to the Northern basin and were successful in locating shallow coal over a large area.

TOWNSHIP.

The township has been established at Telford on the northern edge of the main (Telford) coal basin. It consists at present of some 85 houses, together with single men's quarters, single women's quarters, officers' quarters, mess accommodation, community hall, cinema, school, post office, police station, a hospital run by the Australian Inland Mission, and a co-operative store. The community numbers rather more than 500, including some 350 employees of the Trust.

An effort has been made to offset the natural disabilities of the area by establishing as high a standard of accommodation as practicable, the houses being provided with electricity, water supply, and sewerage. Air conditioning units and refrigerators are available at a low rental. Some of the houses are of concrete block construction, and some are timber framed with asbestos cement covering. Styles vary, but the general standard may be judged from the accompanying photographs. Work has now begun on a standard Olympic size swimming pool.

Workshops, power station, stores, and offices are located closer to the open cut, and adjacent to the coal crushing and screening plant.

Transport to and from the field has been facilitated by the opening of the Leigh Creek aerodrome in October, 1950. This aerodrome is generally accepted to be the best in the State, and Leigh Creek is now one of the regular stopping points on the Adelaide-Darwin route. At present there are five services per week to and from the field. The journey which formerly took a full day by car or two days by train, can now be made in a little under two hours.

GEOLOGY—REGIONAL.

The Leigh Creek coalfield lies in a plain near the junction of diverging spurs of the North Flinders Ranges. The plain extends northwards from the intersection of the ranges and gradually merges into the low-lying depression of the Lake Eyre region. As far as is known, the coal-bearing rocks are confined to an area of 15 to 20 square miles. The surrounding basement rocks comprise pre-Cambrian upper Proterozoic rocks of the Adelaide System which also form the adjoining ranges. These rocks are overlain unconformably by the Triassic coal measures, which in turn are unconformably overlain by Cretaceous and Tertiary sediments.

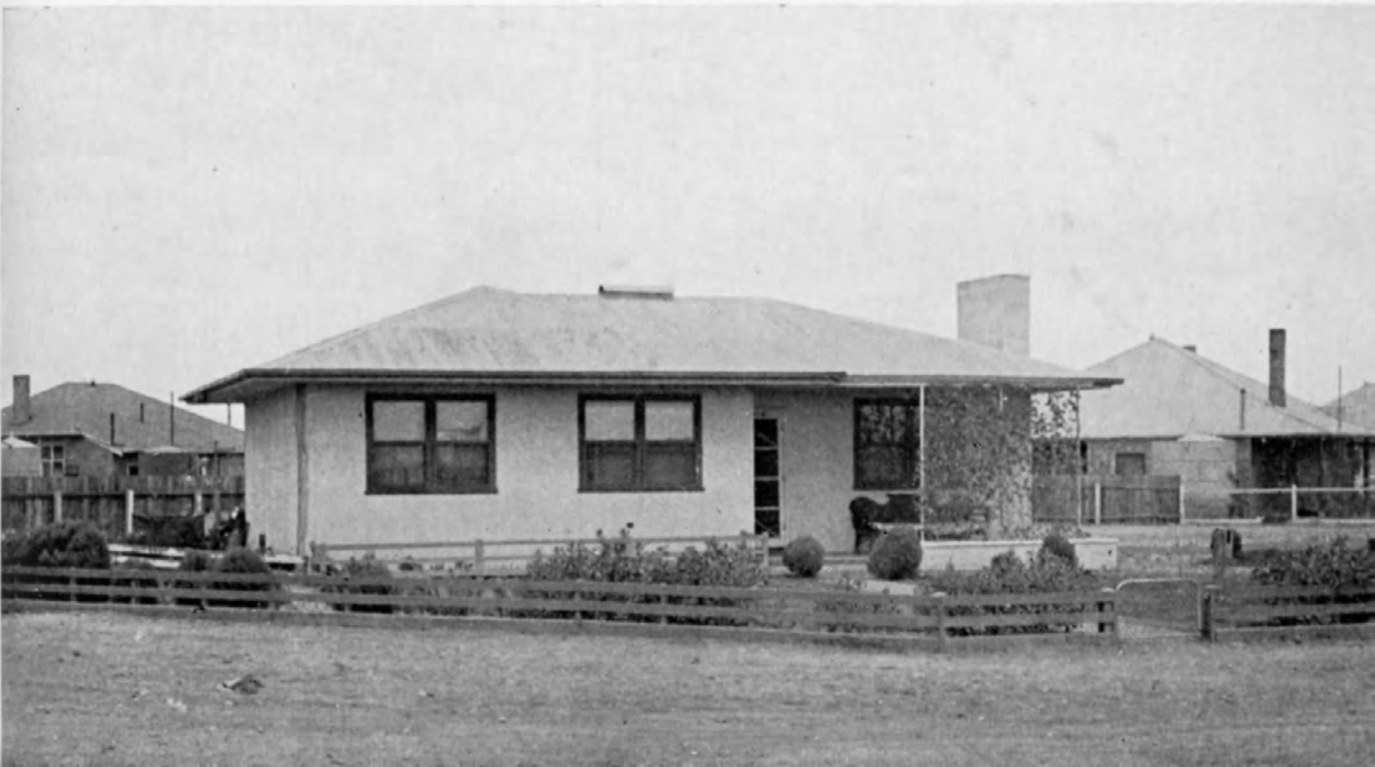
The ranges to the west of the coalfield have a strong linear form largely defined by two resistant quartzite beds having a remarkably uniform north-west south-east strike and steep easterly dip extending for many miles. The more easterly of these two quartzites is the Aroona quartzite forming the base of the Adelaide System. Its western margin coincides with a major high angle thrust, the Myrtle Springs fault, which is parallel to the bedding. On the west side of the fault lie the lower Cambrian beds with the fossiliferous Archaescyathine limestone lying under the Aroona quartzite, followed by the normal sequence down to the upper members of the Adelaide System.

In contrast, the Ranges to the east of the coalfield have a very irregular form. The rocks are folded along axial lines trending in a west-north-westerly direction and pitching at low angles to the north-west. The same lithological units are present as in the western ranges and the structures in them are traceable across the plain and can be related to those on the western side. Local faulting complicates the structures, some faults being of considerable magnitude associated with well developed breccias. Certain major faults are the loci of basic intrusives and extensive silicification.

The most widespread horizon comprises the dolomite and flaggy slates of the Sturtian Series which, folded into broad flat pitching structures, cover a large part of the area. These beds pitch across and under the Leigh Creek plain with some local cross folding and on the western side are turned up into steep easterly dips. The Triassic coal measures lie in four structurally distinct basins in which the beds have been laid directly upon the Adelaide System rocks with no recognizable intermediary formation other than a thin basal grit. The coal measures consist of grey shales, carbonaceous shales, coal seams, and occasional

Second Street, Leigh Creek.

Typical Asbestos House.



Typical Cement Block House.

Workshop Area from Crushing and Grading Plant.

ferruginous sandstones attaining a thickness in the case of the Telford basin of at least 1,900ft. In general, the beds dip radially from the margins towards the basin centres, but in several instances they have been folded and dips as high as 65° are recorded. Fold axes are colinear with some of those defined in the adjoining basement rocks. Faulting in the coal measures is fairly common, particularly in the deep Telford basin.

Overlying the coal measures is a surface conglomerate horizon up to 20ft. in thickness. It is unconformable upon the grey shales and post dates the faulting of the coal measures. The conglomerate is in turn overlain by the gypseous clays and boulder conglomerates of the Eyrian tableland formation which masks large parts of the area.

The Triassic deposition at Leigh Creek provides one of the few clearly defined records of sedimentation in South Australia between the Cambrian and the Tertiary, and some interesting inferences can be drawn concerning the sequence of events leading up to and following the formation of the coal measures. The coal measure beds are fine grained shales and coal seams such as could only be formed under fresh water swamp conditions with sluggish drainage and little or no nearby physiographic relief. Since the coal measures are laid directly upon folded Adelaide System rocks with no intervening sediment except a thin basal grit, it appears that immediately prior to Triassic times the land surface was an eroded rock shield. The next stage calls for the gradual development of shallow depressions by gentle warping of the land surface. These depressions would be local centres of drainage where dense swamp forest flora developed; at no stage could drainage have been vigorous as no coarse sediments are found. The down warping process continued as sediments accumulated but with periodical respites during which the coal forests flourished, later to be buried as the process was renewed. Ultimately, it must be inferred, many thousands of feet thickness of coal measure beds were laid in the area and yet at no stage could the surrounding relief have been marked.

Sedimentation was brought to a close by a more vigorous "orogenic" movement resulting in upthrusting of the whole region with possibly the major movement taking place along the Myrtle Springs fault, coupled with a differential gentle but pronounced warping or folding of both the coal measures and the pre-Cambrian formations in the area to the east of this fault line. Whatever the precise mechanism of this complicated movement may have been, the net effect was to impose a marked vertical relief between the coal measures and the basement rocks to the east and west. The differential downwarping of the coal measures in relation to the surrounding basement rocks has led to their preservation in the four isolated basins. The new cycle which was thus initiated by the local orogeny led to the removal of thousands of feet of Triassic sediments and the later deposition of coarse sediments on the eroded coal measure remnants. There is evidence to suggest that deposition occurred in two distinct post-Triassic periods but this has not been fully substantiated.

Probably the most notable feature of the regional geology of the Leigh Creek area is the infolding of the Triassic coal measures into the basement rocks. This conclusion has been established with a fair degree of certainty although the regional geological study has not yet been completed. The genetic relationships of the folding and faulting in the coal measures and in the pre-Cambrian rocks have yet to be worked out in detail, as also the broad relationship of these to the Myrtle fault.

The geological plan (fig. 1) shows in a generalized way the present-day relation of the coal basins to the surrounding basement rocks, and the cross section is a simplified interpretation of the geology.

EXPLORATION.

The exploration of the known coal deposit, the blocking out of reserves, the compilation of detailed operating plans and sections and the search for new deposits are the particular responsibility of the Department of Mines. Exploration is carried on continuously in close detail and on a regional scale. Basic information on the structure of the coal basins and their relation to the surrounding basement rock is sought by geological mapping on both regional and detail scales, the work being based on the use of vertical aerial photographs. Detail mapping of the outcropping portions of the coal measures and the plotting of general structure from bore information serves to guide the boring programme in the search for further mining sites.

Boring is carried out under geological control in the selection of sites and in the checking of samples. A description of the boring equipment and methods appears below.

As a further aid to exploration, geophysical methods have been used in areas which are completely masked from geological examination by more recent deposits. Several deep bedrock depressions have thus been located and test drilled but so far without discovering new coal deposits.

BORING EQUIPMENT AND PRACTICE.

Initial exploratory drilling was carried out with a portable rotary plant constructed in the Mines Department workshops. This plant comprised a Sullivan type "H" hydraulic head powered by a 20 h.p. Buda petrol engine. Size NX holes were drilled providing a 2⅛in. core. Later, trial holes with a percussion drilling plant using a specially devised sampling tool showed that this method was both a faster and cheaper technique. Percussion drilling was commenced with six Horwood Bagshaw type "500" portable plants. These plants although satisfactory for the purpose, have now been largely replaced by the more modern Ruston Bucyrus type 22W machine, capable of drilling a 5in. hole to 800ft. depth. This plant is mounted on an all-steel chassis with dual pneumatic wheels. It is powered with a built-in 20 h.p. twin cylinder high speed Ruston Hornsby diesel engine. Engine power is used for hoisting the telescopic lattice steel derrick in which is incorporated a rubber shock absorber for the crown sheave. Total weight of the plant is six tons without drilling tools. It is readily manouvreable in open country by truck towage.

Drilling plants are operated by a crew of two men per machine, under the supervision of a resident drilling foreman, with geological control by a resident Mines Department geologist. When circumstances permit, plants are grouped to facilitate servicing and supervision. Holes are drilled 5in. in diameter and in most cases without casing. A plain chisel bit and sludge pump are used when drilling in shale, the sampling tool being substituted when carbonaceous material is reached. The sampling tube comprises a 15in. tube of 2in. internal diameter flared to a cutting shoe at one end and threaded at the other. This is attached to an anvil block integral with a guide tube carrying an anvil which is attached by a guide rod to the sinker bar. In operation the sampling tube and anvil blade remain stationary at the hole bottom and are driven down by blows from the anvil and sinker bar. Approximately 8in. of sample is cut at a time, the core being forced out of the tube by a hand operated screw press.

All sample material is placed in 7 lb. press top tins by the driller and this material, together with sludges, is logged by the geologist and samples selected for analysis.

During 1950, approximately 57,000ft. of drilling was completed by an average of eight operating plants. Drilling speed varies considerably with the skill of the operator and to a lesser extent with the nature of the ground. A skilled driller has averaged 40ft. per eight hour shift. Operating costs during 1950 averaged 10s. 4d. per foot drilled.

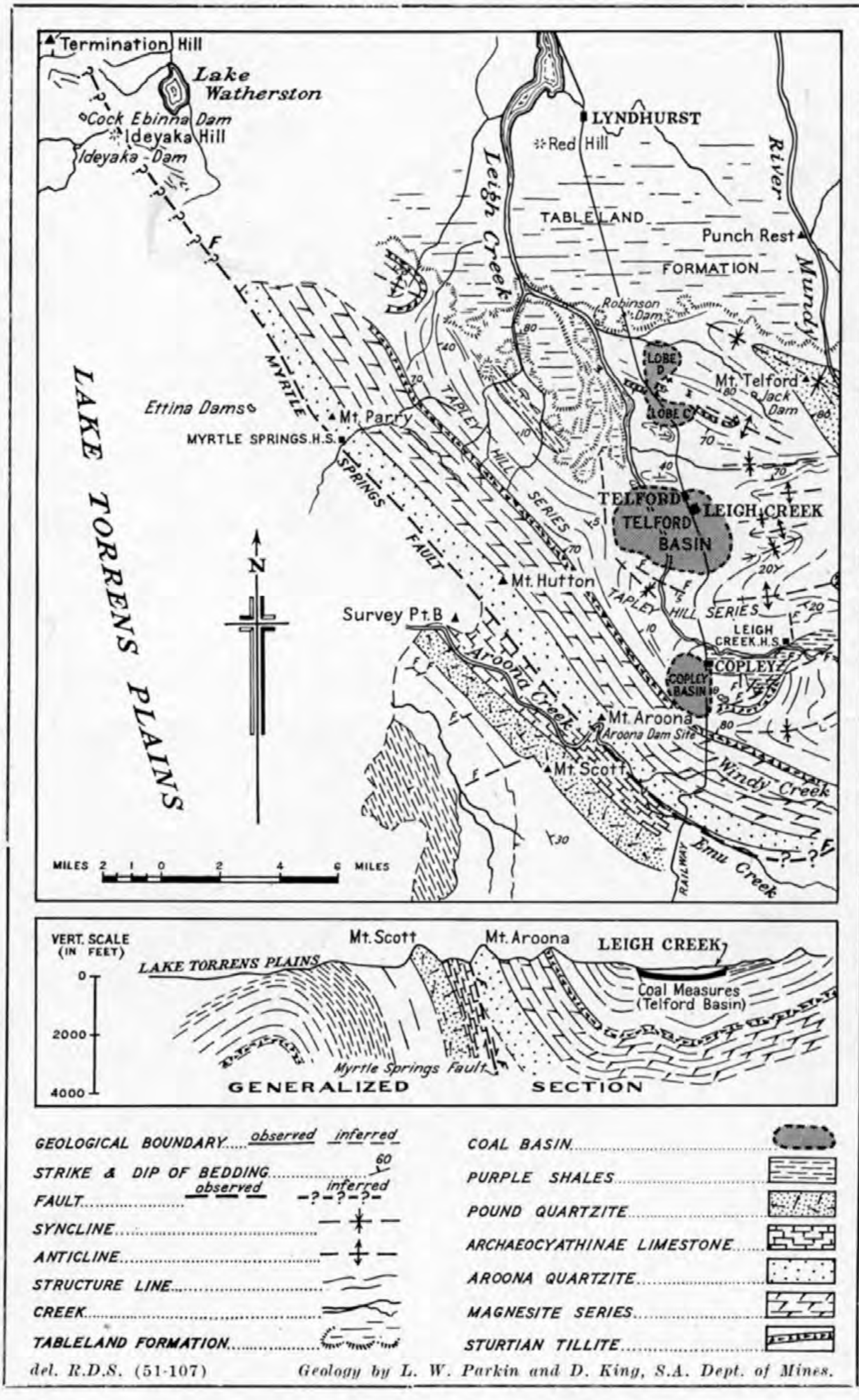
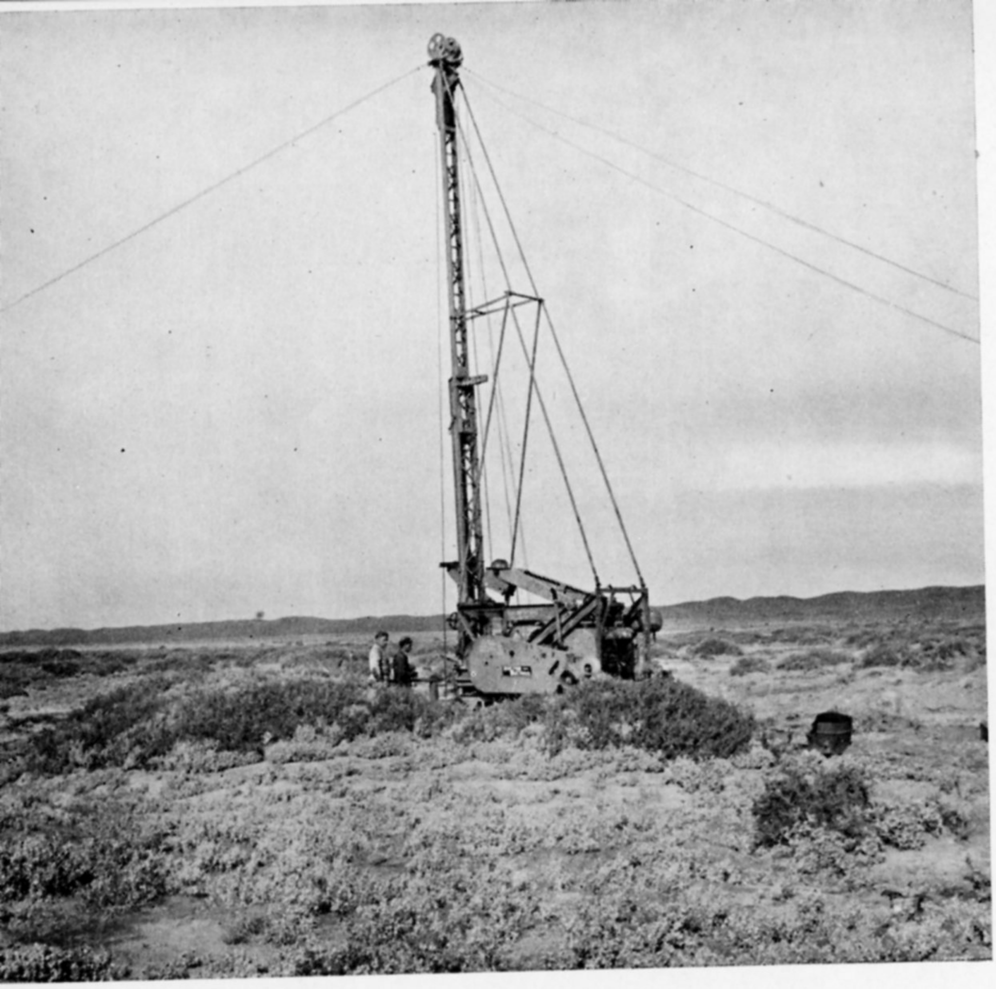
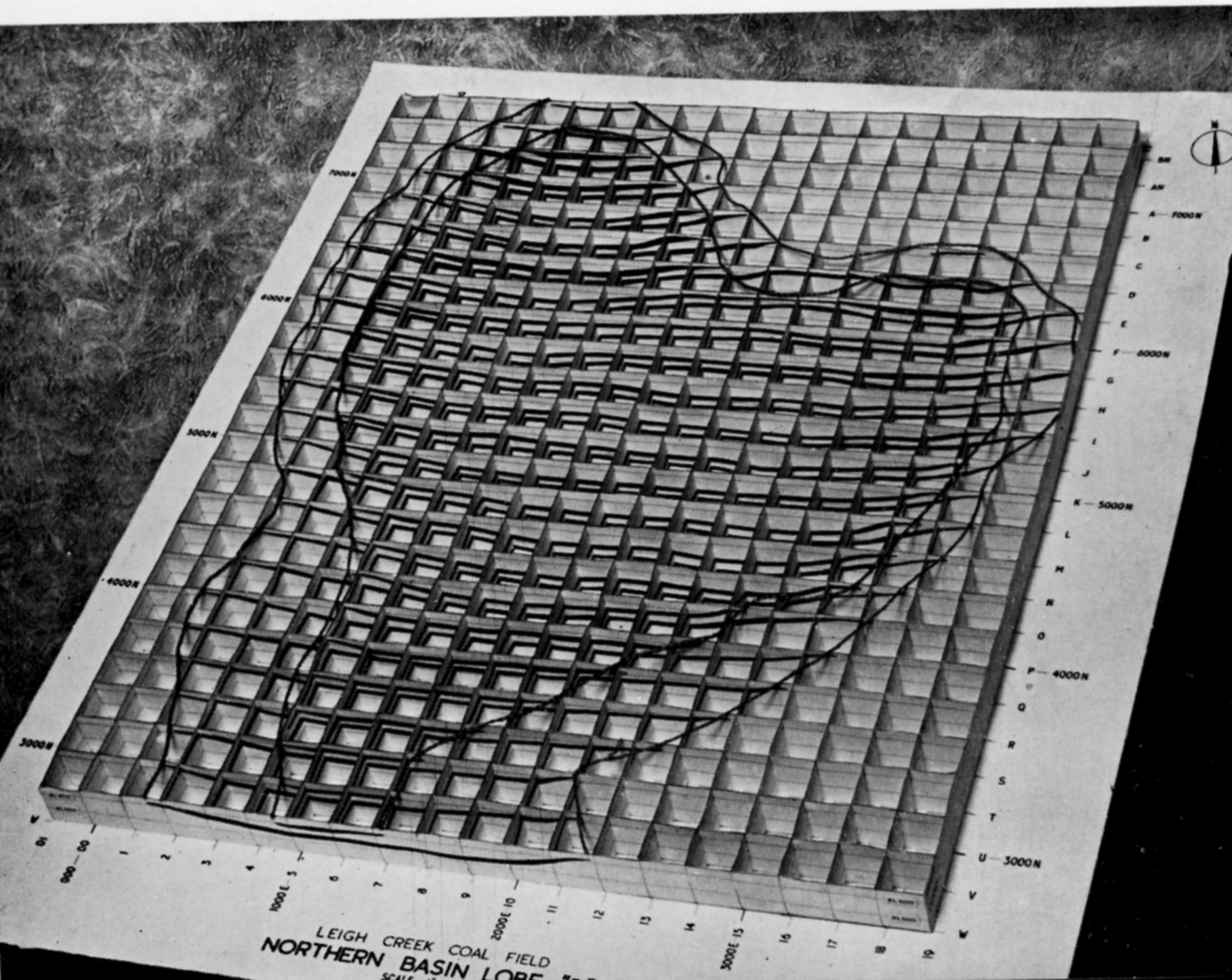


Fig. 1.—Map of Leigh Creek Area showing Regional Geology.



Leigh Creek: Ruston Drill Rig.

Model of North Field Showing Two Seams.



THE COAL BASINS.

1. The North Field.

The north field lies five miles to the north of Leigh Creek township. It comprises two distinct deposits connected by a narrow neck of Triassic shales. The more northerly, known as Lobe D, is the larger, covering an area of some 200 acres and containing important coal reserves. The southern lobe (Lobe C) has seams of high ash coal, parts of which may provide open cut sites. Exploration of Lobe C is still in progress.

Lobe D contains two main coal seams, the upper one being 30ft. in thickness over the greater part of the basin, and the lower between 20ft. and 25ft. thick lying 30ft. below the upper seam. The two seams have an irregular saucer like structure, lying close to the surface at their margins and dipping at low angles toward the centre of the field, the depth of the upper seam below the surface ranges from less than 20ft. at the margin to 145ft. at the centre. The lower seam flattens at the south end of the basin and forms an apron of shallow coal which approaches the northern end of Lobe C.

An interesting feature of the upper seam is the fact that a portion of the south-western, southern, and south-eastern marginal area has been affected by natural combustion. Bores have penetrated considerable thickness of baked shales and coal clinker and these also outcrop along the south-western margin.

Boring is still in progress on Lobe D, but preliminary estimates show that the upper seam contains 10,300,000 tons of coal and the lower seam 10,700,000 tons.

2. Telford Basin.

The Telford basin is the site of the original exploratory work and is the source of current production from the field. The basin covers an area of some nine square miles and is nearly circular in shape. The main coal seam approaches the surface around the northern and eastern periphery of the area where it has a normal thickness of 40ft. and an average dip of 15°-20°. For certain zones the seam is divided by shale partings into two or three bands. Areas for opencast mining have been blocked out by boring along these margins, and elsewhere on the southern and western margins, exploratory drilling to locate the main seam has been undertaken and is still in progress. Considerable faulting has occurred in several sectors of the proved areas so that close boring has been necessary to provide adequate information for extraction purposes.

Underlying the main seam, and separated from it by 300ft. of shale, is a thin lower seam concerning which very little is yet known. The old No. 2 bore which was sunk about one mile south of the present Telford cut passed through the main seam between 1,496ft. and 1,544ft. and the lower seam between 1,849ft. and 1,852ft.

The behaviour of the coal measures in the southern and western portions of the basin is not yet clearly understood. It is evident that the beds have here been folded into a synclinal structure and it is hoped that further boring will prove the existence of new reserves. Recent boring has established evidence of an upper seam with a thickness of 20ft. in this area. It is dipping steeply and is being traced by boring to assess its potentialities.

Reserves of opencast coal proved since exploration began amount to approximately 5½ million tons and probable reserves, not yet completely established, a further 2 million tons. It is not expected that the total open cut reserves of the Telford Basin will exceed 10 million tons. Insufficient deep boring has been done to make any estimate of reserves available for underground mining, but it appears they will be substantial.

A typical cross section of the open cut portion of the main seam is shown in figs. 2 and 3.

3. Copley Basin.

This area lies five miles south of Leigh Creek township adjacent to the Copley railway siding. A single bore sunk in 1918 penetrated Triassic shales and thin coal seams to a depth of 781ft., but failed to locate any seam of minable thickness. Recently the area has been under reinvestigation and a seam 7ft. 6in. in thickness has been disclosed at a depth of 106ft. 6in. Further boring has successfully traced this seam over a considerable area and drilling is still in progress.

COAL WINNING.

Open cut working has been adopted, the whole of the material overlying the coal (viz., the "overburden") being removed prior to the excavation of the coal. This method can be applied economically so long as the cost of removing the overburden does not become too great a proportion of the total cost of winning the coal. In due course, when the coal reasonably close to the surface has been won, it may be necessary to resort to deep mining. Because of the considerable depth at the centre of the Telford seam and because of the steep slope towards the centre at the edges it will only be practicable to use open cut methods over a relatively narrow strip round the edges, and then only at places where the edge of the seam approaches close enough to the surface. The whole of the coal in the northern field, on the other hand, is close enough to the surface to be won by open cut working when sufficiently large excavating plant has been obtained.

It is not practicable for various reasons to use the specialized types of plant which are common to the Victorian and German brown coal fields. Chief among these reasons are the hardness of the overburden and coal, the steep slope of the seams, the prevalence of shale bands in the coal, and the extensive "faulting," *i.e.,* sudden changes in depth or slope of the seam due to the coal bed having been broken by prehistoric subterranean disturbances. (Such a fault may be seen in the coal seam in fig. 2.) Because of these difficulties it is preferable to use conventional but more versatile earth moving equipment, such as dragline and shovel excavators, bull-dozers, scrapers, etc. Both overburden and coal are loosened by blasting before being picked up by the excavator.

The excavating plant at present on the field is as follows, the capacity of the bucket, in cubic yards, being indicated in each case:—

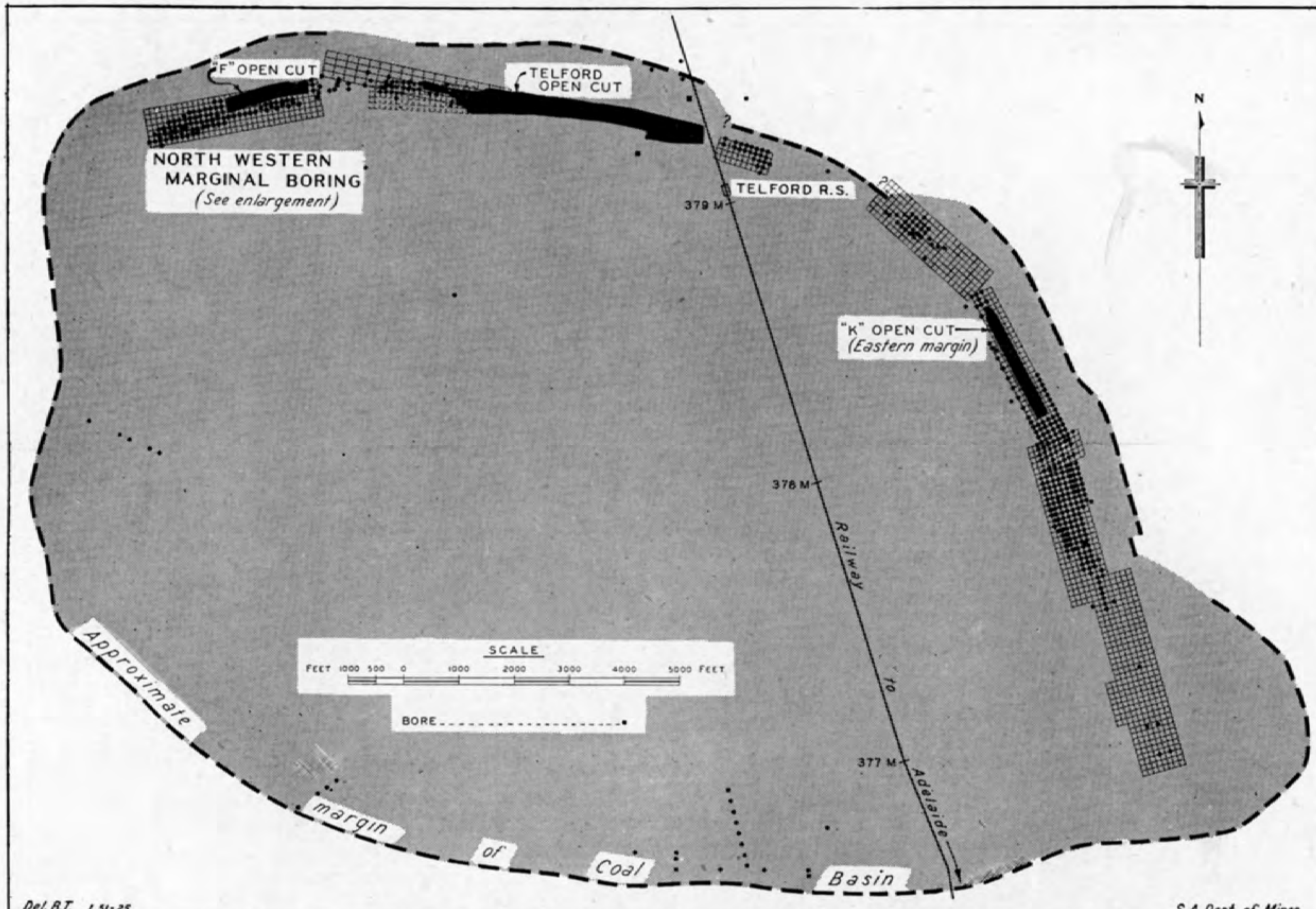
Draglines.	*Shovels.*
55 RB (2½)	Northwest 2 (1½)
Harman M (2½)	Northwest 3 (1½)
Northwest 1 (1½)	Lorain 82 (2)
Bucyrus 9W (10)	100-RB (3½)
	Osgood (2)
	Link Belt (2½)

Many of these excavators are unsuitable for large scale production, but it was necessary to make the best of whatever plant became available; most of the units were secondhand when purchased.

Of the existing excavators the 9W Dragline is by far the largest and most spectacular. It can be fitted either with a 10 cubic yard bucket and 160ft. boom or 7 cubic yard bucket and 200ft. boom.

With the 200ft. boom fitted and operating at an angle of 35° to the horizontal the top of the boom is approximately 125ft. above ground level. As an indication of its size, compare this with the tallest building in Adelaide, the C.M.L., which is 132ft. 6in. high.

Instead of the customary caterpillar tracks, the 9W is fitted with walking gear by means of which it lifts its 460 tons weight in 7ft. 6in. steps, giving a normal walking speed of 0·15 m.p.h.



Leigh Creek Coalfield, Main Basin, showing Gridded Areas.

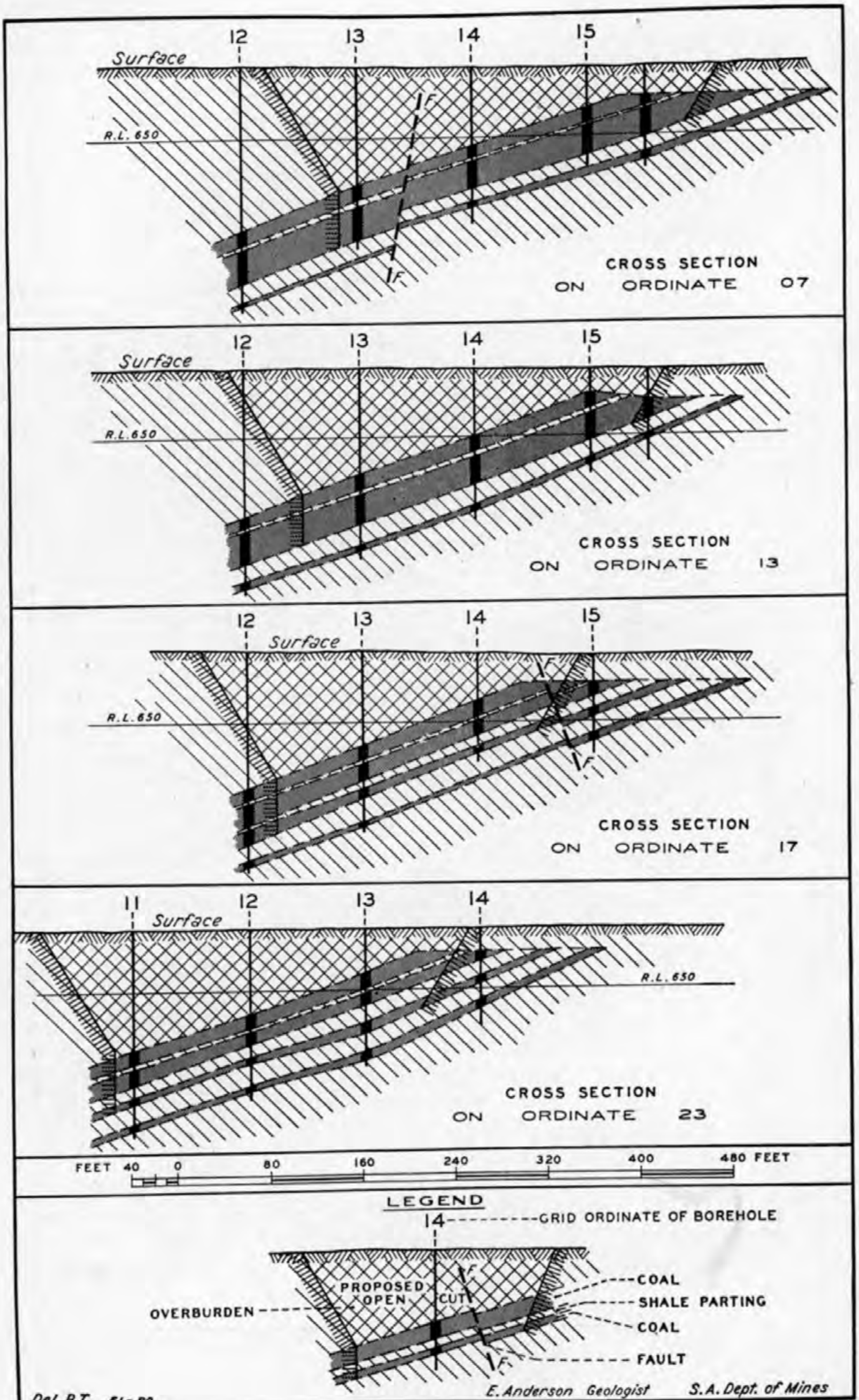


Fig. 2.—Leigh Creek Coalfield Main Basin. Typical cross sections of North-Western Marginal Area.

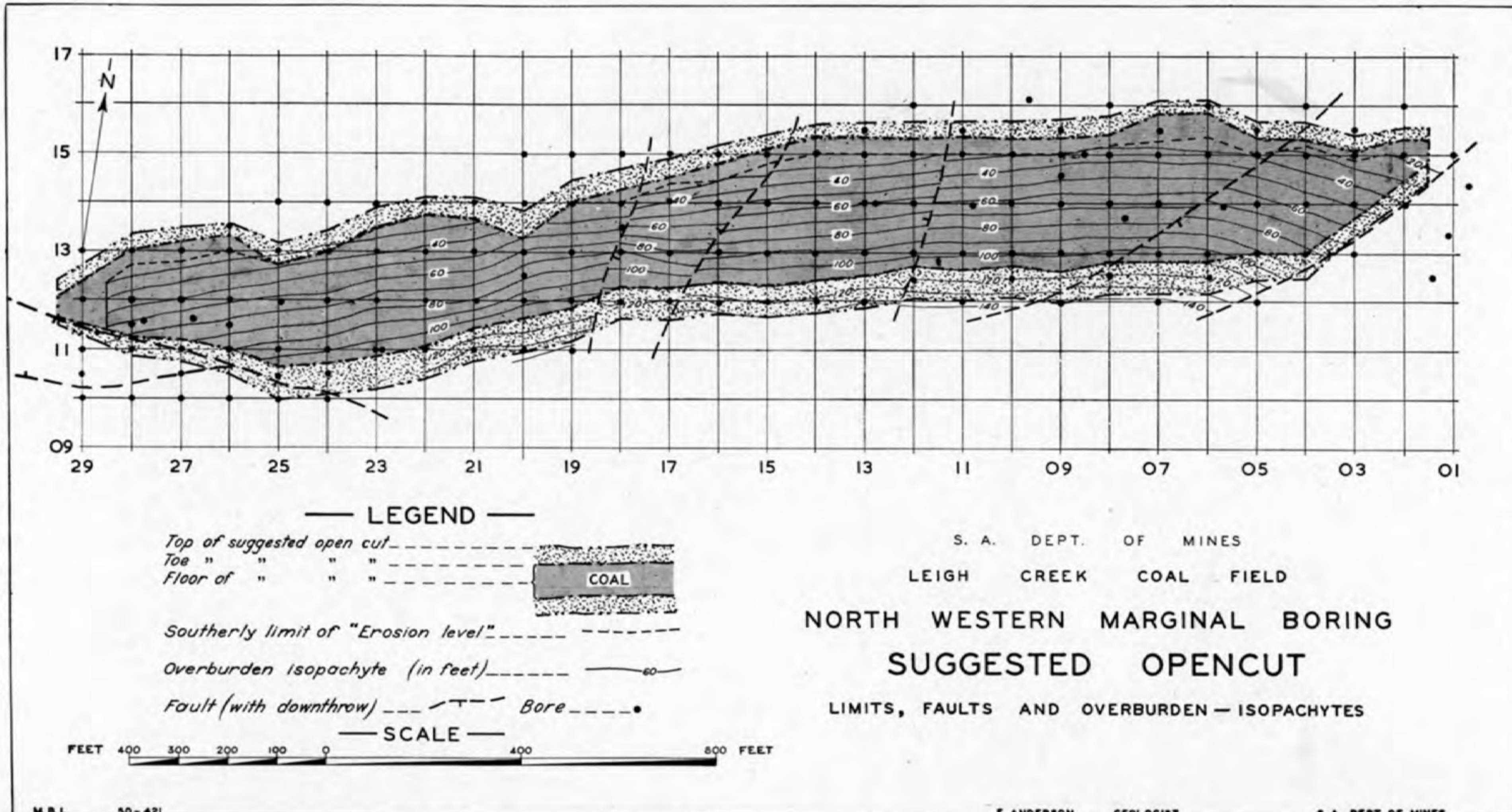

S. A. DEPT. OF MINES
LEIGH CREEK COAL FIELD
NORTH WESTERN MARGINAL BORING
SUGGESTED OPENCUT
LIMITS, FAULTS AND OVERBURDEN — ISOPACHYTES
LEGEND
Top of suggested open cut
Toe " " "
Floor of " " "
COAL
Southerly limit of "Erosion level"
Overburden isopachyte (in feet)
60
Fault (with downthrow)
Bore
SCALE
FEET 400 300 200 100 0 400 800 FEET
N
M.B.L. 50-421
E. ANDERSON GEOLOGIST
S. A. DEPT. OF MINES

Fig. 3.

*C

North Field Open Cut.

Telford Open Cut.

Blasting.

Harman Dragline.

Osgood High Lift Shovel.

To permit the retirement or disposal of some of the small excavators now in use, orders have been placed for two (2) 5W walking draglines. These draglines are really a smaller version of the 9W machine. They can be fitted either with a 4 cubic yard bucket and 135ft. boom or 5 cubic yard bucket and 120ft. boom. Delivery is expected of one in 1951 and the other in 1954.

In the past, overburden and coal were loaded by the excavators into motor trucks for removal from the cut. However, motor transport is costly, and will be reduced to a minimum in future operations. The 9W dragline is used for overburden removal, and the length of its boom is sufficient for it to deposit its spoil, for the most part, clear of the workings. It has the further advantages that it is able to dig overburden at a faster rate and to a greater depth than was practicable in the past. The main function of the 5W dragline will be to remove the layer of shale which separates the upper and lower seams of the Northern basin. The 3½ yard shovel will then probably be used for coal winning, together with some of the existing smaller equipment.

Although the large draglines should eliminate the use of motor trucks for overburden removal, there remains the problem of carrying the coal from the excavators to the crushing and screening plant.

To reduce costly truck transport of coal 2,500ft. of 36in. conveyor has been purchased and should be in operation shortly. This conveyor, running at 300 feet per minute, will carry 250 tons per hour.

The Telford open cut still being operated was opened by the Engineering and Water Supply Department in 1943 and has been worked ever since. This cut, nearly a mile in length, extends westward from the railway line along the northern edge of the Telford seam.

Two more cuts are now being worked in the Telford basin—one known as "F" cut about ¼ mile to the west of the main Telford cut, and "K" cut on the eastern boundary of the basin.

Plans have been prepared for a rail siding, and a crushing and grading plant at "K" cut. This will enable coal to be loaded into trains at the cut and save the expensive truck transport of coal from the cut to the Telford crushing and grading plant. When "K" cut is worked out (in approximately five years time) it is intended to shift the major portion of the plant to the North Field.

The North Field was opened in 1948 and a considerable quantity of coal from the top seam has been removed, particularly during the New South Wales coal strike of 1949, when maximum output was essential. Under present conditions, however, working of the North Field is unfavourable because the coal must be carried some 5 miles in motor trucks to the crushing and screening plant at Telford. It is improbable that this field will be worked until crushing, screening, and loading plant, and a railway siding have been established close to it. Thereafter it will probably be, for many years, the main centre of production.

OUTPUT OF COAL.

Since the field was opened, roughly 3,900,000 cubic yards of overburden have been removed and 1¾ million tons of coal won. Of the total coal won, about 400,000 tons of fines have been stock-piled, the balance having been delivered to rail.

The maximum weekly production occurred during the 1949 coal strike, and amounted to 18,300 tons of coal won. The maximum weekly quantity delivered to rail was 13,400 tons. It would not have been practicable to maintain these emergency outputs continuously, however, with the then existing plant, for the plant normally engaged on overburden removal had been diverted to coal winning.

It is not possible to forecast with a high degree of accuracy the rate of growth of output. This is dependent not only on the capacity of the plant to produce coal, but also on the potential demand for it, and the most important "unknown" affecting the demand will be the ability of the New South Wales coalfields to meet the growing requirements of the State. However, it is expected that the output will reach about 800,000 tons per year within five years.

COAL CRUSHING AND SCREENING.

At present, motor trucks deliver coal to a crushing and screening plant at Telford. The lorries tip the coal into a hopper from which it is fed to a crusher wherein the size is reduced to a maximum of about 5in. From the crusher the coal is carried by a conveyor to the screens, where it is separated into three different sizes—below $\frac{7}{16}$in., $\frac{7}{16}$in. to 2in., and 2in. to 5in. The "fines" below $\frac{7}{16}$in. are at present very little used, and most of this coal is carried away in lorries and stock-piled nearby. The other two grades are loaded into railway trucks beneath the screen house for transport to consumers.

RAIL TRANSPORT.

At present most of the coal is brought to Adelaide. It is carried by the Commonwealth Railways on a 3ft. 6in. gauge line to Quorn, whence it is taken (in the same trucks) by the South Australian Railways to Terowie. At Terowie a "tippler" plant empties the 3ft. 6in. gauge trucks into 5ft. 3in. gauge trucks, in which the coal is carried to its destination.

When the Port Augusta power station comes into operation, it is probable that half or more than half of the output (including most of the fines) will be railed to Port Augusta, being transported by the Commonwealth Railways throughout. Because of the increased quantities which will then need to be transported, it is understood that the Leigh Creek to Port Augusta line will be given a high priority in the national scheme for rail standardization. The sidings and coal handling equipment at the North Field and at the Port Augusta power station site are being designed to facilitate conversion to standard gauge when the time comes.

THE NATURE AND QUALITY OF THE COAL.

Leigh Creek coal is broadly described as sub-bituminous in character, that is to say, intermediate between the woody or earthy brown coals and the harder black bituminous coals. Much of the coal is dull black in appearance, but there are numerous narrow bands of bright lustrous coal in the seam. The coal is a hydrous one, containing between 30 per cent and 40 per cent moisture in its raw state and, like all hydrous coals, it disintegrates on air drying.

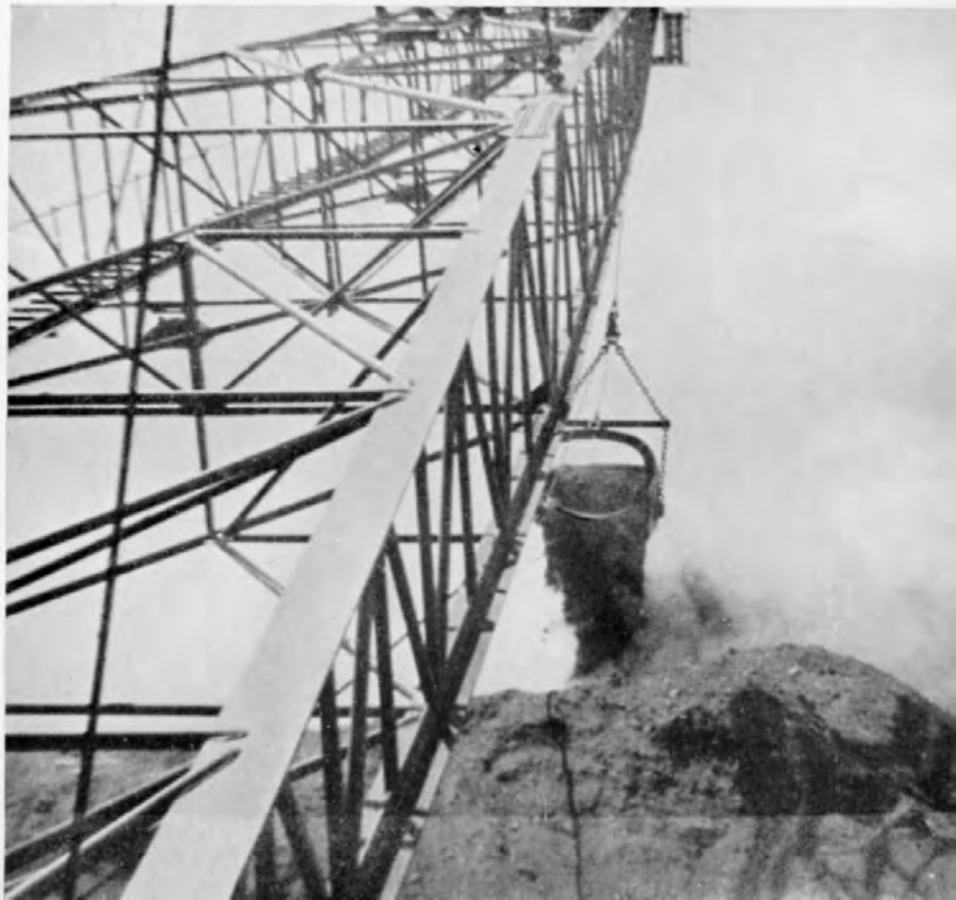
It is customary to compare coals by a study of their "proximate" analyses, which show the percentage of moisture, volatile matter, fixed carbon, and ash in the coal. In addition, separate determinations of sulphur content are usually made. "Ultimate" analyses are also carried out to show the percentages of the elements carbon, hydrogen, nitrogen, sulphur, and oxygen, and any others which may have a bearing on a particular investigation.

With Leigh Creek coal, the chief variable is the ash content, although the moisture content frequently shows an apparent variation thought to be mainly due to differing sampling conditions. In order to enable a direct comparison of the other constituents, proximate analyses are usually recalculated to a standard moisture basis. The following tabulation shows typical proximate analyses for each seam at Leigh Creek.

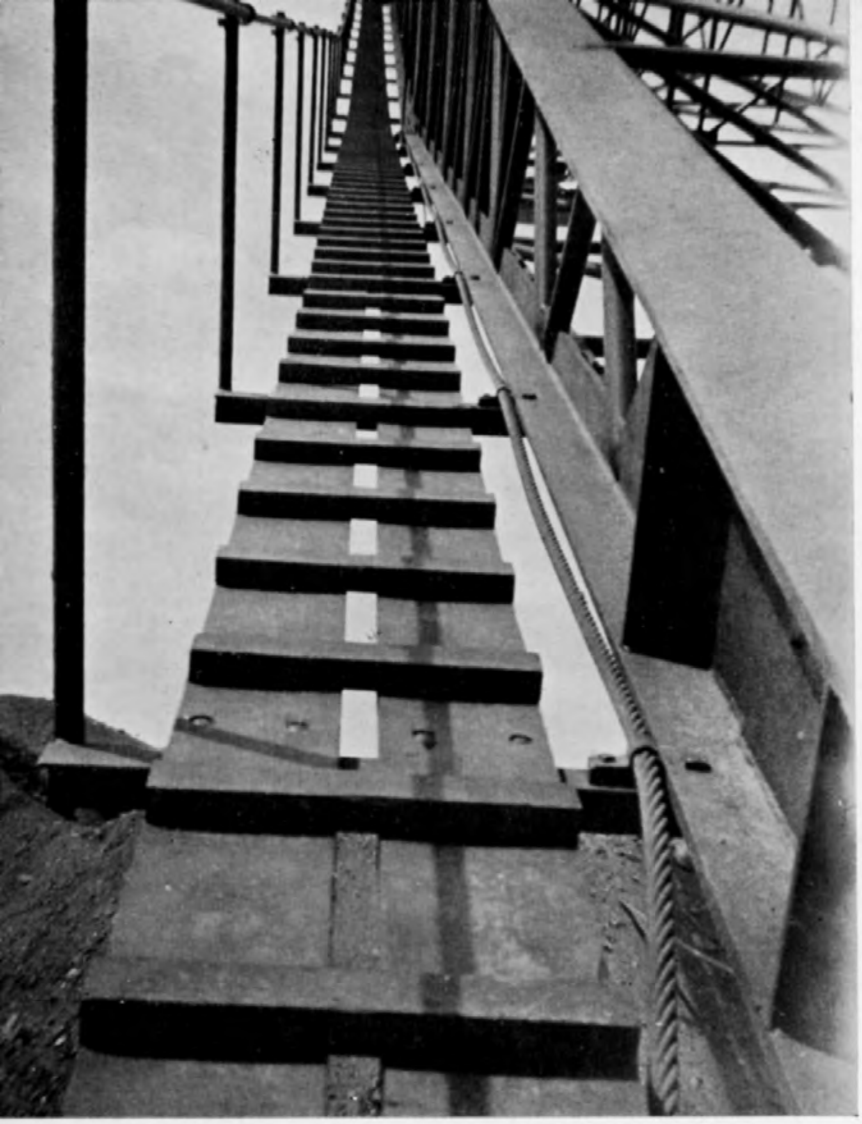
LEIGH CREEK COAL—PROXIMATE ANALYSES.

		Standard Moisture Basis.			
	Moisture (as sampled).	Moisture.	Volatile.	Fixed Carbon.	Ash.
	%	%	%	%	%
Telford Basin	33·8	12·0	28·1	37·7	22·1
Lobe D, Upper Seam	38·0	12·0	32·2	45·2	10·6
Lobe D, Lower Seam	35·8	12·0	30·2	40·9	16·9
Lobe C	29·1	12·0	27·5	34·6	25·9
Copley Basin (two bores only)	37·8	12·0	28·4	44·5	15·1

9W Dragline.



View from Operator's Cabin, 9W Dragline.

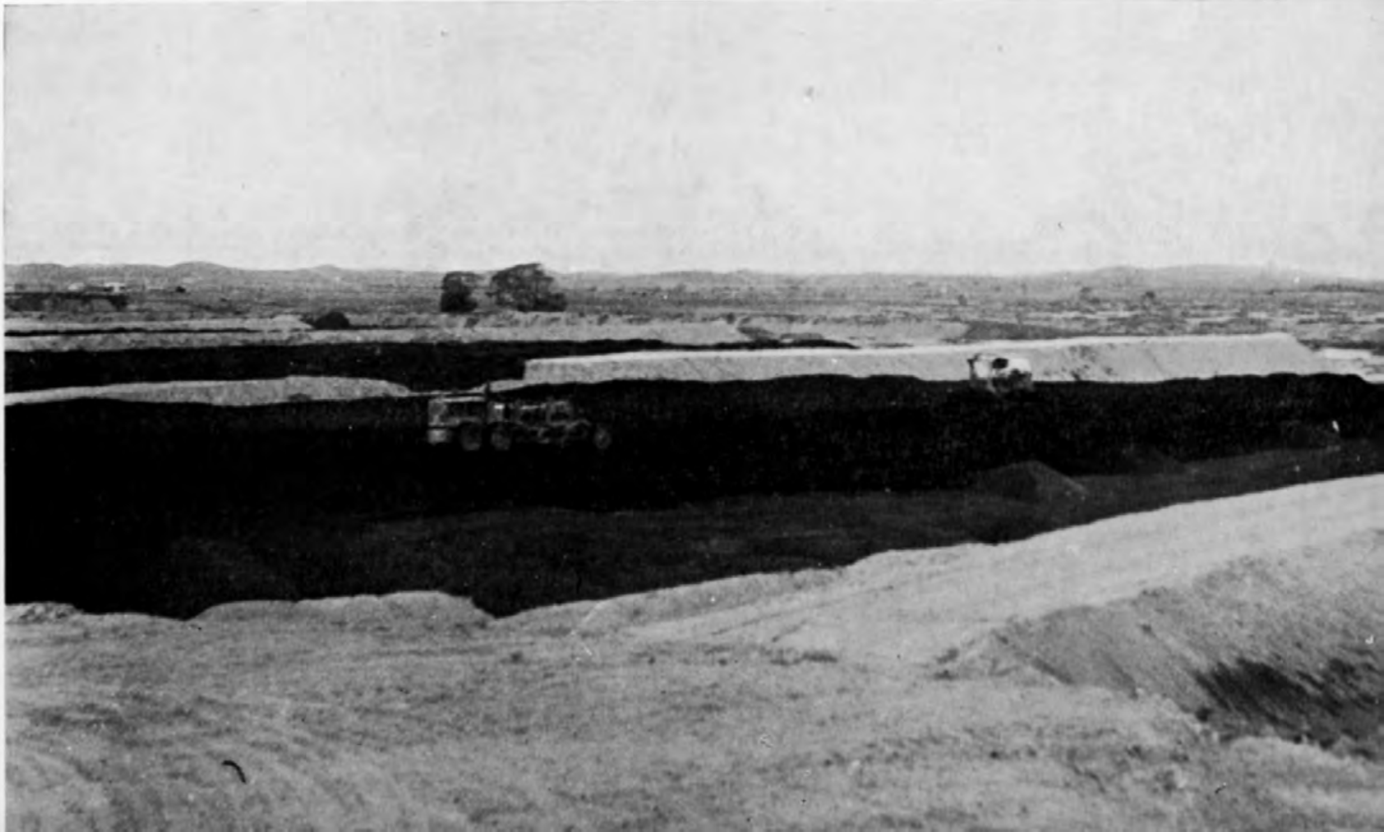


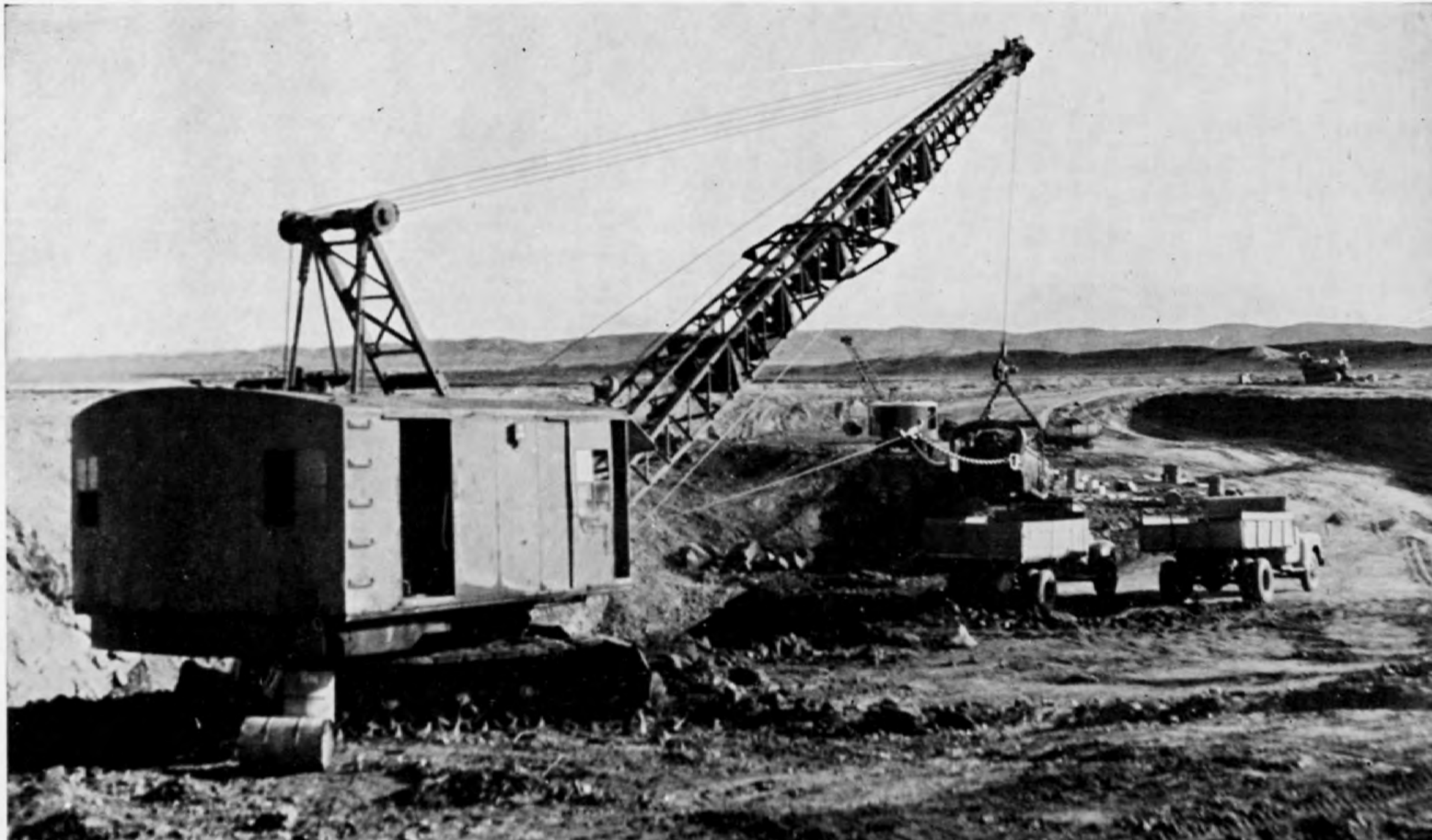
Looking Up Walkway of 9W Dragline Boom.

9W Dragline Bucket.

K Cut from Top of 9W Dragline.

Stockpiling of Fines.





Stripping Overburden, North Field.

The calorific value of a coal is an expression of its energy value in terms of heat and from many points of view is the most significant laboratory determination made. Leigh Creek coal has a calorific value equal to about half that of Newcastle black coal; on the other hand, its value is such that two tons of Leigh Creek coal would have a heating capacity equivalent to three tons of brown coal. The following table shows average calorific values for Leigh Creek coal.

LEIGH CREEK COAL—CALORIFIC VALUES—B.T.U. PER LB.

	As mined.	Standard 12% moisture.
Telford Basin	5,960	7,750
Lobe D, Upper Seam	6,620	9,400
Lobe D, Lower Seam	6,350	8,700
Copley Basin (single bore)	6,456	9,134

Sulphur is an undesirable constituent in a coal for any purpose, and when in excess of 3 per cent serious difficulties are experienced in dealing with the flue gases during combustion. In general, Leigh Creek coal is reasonably free from sulphur, but the Lobe D, lower seam, is a notable exception with an average sulphur content of 3·3 per cent.

COMPARISON WITH OTHER AUSTRALIAN COALS.

Type of coal.	Moisture. %	Volatile. %	Fixed carbon. %	Ash. %	Calorific value, B.T.U. per lb.
N.S.W. steam	0·64	23·18	65·21	10·97	13,345
N.S.W. typical	4·2	31·2	45·9	18·7	11,010
N.S.W. gas	1·96	40·57	50·74	6·73	13,055
Collie, W.A.	20·98	24·58	47·53	6·91	9,380
Moorlands, S.A.	52·0	20·4	13·5	14·2	4,300
Wonthaggi (Vic.)	6·92	36·88	48·08	8·12	13,110
Leigh Creek (Telford)	33·8	21·2	28·4	16·6	5,960
Victorian lignite	64·0	19·4	15·9	0·7	3,900

POWER GENERATION.

A steam power plant at the North Field has recently been commissioned. The boilers in this plant are equipped with B. & W. Detroit spreader stokers and successfully burn the Leigh Creek coal "fines" (— 7/16in). Two turbo-alternators of total capacity 1,400 kw. are installed; extensions already planned will increase this capacity to 4,400 kw. The need for such a plant is due mainly to the high peak demands of the electric excavators. In particular, the "9W" dragline makes momentary demands in excess of 1,000 kw., and with the regenerative control provided on the machine, a total load swing of 1,500 kw., over roughly a one minute cycle, is imposed upon the station.

WATER SUPPLY.

One of the chief difficulties is water supply. The present supply is pumped through a pipeline from bores at Sliding Rock, roughly 28 miles from Telford. This water is poor in quality and there are signs that the quantities available, particularly in drought years, will be below requirements. Moreover, the hardness of the Sliding Rock water is such that expensive treatment is necessary to render it suitable for power station use.

To overcome this water shortage, preliminary work has begun on a 1,650 million gallon dam at Aroona Gorge, which is about 8 miles from Telford. In spite of an evaporation rate approaching 100in. per annum, it is considered that enough water can be impounded during the infrequent floods to meet the requirements of the field.

UTILIZATION OF LEIGH CREEK COAL.

Coal production at Leigh Creek during 1949-50 totalled 438,873 tons, making a total of 1,425,242 tons since open cut production first began in 1943.

The anual tonnages of coal produced, stock-piled, and sold since operations commenced were:—

Year.	Coal produced. Tons.	Coal crushed and graded. Tons.	Fine coal stock-piled. Tons.	Coal sold, including fines. Tons
1943-44	8,955	—	—	8,325
1944-45	37,206	—	—	37,836
1945-46	90,840	72,408	10,252	80,588
1946-47	207,414	207,414	45,296	162,118
1947-48	275,894	275,894	69,393	206,501
1948-49	366,060	366,060	69,869	289,500
1949-50	438,873	438,873	122,131	310,859
Total	1,425,242	1,360,649	316,941	1,095,727

The fine coal, stock-piled on the field, will be used in the Port Augusta power station now in course of construction.

For comparative purposes the quantities of coal imported into South Australia from New South Wales and overseas are shown in the accompanying tables and it will be seen that the production from the Leigh Creek field is now supplying an appreciable proportion of the State's coal requirements. About 50 per cent of the Leigh Creek coal is used for electric power generation, 34 per cent in industry, 15 per cent by the Commonwealth and State Railways, and 1 per cent for domestic use.

CONSUMPTION OF LEIGH CREEK COAL.

Year ended 30th June, 1950—

	Tons.
South Australian Railways	33,475
Commonwealth Railways	12,164
Heat, light, and power—	
Gas	3,519
Electricity	150,914
Secondary industries, etc.	112,124
Bagged coal	4,547
	316,743

Individual industrial consumers number more than 250 and approximately 80 per cent of the State's industries, which depend on steam (excluding the public utilities), are now using Leigh Creek coal in varying quantities up to 100 per cent of the total fuel consumed. In addition, during the winter months of 1950 the domestic consumption reached 250 tons per week, notwithstanding the fact that rationing was necessary to maintain supplies to industry.

This remarkable expansion in the use of Leigh Creek coal, although attributable chiefly to the shortage of black coal, has been in no small measure due to the keen public interest in the development of the field and the determination of those concerned to avert, if possible, a serious dislocation of local industry consequent on the shortage of coal supplies.

The following notes outline some of the highlights of the expansion and the progress made in the utilization of Leigh Creek coal.

As it comes from the mine Leigh Creek coal carries from 25 per cent to 35 per cent moisture and from 5 per cent to 25 per cent ash. Its calorific value, as mined, ranges from 6,000 B.T.U. to 6,500 B.T.U. per lb. and although in

Coal Crushing and Screening Plant, Telford.

Tipping Coal at Crushing and Screening Plant.

DISTRIBUTION OF COAL CONSUMPTION IN SOUTH AUSTRALIA 1940-1949.

(Year ending 30th June.)

Classification.	1940.	1941.	1942.	1943.	1944.		1945.		1946.		1947.		1948.		1949.	
					N.S.W.	Leigh Creek.	N.S.W.	Leigh Creek.	N.S.W.	Leigh Creek.	N.S.W.	Leigh Creek.	N.S.W.	Leigh Creek.	N.S.W.	Leigh Creek.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Factories—																
Cement and cement goods	14,418	16,664	21,207	19,487	17,418	2,179	14,510	4,590	13,689	6,479	13,243	12,147	16,783	10,510	18,991	10,521
Bricks, tiles, and pottery	11,110	16,385	14,985	7,357	6,681	—	6,953	65	8,664	339	9,976	1,182	12,639	681	14,675	542
Chemicals	4,830	23,044	30,920	31,744	30,114	1,895	35,496	6,789	32,514	6,961	38,260	2,265	36,854	4,146	37,269	4,428
Metals, machinery and conveyances	12,446	15,562	26,924	26,889	24,944	—	18,015	3,297	15,648	2,314	16,792	4,982	8,344	6,962	6,306	11,233
Woolscouring, spinning, and weaving	5,537	7,406	9,908	9,352	9,290	46	9,208	—	8,325	1,758	3,181	10,922	2,639	11,047	1,828	18,443
Food and drink	19,335	19,337	23,476	30,784	29,096	255	28,098	815	23,706	5,780	20,648	18,280	19,553	22,060	13,694	31,770
Other factories	5,257	7,189	16,723	45,839	27,744	5,715	9,817	6,014	4,887	3,461	1,670	728	2,414	4,326	1,624	8,676
Heat, Light and Power—																
Gas	80,779	84,934	101,116	113,909	117,818	—	118,223	—	121,907	—	109,790	—	126,238	—	125,389	—
Electricity	172,980	192,766	223,737	246,763	234,646	8,730	253,441	12,638	237,207	32,614	246,647	45,695	250,274	85,069	245,260	145,849
Railway locomotives	224,396	256,288	339,291	409,067	408,346	—	390,281	—	365,055	7,952	323,974	31,582	352,550	31,171	374,537	32,207
Shipping (bunker)—																
Overseas	4,875	1,921	16,178	4,635	7,470	—	7,077	—	7,814	—	4,914	—	10,321	—	7,090	—
Interstate and intrastate	8,703	14,841	17,012	17,088	17,330	—	13,705	—	28,398	—	18,014	—	17,312	—	20,445	—
Mining and quarrying	258	212	410	380	—	—	—	—	—	—	—	—	—	—	—	—
Private, domestic, hotels, theatres, etc.	785	1,213	1,357	1,110	904	—	844	—	200	1,267	—	680	—	818	—	4,275
Commonwealth Government Port Augusta (other purposes)	—	—	—	—	—	—	—	—	—	—	1,456	500	1,061	345	1,131	426
Total	565,709	657,762	843,244	964,404	931,801	18,820	905,668	34,208	868,014	68,925	808,565	128,963	856,982	177,135	868,239	268,370

COAL IMPORTS INTO SOUTH AUSTRALIA FROM NEW SOUTH WALES AND OVERSEAS, 1926-1950.

Year.	Imported by Sea.						Railed to South Australia via Broken Hill.	Total.	Exported to Broken Hill via Port Pirie.	Total Coal Imported for Consumption in South Australia.
	Osborne and Port Adelaide.	Port Pirie.	Port Lincoln and Thevenard.	Wallaroo.	Port Augusta.	Whyalla.				
June—	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1926	423,627	235,772	9,175	11,638	24,985	—	—	705,197	141,349	563,848
1927	562,451	310,839	12,895	16,137	28,299	—	—	930,621	166,724	763,897
1928	544,502	280,343	14,088	6,662	29,066	—	—	874,661	133,432	741,229
1929	377,394	176,790	6,585	4,393	27,112	—	—	592,274	85,503	506,771
1930	461,993	225,115	7,643	1,683	25,600	—	—	722,034	107,001	615,033
1931	294,109	135,307	7,303	1,030	24,051	—	—	461,800	57,459	404,341
1932	298,577	57,087	5,368	621	10,647	—	—	402,300	17,963	384,337
1933	324,858	70,464	8,392	1,127	14,608	—	—	419,449	7,601	411,848
1934	317,604	75,541	5,227	488	18,380	—	—	417,240	6,964	410,276
1935	338,167	83,475	7,721	1,231	17,205	—	—	447,799	8,111	439,688
1936	370,127	99,341	3,392	820	28,147	—	—	501,827	10,361	491,466
1937	434,194	93,764	4,053	1,205	22,493	—	—	555,709	11,497	544,212
1938	446,316	133,896	6,052	733	29,186	—	—	616,183	12,899	603,284
1939	433,225	131,734	5,966	1,708	29,120	—	—	601,753	9,835	591,918
1940	414,266	96,763	3,015	1,282	31,919	6,540	—	553,785	8,546	545,239
1941	559,969	95,667	9,268	2,068	50,938	44,172	—	762,082	6,978	755,104
1942	666,071	64,640	—	765	62,732	13,845	—	808,053	7,019	801,034
1943	700,169	93,998	2,981	—	79,441	7,582	52,700	936,871	911	935,960
1944	687,547	85,405	6,074	—	51,322	10,859	66,480	907,687	—	907,687
1945	713,102	97,453	6,788	—	41,298	2,594	64,527	925,762	—	925,762
1946	656,469	66,191	5,104	—	41,435	10,683	62,217	842,099	—	842,099
1947	670,443	26,184	4,048	—	46,264	12,786	49,610	809,335	—	809,335
1948	736,002	8,419	7,588	—	45,776	16,182	—	813,967	—	813,967
1949	768,898	14,655	7,777	—	54,737	18,466	—	864,533	—	864,533
1950	778,460	10,824	7,282	—	54,433	15,249	3,743	869,991	—	869,991

NOTE.—Broken Hill powerhouse converted from coal fuel to oil fuel in July, 1931.

Loading Coal to Railway Trucks.

Loading Coal to Railway Trucks.

general it is reasonably free from sulphur, in one seam the sulphur content is of the order of 3 per cent to 4 per cent. Exposed to the atmosphere it disintegrates with the development of dust and fines and, if stored in large heaps, it becomes prone to spontaneous ignition. With these characteristics, so different from those of the good quality bituminous coals for which most of the coal-consuming plants within the State had been designed, it was no easy problem to effect a changeover of industry to the use of this low grade fuel with its excessive moisture and ash content.

Early in 1943 the Factories and Steam Boilers Department was commissioned by the Government to carry out a comprehensive series of tests in co-operation with private industry and other Government authorities. This department conducted experiments with hand-fired boilers, with screw stokers, with spreader stokers, with chain and travelling grate stokers of different types, and pulverized-fuel equipment using both Leigh Creek and New South Wales coal to obtain comparative performances. Gradually satisfactory methods of burning Leigh Creek coal in each particular type of plant were evolved, and at the same time data was accumulated which could be used in designing new plant specially for Leigh Creek coal. The results of much of this work have been published in the *Mining Reviews* and reference need only be made to the main developments.

Probably the most notable of the earlier achievements was the fitting of pre-ignition grates, at relatively little cost, to stationary boilers fired by chain grate stokers and designed originally to burn good quality black coal under natural or induced draught conditions. These pre-ignition grates had been used for many years in Germany for the combustion of brown coal briquettes and had also been introduced in a modified design into Victoria for a similar purpose.

The principle involved (see fig. 4) is that the front apron plate in the coal hopper of the chain grate stoker is replaced by the pre-ignition grate on to which portion of the coal on its way to the chain grate is ignited and kept burning by jets of compressed air. The coal so ignited is carried under the main fuel bed into the furnace proper and the air drawn upwards also spreads the combustion from this ignited coal through the fuel bed.

A number of large water-tube boilers are now operating very satisfactorily with pre-ignition grates using 100 per cent Leigh Creek coal as fuel. These include nine boilers at the Municipal Tramways Trust power station. In one plant, Leigh Creek coal dust, screened from the coal prior to entering the stoker hopper from the bunker, is blown into the furnace above the fuel bed. In other plants oil-assisted ignition has been considered necessary, and recently a number of plants have been provided with forced draught fans to increase the rate of combustion with very satisfactory results. Modifications, such as these, to boiler plants originally operating on bituminous coals have resulted in a greatly increased use of Leigh Creek coal. In a continuous endeavour to save as much bituminous coal as possible the officers of the Factories and Steam Boilers Department are giving technical assistance to all steam users with respect to their combustion problems and where load requirements and boiler capacity permit, advice is being given on how plants can be converted at the minimum expense to burn Leigh Creek coal.

Concurrently with this expansion of the industrial use of Leigh Creek coal, two boilers specially designed to burn Leigh Creek coal were recently installed in our Osborne "A" power station. This achievement marks a major development in the utilization of Leigh Creek coal. Supplied by Riley Dodds Aust. Ltd., each with a capacity of 40,000 lb. steam per hour, operating at 285 lb. per sq. in. pressure, they were brought into commission in June, 1950, and their fuel consumption is estimated at 75,000 tons of raw Leigh Creek coal per annum.

A trial was conducted on one of the abovementioned boilers in October, 1950, a summary of which is as follows:—

Duration—6 hours.

Steam—	
Mean pressure (drum) lb./sq. in.	305
Mean pressure (superheater outlet) lb./sq. in.	279
Temperature at superheater outlet	587 deg. F.
Water—	
Total weight used (lb.)	259,000
Temperature entering economizer	182 deg. F.
Temperature entering boiler	241 deg. F.
Gases—	
Temperature at air heater, inlet	654 deg. F.
Temperature at air heater, outlet	447 deg. F.
Analysis—	
CO_2	13·3 per cent
Co	—
O_2	6·1 per cent
N_2 (difference)	80·6 per cent
Air—	
Temperature at air heater, inlet	120 deg. F.
Temperature at air heater, outlet	514 deg. F.

Draughts—

Wind box Nos.—	1	2	3	4	5	6	
Pressure under grate	0in.	·41in.	2·05in.	·83in.	0in.	0in.	W.G.
Pressure in furnace						—·01in.	W.G.
Pressure at boiler exit						— 1·08in.	W.G.
Pressure at economizer exit						—1·97in.	W.G.
Pressure at air heater exit (gas)						— 4·74in.	W.G.

Fuel—

Origin, Leigh Creek No. 3 grade (7/16in.–2in.)

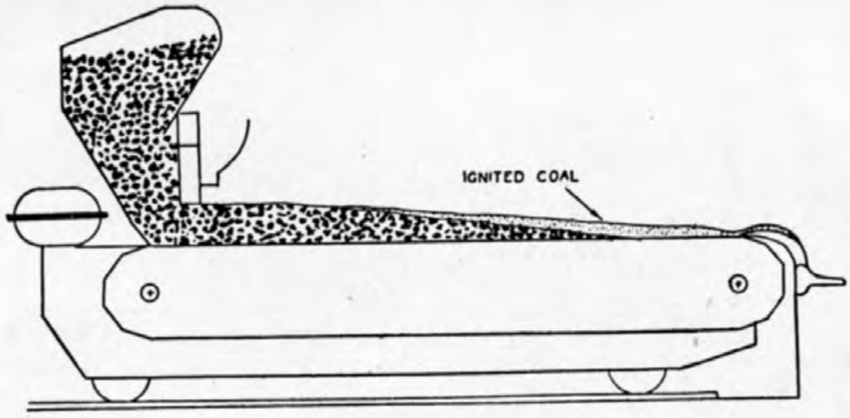
Total weight consumed, lb.	62,720
Total weight consumed lb./hour	10,453
Calorific value as fired, B.T.U./lb.	6,600
Fuel bed thickness	15in.
Grate speed	58 per cent

This boiler operated for a period of 2,961 hours on 100 per cent Leigh Creek coal prior to this test. From this test a gross efficiency of 72·45 per cent was recorded. These results are good and comparable with those using New South Wales coal, when due allowance is made for the high moisture content of Leigh Creek coal.

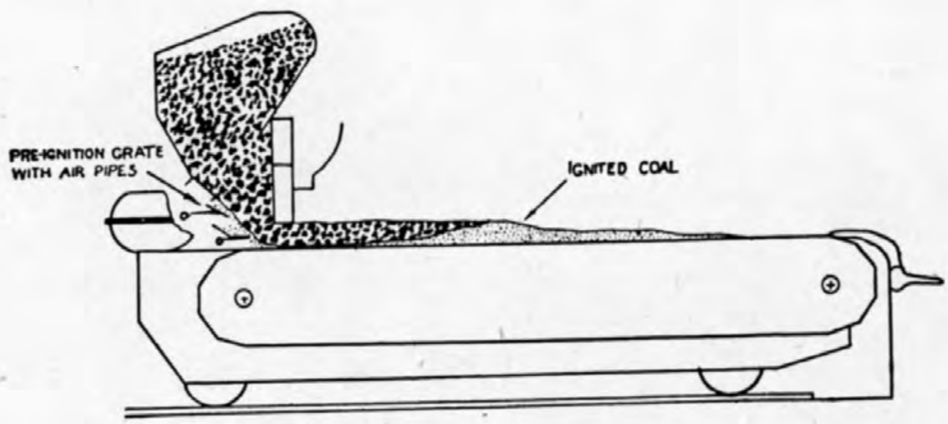
Early in January, 1951, we brought into operation a boiler plant at Leigh Creek to supply the electricity requirements of the field. This boiler plant was specially adapted to burn Leigh Creek coal containing a high percentage of fines.

Besides its use in stationary boiler plants Leigh Creek coal, mixed with New South Wales coal, has been used by the South Australian and Commonwealth Railways in locomotives for steam raising. It is also being used successfully in cement kilns and recently encouraging results have been obtained from tests in brick kilns where it is taking the place of firewood and Newcastle coal.

With regard to the use of Leigh Creek coal for cement manufacture, it is of interest to record briefly the work carried out by the South Australian Portland Cement Company in developing Leigh Creek coal as a substitute fuel. Prior to 1944 coke breeze was mixed with black coal to provide a suitable pulverized mixture for firing the cement kiln. With the shortage of New South Wales coal the company began adding Leigh Creek coal to this mixture, using existing drying



(a) Overfire Ignition.



(b) Underfire Ignition.

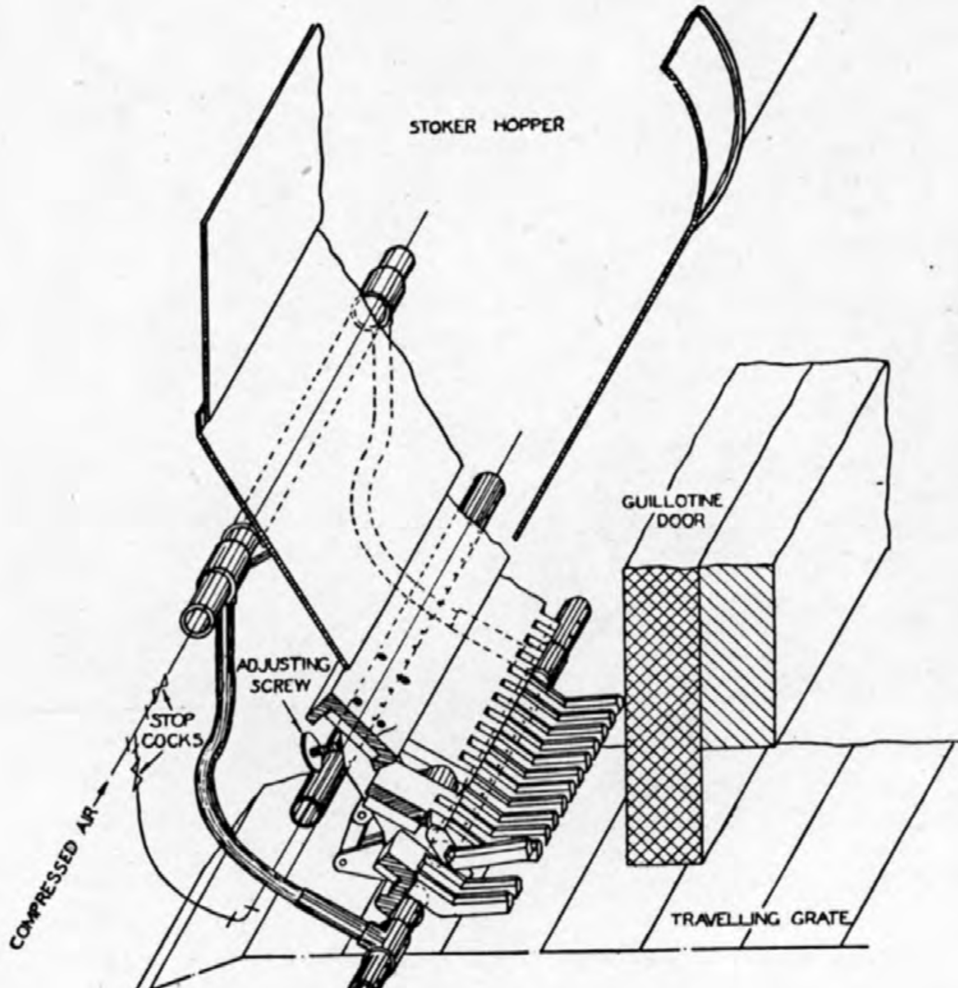
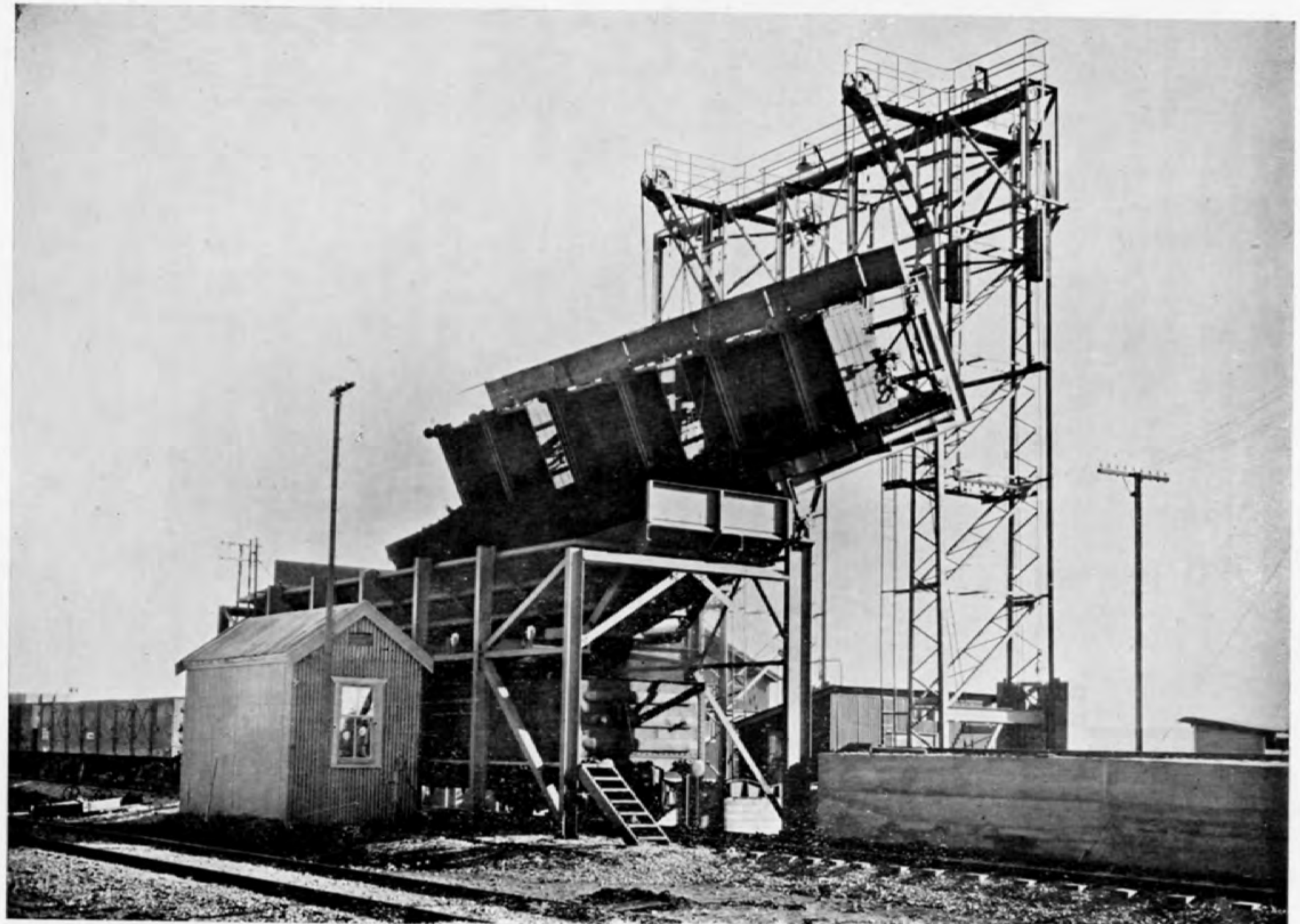


Fig. 4.



Tippler, Terowie.

Tippler, Terowie.

Steam Power Station
at North Field.

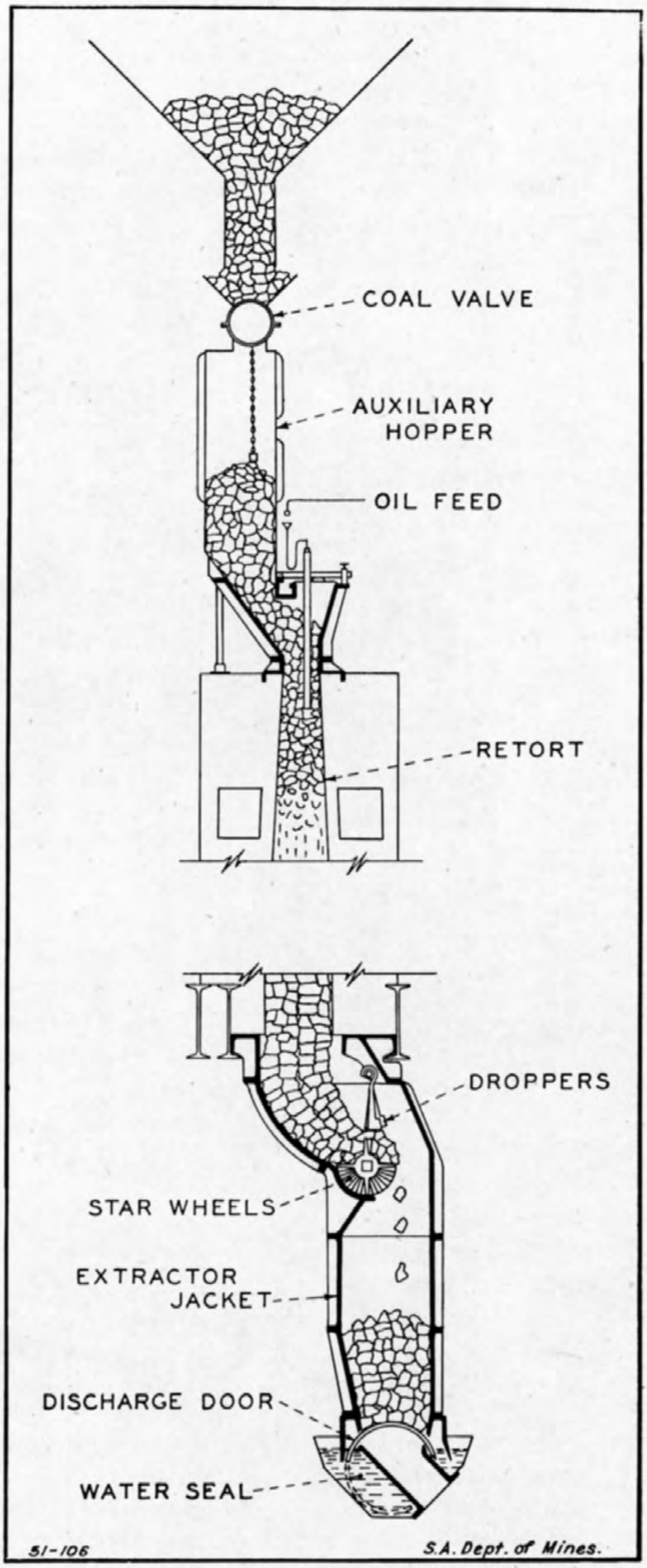


Fig. 5.—Section through W-D Continuous Vertical Retorts.

and pulverizing equipment. This equipment comprised a separate coke-fired dryer and tube mill. Designed to handle about 5 per cent moisture, this plant was soon found to be unsuitable for the high moisture content of Leigh Creek coal, and in May, 1948, was replaced with a unit swept with hot air and capable of drying and grinding in one operation.

Since its installation a fuel mixture with an average moisture content of about 15 per cent has been used, the mixture containing approximately 40 per cent of black coal, the balance being made up of Leigh Creek coal and coke breeze in varying proportions.

In view of the fact that it is hoped to use Leigh Creek coal exclusively in the new Angaston works of this company, now under construction, a three-day test was run in December, 1950, in which only that fuel was used, the result being quite satisfactory. Production was 90 per cent of normal, the reduced output being due to the inability of the feeding mechanism to provide coal in sufficient quantity.

During the test the moisture content of the raw coal ranged from 20 per cent to 28 per cent, grinding and drying being accomplished by the introduction of hot air at 1,000 deg. F. from a furnace, the mill discharge temperature being held at 160 deg. F. The steam generated was blown into the kiln with the pulverized coal, which itself contained 7½ per cent of residual moisture.

The Adelaide Cement Company also uses Leigh Creek coal fines in cement manufacture and the quantity amounts to approximately 30 per cent of the total fuel used. This company is making provision for grinding increased quantities of Leigh Creek coal. In 1952 its construction programme will be completed, and the cement plant will have doubled the capacity of the present plant.

Another notable development in the use of Leigh Creek coal concerns its use by the South Australian Gas Company during the coal strike of July and August, 1949. Although unsuitable, both from the point of view of efficiency and economical method of operation, the use of Leigh Creek coal avoided a complete cessation of gas supplies to the community. The following notes briefly outline the manner in which the South Australian Gas Company used Leigh Creek coal during this critical period.

The base-load gas-making plant consists of vertical retorts (see fig. 5). These are designed to handle a highly coking coal which is gravity fed into the small feed hopper at the retort head. As the coal travels down through the retort it is gradually heated to a temperature of over 1,200 deg. C. and swells to a semi-plastic mass. Further in its travel it slowly cools until at the base of the retort it is quenched by a water spray. The coke is pulled away from the almost solid charge by the slowly revolving star wheel and the pieces of coke fall into the bottom extractor casting to be periodically taken away by opening the semi-circular door which, when closed, dips into a water seal.

As can be seen, it is a continuous process, and the amount of coal entering the retort is regulated by the speed of the star wheel extracting the coke at the bottom.

To conserve the steadily dwindling stocks of black coal, it was decided to use a certain percentage of Leigh Creek coal which is non-coking. This was thoroughly mixed with the black coal before elevating to the retort house bunkers. The amount of Leigh Creek coal added was steadily increased up to 25 per cent without any coal "running" through the retorts uncarbonized. During this time the throughput was decreased from 4 tons per retort per day to 3·5 tons, the longer carbonizing time being needed to convert the Leigh Creek coal to a good "char."

The resulting coke from this coal mixture was not homogeneous as usual, but each piece was a heterogeneous mass of coke enveloping smaller pieces of char and unconverted Leigh Creek coal. The overall coking quality of the coal mixture was sufficient to allow the retorts to function normally.

When this percentage rose to 30 per cent, the coal began to run down through the centre of the retort unaffected, and above this quantity of Leigh Creek coal in the mixture, the coking quality of the mixture was not sufficient to hold up the charge, and the mixture of char, coke and coal ran over the star wheel and pushed the hanging weights aside. To maintain gas production under these conditions, a different working technique was followed. The extractor jacket is kept full and a set amount of the "coke" taken out at specified times, as the normal extraction gear is no longer capable of controlling the throughput.

As the quantities of Leigh Creek coal in the mixture increased, so the gas made per ton of coal and the calorific value of the gas made fell steadily from 15,000 cubic feet and 530 B.T.U. per cubic foot respectively for all black, to 10,000 cubic feet and 500 B.T.U. with 25 per cent of Leigh Creek coal in the mixture.

It is of interest to note that a small percentage of the Leigh Creek coal used seemed to be weakly coking. It was assumed from casual observation that this property was possessed by the blacker and somewhat shiny pieces of coal which were interspersed in the supplies.

This brief survey on the utilization of Leigh Creek coal shows the important part this local fuel is playing in the economy of the State. In spite of its relatively low calorific value, its high ash content, its high moisture content, and its friability, it is being used successfully in a wide range of combustion equipment.

One of the biggest problems, that of utilizing the coal fines, has been overcome by the decision to build a regional power station at Port Augusta. This power station has been designed to burn pulverized coal and will burn the fines already stock-piled at the field (approximately 400,000 tons), plus the greater percentage of all future fines produced.

RESEARCH ON LEIGH CREEK COAL.

Investigational work with the object of increasing the usefulness and production of Leigh Creek coal has been carried on continuously, and the results are published from time to time in the Department of Mines half-yearly reviews. Various authorities, both inside and outside the State, are co-operating with the South Australian Government Fuel Research Advisory Committee to provide consumers and interested persons with accurate scientific information on the characteristics of South Australian coals. It is only possible here to make brief reference to the main lines of inquiry.

Storage Behaviour of Leigh Creek Coal.

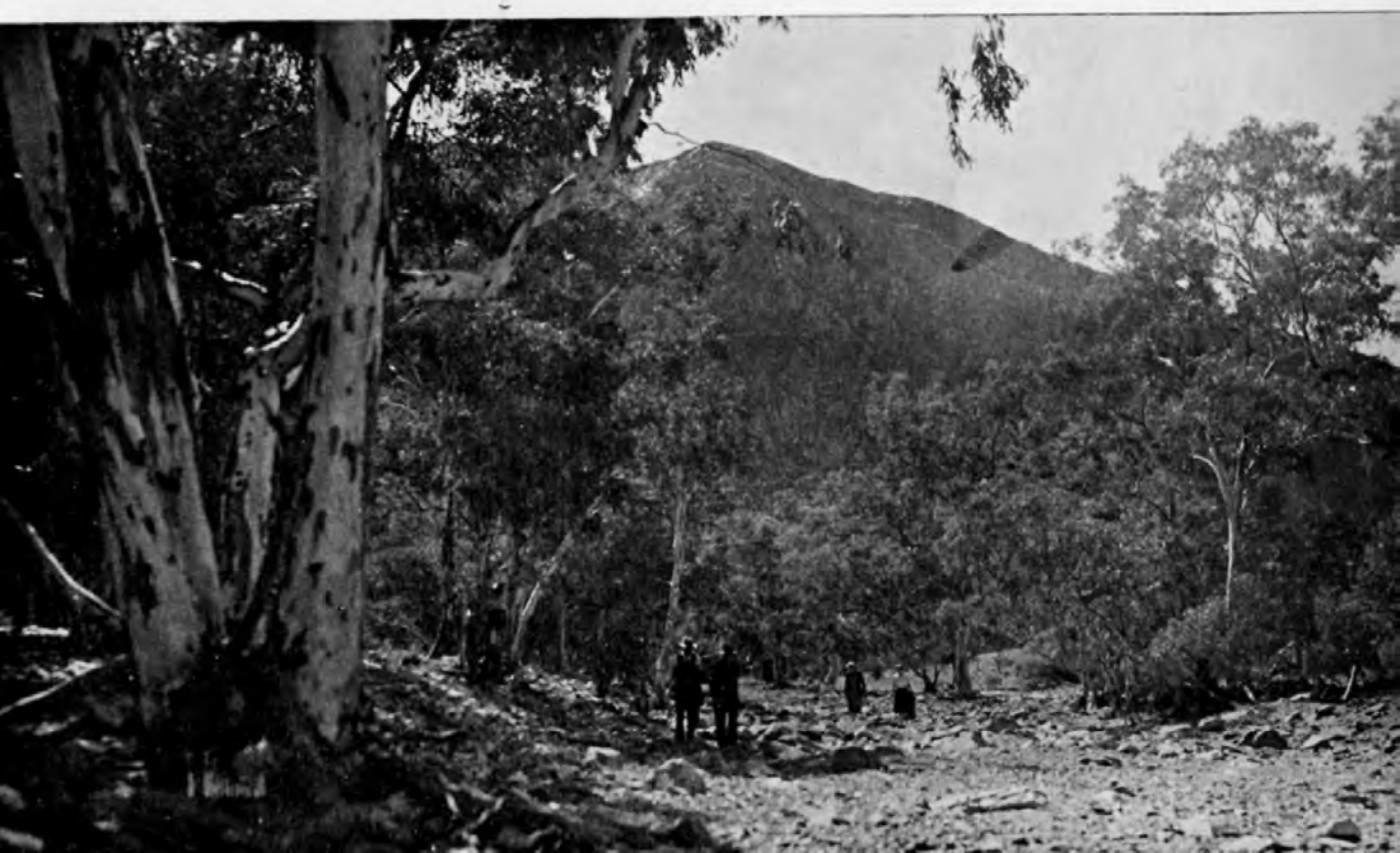
Investigations on the storage behaviour of Leigh Creek coal were begun in Adelaide in 1947. The factors influencing the rate of heating, both chemical and physical, were studied and the rates of oxidization of various Australian coals, including Leigh Creek, were measured. The results were related to the rates of heating which would take place within actual coal heaps and conclusions were reached regarding the conditions which would be least prone to permit heating to take place. It was found that the tendency to spontaneous heating within a pile of coal is dependent on the degree of compaction, the initial rate of oxygen consumption, and the height of the pile, the last factor being subject to calculation once adequate experimental data were available. Portion of this work has been carried out in the Engineering Department of the University of Melbourne and the results have provided useful information for improving present methods of storage.

Gasification.

Experimental work on the gasification of Leigh Creek coal began shortly after the beginning of coal production in 1943. The early work was carried out by the Metropolitan Gas Company, which investigated many processes of German

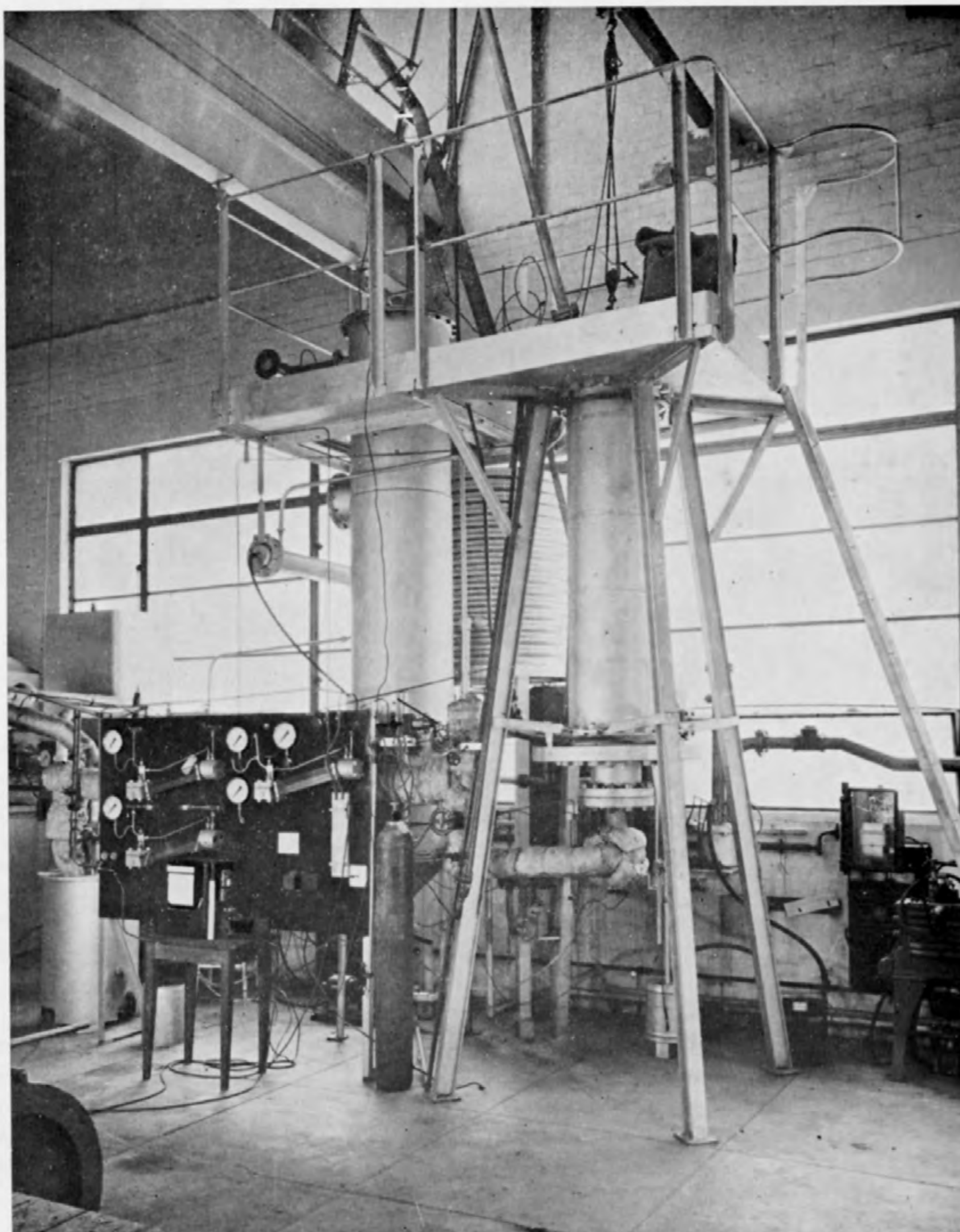
Sliding Rock.

Aroona Gorge.



Aroona Water.

Aroona Gorge.



Lurgi gasification experimental plant, University of Melbourne.

origin developed for the gasification of hydrous fuels. The Lurgi high-pressure process for complete gasification proved to be the most satisfactory for local conditions and, in consequence, researches on gasification since 1947 have been concerned almost solely with this process. Most of the experimentation is being carried out at the Melbourne University with funds provided by the Victorian and the South Australian Governments and arrangements have been made with the Lurgi Company for larger scale tests overseas.

The Lurgi process involves the complete gasification of solid fuels with oxygen under pressure leaving only the ash as a residue. It produces a mixture of water-gas and methane with a calorific value of approximately 430 B.T.U.'s per cubic foot.

A wealth of information has already been accumulated on the behaviour of Leigh Creek coal. Work recently completed has borne out the conclusions expressed by Dr. F. S. W. Danulat and E. A. Bruggeman on gas yields and composition. If it be deemed desirable to install a full-scale commercial plant at some future date, the pilot plant data already available will assist considerably in the design and construction of a suitable plant. This process has been adopted in Victoria for the production of town gas from Yallourn brown coal.

More detailed information on gasification is published in the report of Messrs. J. W. Harrod and K. H. Milne on the "Production of Gaseous and Liquid Fuels from Brown Coal" (*Mining Review* 90), and the report of the South Australian Government Fuel Research Advisory Committee on the "Lurgi Gasification Process in Relation to its Possible Development in South Australia" (*Mining Review* 91).

In addition to this research work on the Lurgi process investigations by the South Australian Gas Company have been carried on continuously with a view to using greater quantities of Leigh Creek coal in their existing plants.

This investigational work has comprised the production of producer gas in static and mechanical grate generators.

Although the results of these tests were most encouraging for the production of good quality producer gas, it is thought that a generator with the conventional type of rotary grate in unsuitable for handling a fuel with such a low ash fusion temperature.

The Power-Gas Corporation has an adaption of the standard rotary grate which incorporates raking bars to keep the top of the fuel bed agitated and so obviates the necessity of stopping the gas output to break up the clinker forming in the upper section of the fire. This has been used successfully in New Zealand to handle a coal of somewhat similar ash fusion point.

If this clinker trouble could be overcome, there is little doubt that a good quality producer gas up to 165 B.T.U. per cubic foot could be continually and economically produced from Leigh Creek coal.

From the test run in the production of carburetted water gas, it is obvious that Leigh Creek coal can be used in the standard unit equipped with the conventional type mechanical grate. It will be realized, of course, that a loss of capacity from the plant is unavoidable. Under ideal working conditions, Leigh Creek coal would yield 60 per cent of the gas obtained when using coke, which is the normal fuel in the water gas plants, but 50 per cent would be a better figure to work to if continued operation was attempted.

Briquetting.

Briquetting of Leigh Creek coal without the use of a binder has been the subject of research investigation for several years. In 1943, Professor Robin carried out preliminary experimental work at the Engineering School of the University of Adelaide, and later in 1946 Mr. D. R. Blaskett found that satisfactory briquettes could be made if the coal is properly sized and if the moisture content is carefully controlled. It was also demonstrated that the briquettes could be stored under cover on dry floors without deterioration, but they would not withstand direct contact with water. It was necessary, therefore, to find a suitable method for improving the weathering properties of the briquettes before they could be regarded as a commercial fuel.

In 1949 tests were carried out by the Lurgi Company in a ring-roll press, but the briquettes so produced still failed to withstand wetting. It is considered likely that a marketable fuel, resistant to weathering, can be produced by pre-heating the coal, prior to briquetting. A process involving the combination of briquetting and carbonization has already been successfully applied to certain low-grade coals overseas, and this and other treatment methods appear to be worthy of investigation. Our decision to build a power station at Port Augusta has overcome the need to find a means of utilizing the fines at present being stock-piled on the field. Consequently, a solution of the briquetting problem is not of very great importance as the power house has been designed to burn the coal in pulverized form. The power station on the field itself is already utilizing this fine coal. Messrs. J. W. Harrod and K. H. Milne of the Trust undertook a comprehensive survey of the briquetting problem in relation to the development of the field and their report entitled "Notes on Briquetting of Coal" is published in *Mining Review* 89.

Steam Drying of Coal.

The steam drying of Leigh Creek coal has been the subject of very detailed experimental work. The process is attractive in that it reduces the moisture content of the coal and also the slacking properties, thereby effecting a saving in transport costs and in losses due to the development of excessive fines. It has been investigated in several countries, but so far no commercial development has resulted. Much of the work carried out in South Australia on Leigh Creek coal is probably in advance of work elsewhere largely on account of the process being particularly suited to South Australian conditions. Further experimental work is planned, but as in the case of briquetting, the urgency of finding a method of up-grading the fuel is not so great as the greater proportion of the production will be consumed at Port Augusta.

COMBUSTION STUDIES.

Extensive experimental work has been carried out to determine the behaviour of Leigh Creek coal during its combustion on a fuel bed.

This work was initiated by local authorities, and was subsequently taken further by British boiler manufacturers. As a result of these investigations it was possible to design new boilers, and adapt existing plant to burn Leigh Creek coal.

It is to be expected that with further research, greater uses will be found for this fuel and, as a consequence, increasing demands for Leigh Creek coal can be anticipated.