LEIGH CREEK COALFIELD

SOUTH AUSTRALIA 1946

The Leigh Creek Coalfield

History and Development

By

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Plate 1.—Coal.

Plate 2.—Aroona Gorge.

Plate 3.—Aroona Gorge.

INTRODUCTION.

We Australians take our high standard of life and abundant luxuries very much for granted. In the same way we are quite unconscious, except when strikes or wars interfere with smooth supply, that coal, which seems so common-place, is perhaps the main prop upon which our present standard of living relies.

It is the only substance in the world of which there is enough available at present to provide the light and heat and power that make modern civilization possible. With the possible exception of atomic energy there appears to be no substance ever likely to oust it from its proud position.

It is interesting to note that figures compiled in 1935 showed that the world's industrial energy, calculated on a heat basis, was derived as follows:—60 per cent from coal, 16 per cent from oil, 13 per cent from wood, 7 per cent from water power, and the remaining 4 per cent from natural gases, wind, etc.

The exact date of the first discovery of coal in the world is lost in the mists of antiquity. The ancients appear to have realized that here and there on the surface was found a black substance that could be burnt to provide warmth. The Greeks seem to have used some coal over 2,000 years ago. The Romans worked coal faces in Britain and the tools they used are still being discovered. Marco Polo, who made his first journey to China in 1271, mentions as one of the curiosities of Chinese life the use of a "sort of black stone" as fuel.

It was not until the 17th century that coal was used in any industrial process. From time immemorial the industries of England had used wood and charcoal for heating, and in particular, charcoal for smelting iron ore. In the Elizabethan period, shipbuilding, glassmaking, and saltmaking took large amounts of wood. The forests became fewer and fewer. The sheep-growing and woollen industries discouraged the planting of new trees. Iron works had to move constantly to find a forest that was not depleted. Progress was hampered by the lack of charcoal for smelting.

Necessity proved to be the mother of invention. One Dud Dudley, in 1619, is credited with being the first to smelt iron ore with coal; but history claims Abraham Darby, a Quaker, as the founder of the present process of smelting iron ore with coke made from coal. This was in the early 18th century. His discovery marked the real beginning of coal mining.

Increased production caused more and deeper mines. Flooding became a major problem and difficulties arose with regard to ventilation, haulage, and hoisting in the coal pits. The perfection of the steam engine solved these obstacles, and following the resultant increase in industrial life and enterprise came the need for better transport. The building of the first railway and the cutting of the first canal in England were due to the need for cheaper coal transport in the service of industry.

Thus coal was both a cause and an effect of the Industrial Revolution.

Rapid progress in transport facilities followed, new industries arose, and a long period of industrial expansion and supremacy followed.

Other countries possessing ample coal deposits developed their resources. The United States of America, Germany, and Russia became great world powers. The possession of coal became a necessity for industrial progress, and it is noteworthy that no large industrialization of any nation has become possible unless that nation had large coal deposits and usually its associate, iron ore.

To-day, the United States of America are believed to possess slightly more than half the world's resources of seven million million tons of coal. The development of American industry has been stupendous and American consumers to-day use over 600 million tons of bituminous coal per year. The value of coal production in the States is nearly double the value of iron ore, gold, silver, and copper combined.

The value of coal to a community can best be expressed by quoting that the Pittsburgh Coal Bed, which runs through the States of Pennsylvania, Ohio, Maryland, and West Virginia, has produced more wealth than any other single mineral deposit in the world—the Witwatersrand Gold Reef in South Africa being second.

The increasing demand for coal has necessitated a complete overhaul of production methods. Deep, or pit mining, the traditional method of coal winning, is the removal of coal by cutting out the coal seam only—leaving large pillars of coal intact to keep the roof from collapsing. Outcropping or shallow coal was seldom touched, as the roof was usually unstable and the top of the seam near the surface was usually slightly weathered. The cost of stripping the earth or overburden on top of the coal was much too great to permit economic extraction of the shallow coal.

It was not until 1912 that mechanical excavators were used for strip mining or open cutting. First used in Illinois, this type of coal winning has found increasing application until to-day overburden up to 100ft. in depth is being removed by giant machines to enable other excavators to recover a few feet of coal underneath.

Leigh Creek Coalfield is a typical case where modern machinery has enabled the economic winning of coal by open cutting after the attempts to develop the field by pit mining had failed.

Plate 4.—Aroona Gorge.

Plate 5.—The Burr.

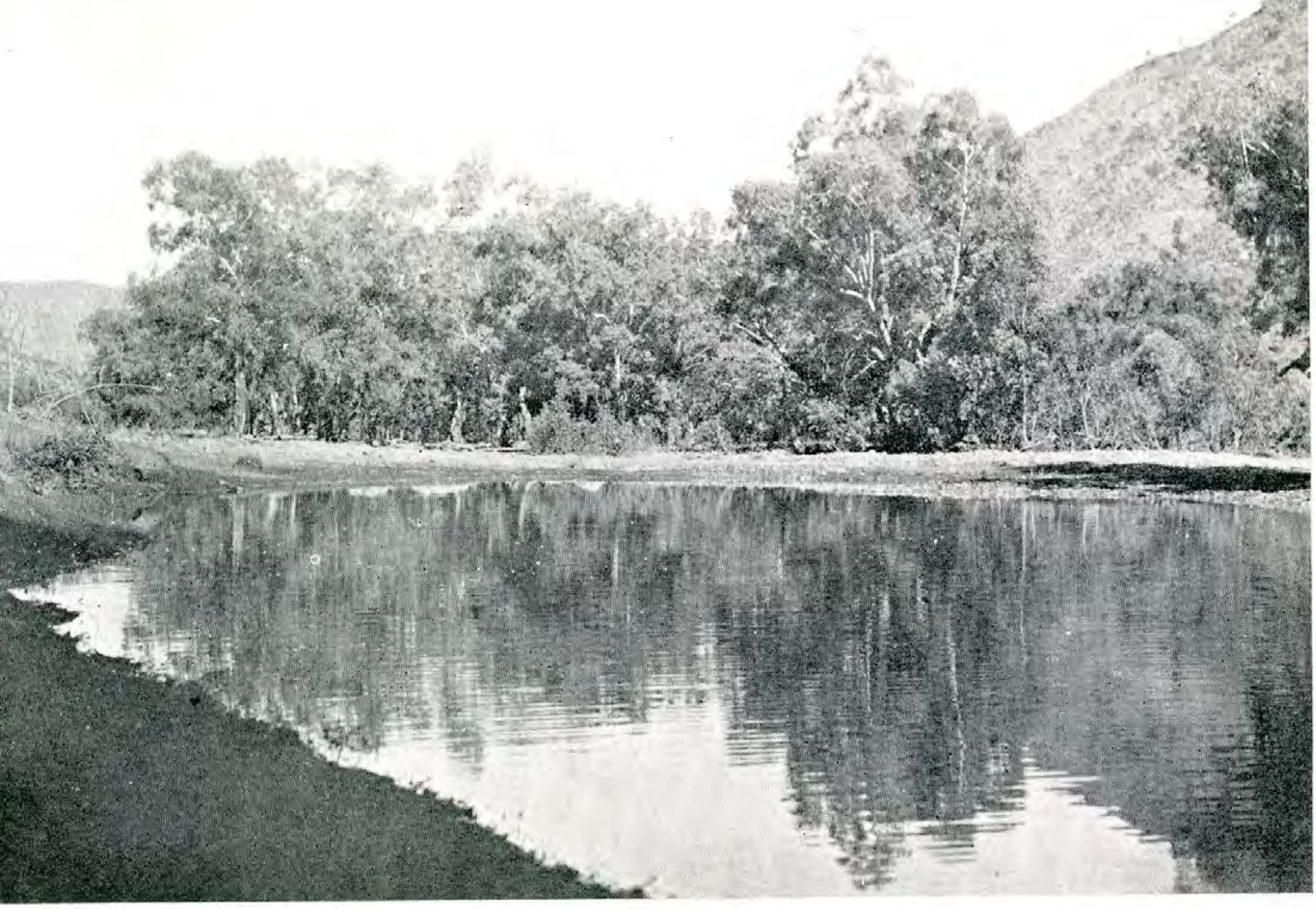


Plate 6.—Aroona Water.

Plate 7.—Mundy Water.

CHAPTER I.

THE NATIVE LEGEND.

The aborigines believe that the giant semi-human creatures that were created at the beginning of the world were responsible for all the creeks, hills, gorges and mountain ranges in Australia.

The stories that explain the topographical features of the southern parts of this State, *i.e.*, how the Morialta Gorge, the Torrens or the Port Rivers were made, have been lost for ever, but the old aborigines of the Northern Flinders Range still remember the stories that explain how their tribal country was made and who were the creators. One of the most beautiful parts of the Northern Flinders Range is Wilpena Pound and the most valuable—the Leigh Creek Coalfield. The origin of both of these places is known to the aborigines through the medium of their folklore.

In the long distant past, somewhat equivalent to the time of our creation period, a Wild Turkey Man persuaded the aborigines to initiate one of the young men of the tribe at the place now known as Wilpena Pound.

The news of such an important event soon spread over the countryside, and finally reached the ears of a gruff old Kingfisher Man called Yulu Yuluru who lived in the desert country west of what is now the Leigh Creek coalfield. For a while the Kingfisher Man was not interested in the doings at Wilpena Pound, but when he heard that the Wild Turkey Man was to be the leader he decided to attend the ceremony, hunt the Wild Turkey Man away and initiate the boy in his own way.

According to the legend he went to Leigh Creek lighting huge fires to announce his coming. These were so large and burnt up so many trees that the charcoal remaining behind formed the present coal deposits at Leigh Creek and at other places along the Ranges. The old natives are firm that their grandfathers knew about the coal deposits. They called it Yulu's charcoal long before the coming of the white man into their country, and it is interesting to point out that recent boring has disclosed that one of the coal basins was partially burnt out, probably many millions of years ago. The existence of the burnt shales or porcelanic shales in the Northern Basin is further confirmation of this fact.

The end of the legend refers only to the creation of Wilpena Pound. It is added to complete the legend of the particular incident.

When the Kingfisher Man was passing through Brachina Gorge on his way to the ceremony he saw two huge snakes travelling in the same direction. These so scared him that he crept behind some low hills so that he could not be seen.

These manoeuvres so delayed Yulu that by the time he reached Wilpena Pound the ceremony was well under way and the Wild Turkey Man was just about to initiate the boy by burning him with a fire-stick. Yulu rushed in, knocked the fire-stick from the hand of the Wild Turkey Man and carried out the ceremony in a much kindlier manner.

This action pleased the assembled people, but unfortunately just as the ceremony was at its height the two snakes that Yulu had seen in Brachina Gorge burst in upon the scene and consumed all but the initiate, the Wild Turkey Man and the Kingfisher Man. The two latter fled south quarrelling loudly, while the youth escaped to the north, only to be transformed into a stony hill near the Wirrialpa Station.

After the great snakes had had their meal of human flesh they stretched themselves out, one along the northern and one along the southern side of the ceremonial ground with heads almost touching. They then willed themselves to death and their bodies were changed into the steep precipitous cliffs that now form the outer walls of Wilpena Pound. The space between the two heads is the gorge through which the water empties into the open plain and is the only entrance into the beautiful pound.

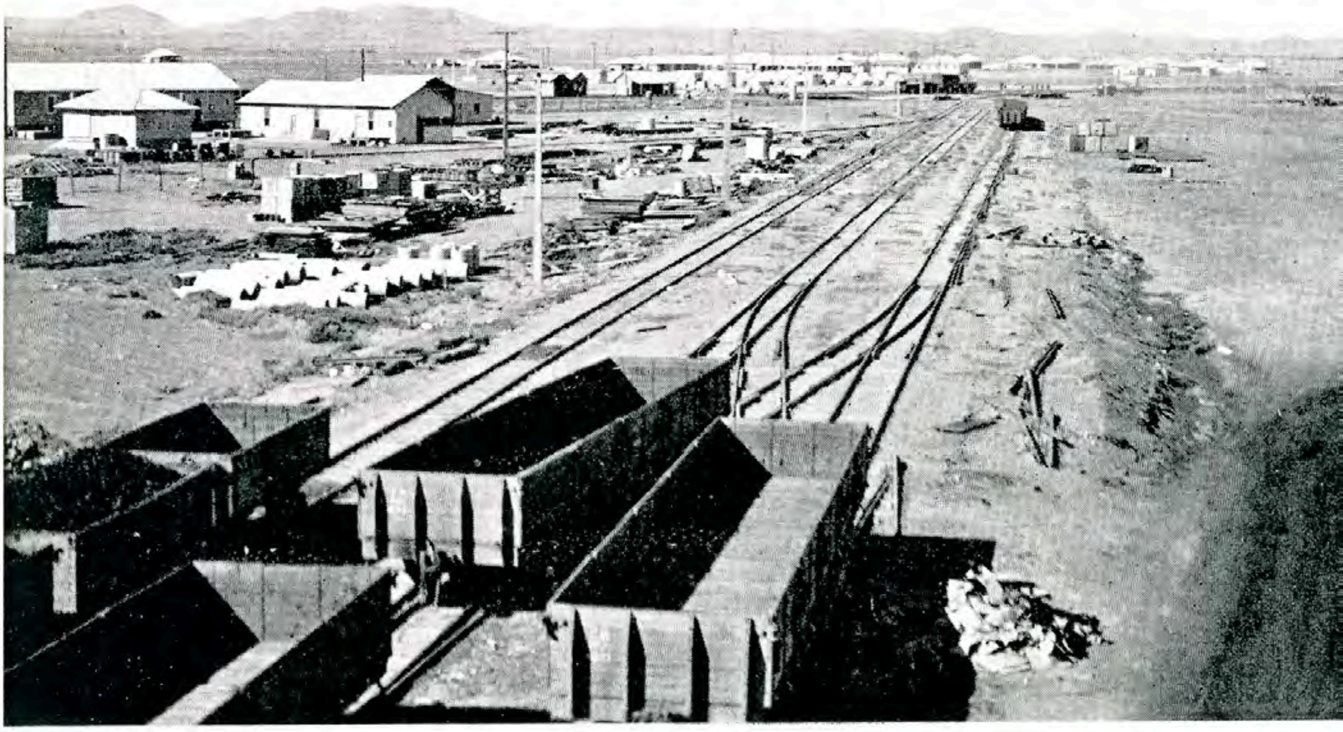


Plate 8.—Leigh Creek from Grading Plant.

Plate 9.—Grading Plant.

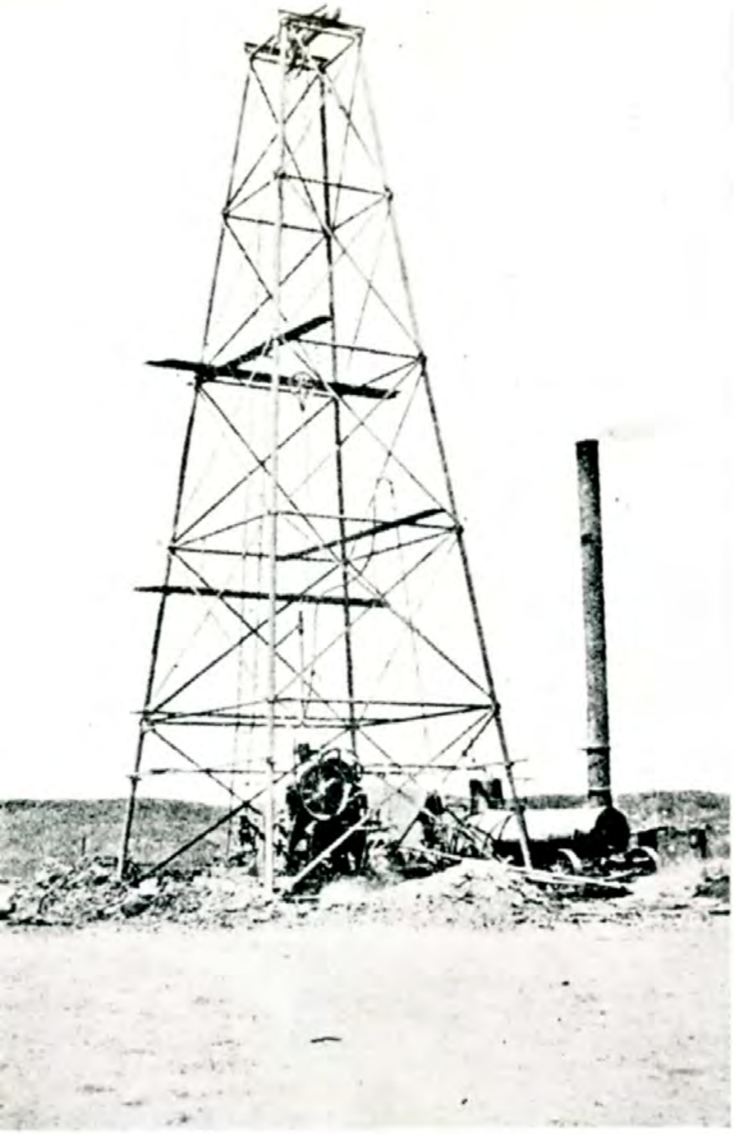


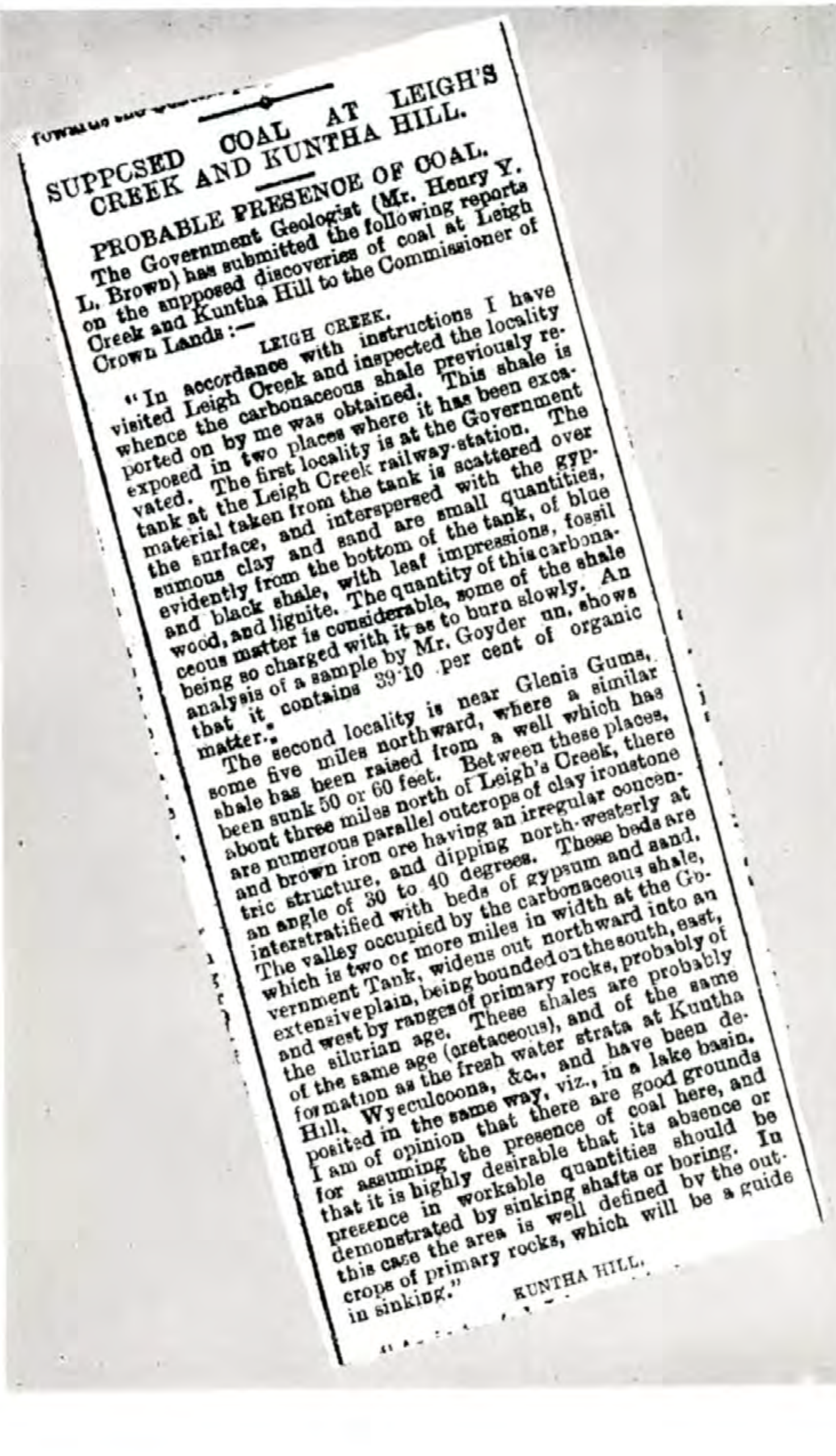
Plate 10.—Sinking No. 2 Bore, 1890.

Plate 11.—Headworks, Leigh Creek Colliery, 1894.

CHAPTER II.

DISCOVERY AND EARLY DEVELOPMENT.

In 1888, a dam-sinking contractor was excavating a dam at the South Australian Railways storage area on the flat about one mile west of Leigh Creek (now Copley) Railway Station. It is believed that the man was Mr. J. H. Reid. Finding a black rock or shale in the excavation he forwarded a sample to Messrs. D. Williams and W. R. Sando, Adelaide, for analysis. The analysis proved that the material was a carbonaceous shale



SUPPOSED COAL AT LEIGH'S CREEK AND KUNTHA HILL.

PROBABLE PRESENCE OF COAL.

The Government Geologist (Mr. Henry Y. L. Brown) has submitted the following reports on the supposed discoveries of coal at Leigh Creek and Kuntha Hill to the Commissioner of Crown Lands:—

LEIGH CREEK.

"In accordance with instructions I have visited Leigh Creek and inspected the locality whence the carbonaceous shale previously reported on by me was obtained. This shale is exposed in two places where it has been excavated. The first locality is at the Government tank at the Leigh Creek railway-station. The material taken from the tank is scattered over the surface, and interspersed with the gypsumous clay and sand are small quantities, evidently from the bottom of the tank, of blue and black shale, with leaf impressions, fossil wood, and lignite. The quantity of this carbonaceous matter is considerable, some of the shale being so charged with it as to burn slowly. An analysis of a sample by Mr. Goyder un. shows that it contains 39·10 per cent of organic matter."

The second locality is near Glenis Gums, some five miles northward, where a similar shale has been raised from a well which has been sunk 50 or 60 feet. Between these places, about three miles north of Leigh's Creek, there are numerous parallel outcrops of clay ironstone and brown iron ore having an irregular concentric structure, and dipping north-westerly at an angle of 30 to 40 degrees. These beds are interstratified with beds of gypsum and sand. The valley occupied by the carbonaceous shale, which is two or more miles in width at the Government Tank, widens out northward into an extensive plain, being bounded on the south, east, and west by ranges of primary rocks, probably of the silurian age. These shales are probably of the same age (cretaceous), and of the same formation as the fresh water strata at Kuntha Hill, Wyeculcoona, &c., and have been deposited in the same way, viz., in a lake basin. I am of opinion that there are good grounds for assuming the presence of coal here, and that it is highly desirable that its absence or presence in workable quantities should be demonstrated by sinking shafts or boring. In this case the area is well defined by the outcrops of primary rocks, which will be a guide in sinking."

KUNTHA HILL.

Plate 12.—Social Gathering, May, 1946.

Plate 13.—Wild Apricots.

and Messrs. Williams and Sando applied for and were granted a "Right to Search" over 10,000 acres by the Government. They sent experienced men to report upon the find. It is understood that further carbonaceous shale was found some five miles north near Glen's Gums, a permanent water hole on Leigh Creek. (It is evident from the later report of the Government Geologist that this carbonaceous shale came from a deep well at or near Glen's Gums and was not an outcrop.) The Government Geologist, H. Y. L. Brown, proceeded to the area almost immediately, and his report was published in the *Register* of 2nd March, 1889.

This favourable report which pronounced an area some 15 miles long by two miles wide as potentially coal-bearing, led to the floating of the Leigh Creek Coal Mining Company to exploit the field. The Company's first operation was the sinking of the No. 1 Shaft near the railway line on the northern edge of the central basin now called the Telford Basin. Water was intersected at a depth of 75ft. and prevented further sinking, whereupon the Government was asked for the loan of a diamond drilling plant to carry deeper the exploration. On the recommendation of the Government Geologist the Government agreed to provide a drilling plant and finance two-thirds of the cost.

The first bore on the field in the No. 1 Shaft at Telford was commenced on 21st February, 1890, and completed on 3rd April of the same year, at a depth of 330ft. It penetrated a seam of coal, 2ft. in thickness, between 135ft. and 137ft., and the pre-Cambrian bedrocks at 170ft. Samples from the seam yielded on assay the following proximate analyses:—

	(1)	(2)	(3)	(4)	Mean.
Moisture	19.02	23.42	16.46	16.94	18.55
Volatile	38.02	34.71	31.16	30.88	33.88
Fixed Carbon	32.52	34.95	45.44	41.00	38.48
Ash	9.72	6.92	6.94	11.18	8.69

The drill was then transferred to the No. 2 site which was commenced on 19th May, 1890. Boring was carried to a depth of 2,101ft., intersecting the main seam of coal, 47ft. 10in. in thickness, between 1,496ft. 8in. and 1,544ft. 6in. and the pre-Cambrian bedrock at 2,034ft. The chemical composition of this deep coal is comparable to that of the open cut area near Telford, but according to H. Y. L. Brown, its physical condition is different, being more compact and showing little tendency to disintegrate over a period of years. Proximate analyses and details of the strata penetrated by this bore are given in the *Record of Mines*, pages 344-5, 1908 (and reproduced in a geological appendix herewith).

In 1892 as a result of the coal discovery in the No. 2 Bore, the Leigh Creek Coal Mining Company decided to sink a new shaft 11ft. by 6ft. in the clear, at a site approximately 500yds. from the No. 1 Shaft, measured in the direction of the No. 2 Bore. Tenders were called for sinking to a depth of 300ft. and Messrs. Martin & Company, of Beltana, were the successful tenderers. Coal was struck at 239ft. and continued to 287ft. The shaft, now known as the "Old Main Shaft" was carried to 300ft. according to the terms of the contract.

In the following year, 1893, about 200 tons of coal were raised from the shaft and sent away chiefly for experimental purposes, and it is interesting to note that in the *Register* of 29th April, 1893, it is stated that arrangements were made with the Railways Commissioners for the transport cost of the coal to any station in the Colony to be a half-penny per ton mile. A production cost of 10s. per ton at the pit-head is also quoted in newspaper reports about this time. Difficulties to secure markets for the coal

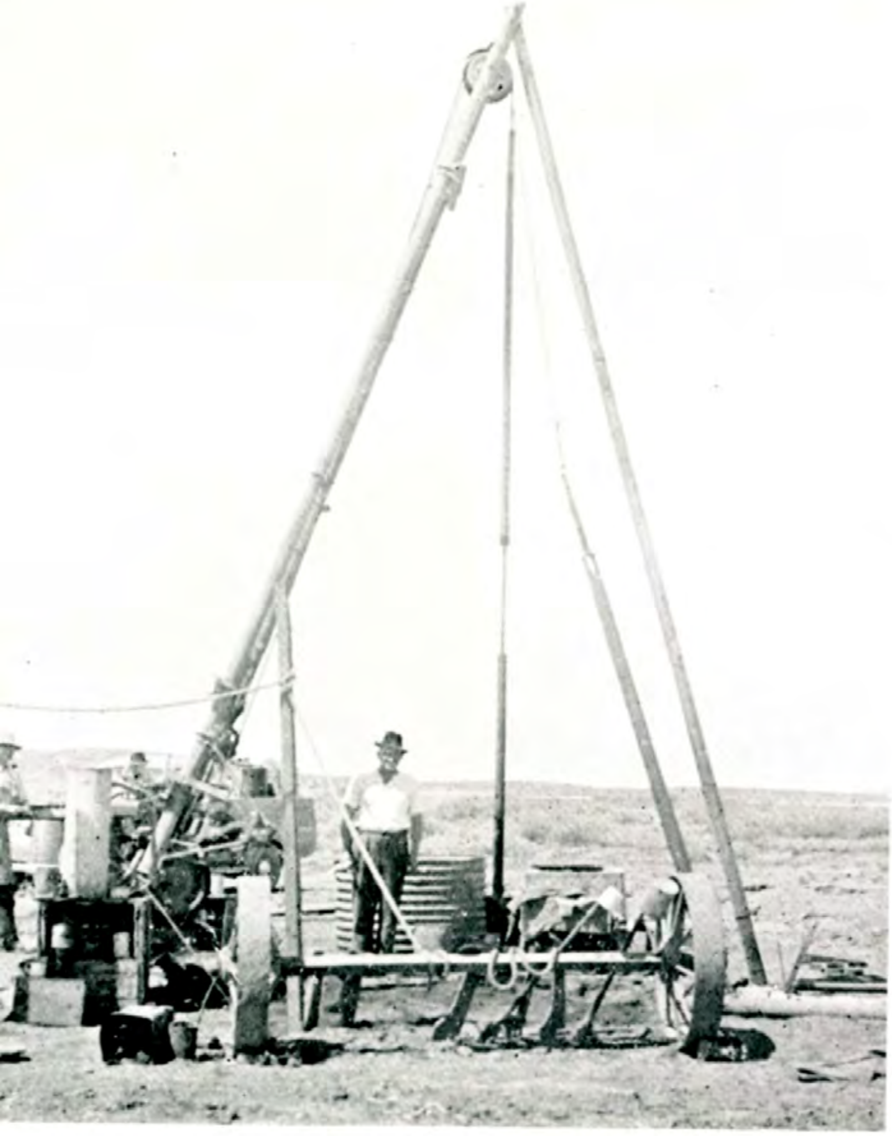


Plate 14.—Boring Northern Field.

Plate 15.—Exploratory Shaft, Northern Field.

prompted the Company in the following year to erect a briquetting plant with a capacity of 30 to 40 tons per day. This project proved to be a complete failure as the plant was a second-hand brick-making machine, entirely unsuitable for the purpose. The mine closed down in 1894.

From 1894 to 1908 the historical record is incomplete. Briefly it is known that the lease held by the Leigh Creek Mining Company passed to John Darling on 13th January, 1906, and to the Tasmanian Copper Company Ltd. on 6th July of the same year, the latter raising 12,455 tons of coal from the main shaft. The coal won was utilized partly for general mining and smelting purposes on the group of copper mines being worked in the north of the State by this Company and partly sold as household fuel. Among other towns Port Augusta, Quorn, Peterborough, Broken Hill and Adelaide were supplied. Tests for suitability as locomotive fuel were also made.

On 27th August, 1908, the lease, originally granted for a period of 15 years, expired and the Coalfield was withdrawn from the operations of the Mining Act. Thus ended development by private enterprise.

Boring operations were resumed by the Government on 12th December, 1910, when the No. 3 Borehole in the Telford area was commenced. This bore entered the coal seam at 608ft. 6in. and remained in coal to a depth of 646ft. 9in., a thicknes of 38ft. 3in. Boring was discontinued at 1,126ft. 4in. after the pre-Cambrian bedrock was intersected at 1,079ft.

Details of the No. 4 Bore are missing from the records. It was bored probably in 1911 immediately following the completion of the No. 3 hole, and abandoned owing to an accident which involved the loss of the boring tools in the hole.

In 1917 the main shaft was unwatered by the Department of Mines. The coal seam was sampled thoroughly and 713 tons were raised and sent to Adelaide for experimental purposes. The coal was tested in locomotives, stationary boilers and gas producer plants besides being subjected to briquetting tests and tests for the generation of coal gas and utilization in a pulverized form. A summary report on the various tests is published in *Mining Review* 29, pages 31-35, and reproduced in a geological appendix herewith. No productive development followed this investigation.

In 1918, further boreholes were drilled, the No. 5 near the railway dam at Copley and the No. 6 Borehole in the southern portion of the Telford Basin. The former, 781ft. deep, entered bedrock at 677ft. and failed to penetrate a coal seam of mineable width. The latter intersected coal, total thickness 20ft. 6in., between 711ft. and 732ft. 6in., with a shale band 1ft. wide from 728ft. to 729ft., and bedrock at 912ft. Boring ceased at a depth of 984ft.

The completion of No. 6 Bore marked the end of all exploration until 1941. It is noteworthy that the period 1888 to 1919 failed to disclose any mineable seam shallower than 239ft.—that struck in the "Old Main" shaft—yet 20 years later scientific deductions enabled coal to be located 150ft. nearer the surface only 200yds. away.

Plate 16.—Poppet Head, New Main Shaft, 1942.

Plate 17.—Boring on Tableland near New Main Shaft, 1942.

CHAPTER III.

THE SEARCH FOR COAL 1940-1946.

Following the completion of the No. 6 Bore in 1919, interest in the Coalfield lapsed for over 20 years.

In 1940 the Premier became deeply concerned with the lack of supplies of coal for public utilities and industrial requirements. Reserve stocks had fallen far below the quantity considered to be a safe margin. Despite efforts to improve the situation it had not been possible to build up stocks to any extent even with the curtailment of public utilities—this being due principally to shipping difficulties and the increased demands of the other States. The Government was forced to give serious consideration to the matter in order to remedy the position and also from the aspect of making South Australia independent, or partly so, for its coal supplies.

Numerous reports on the coal deposits available in South Australia were examined and the Government, on the advice available, decided to proceed with a detailed investigation of the Leigh Creek Coalfield, this being considered the most promising proposition. Leigh Creek coal, a sub-bituminous coal, has the highest calorific value of all accessible coal deposits in South Australia, and from previous reports the deposit also appeared to be the most extensive.

In August, 1941, boring was commenced and the main objective was to find shallow coal. Its successful discovery over an extensive area, first in the Telford and subsequently in the Northern Basin, was the chief factor which led to the present open cut operations. The first few holes, bored on the extreme northern margin of the Central or Telford Basin, were failures. It was then decided to sink a hole on the tableland midway between the old main shaft and the first shaft put down by the Leigh Creek Coal Mining Company. Dr. Ward, the Government Geologist, reasoned that the dip or inclination of the seam in the old main shaft workings was such that it must come to the surface at some point between the old main shaft and the fruitless No. 1 Shaft.

Success followed. The main coal seam 40ft. in thickness was struck 66ft. below the surface. It was evident that the prospects of obtaining shallow coal were exceedingly good. Calculations were made and an area marked out running approximately east and west for systematic boring.

Concurrently with the commencement of this boring the sinking of a new shaft adjacent to the successful bore was commenced to procure coal for experimental purposes, as the old main shaft was found to be in such a bad condition as not to warrant repairs for this purpose. The new shaft penetrated the coal at a depth of 86ft. Two drives were developed and over 1,600 tons of coal were raised during the period between October, 1941, and March, 1943, when production ceased, the poppet head demolished and all plant removed.

During this period boreholes were drilled on the grid until sufficient information was available to map out the position of the coal seam over a length of approximately one mile and provide full information for the development of the Telford open cut. The shallowest coal was struck on the flood plain just west of the tableland and at one place the coal seam was only 13ft. 6in. below the surface. While it is astonishing that in the early days shallow coal was not found in this area, it must be remembered that traditional or pit mining did not consider the few feet extra haulage as being detrimental, and in any case the dangers of sinking the shaft on the flood plain were so great that work on the higher level of the tableland would be preferred by any mining engineer.

A total of 93 bores, excluding the six original bores, have been sunk in the Telford Basin, and in the geological appendix the results of the analyses of samples from these are given.

Following this boring of the northern rim which produced the present open cut, a series of exploratory bores was drilled on the eastern boundary of the Telford Basin. Here bores have not been drilled sufficiently close to make it possible to positively define open cut areas. However the deductions which can be made from the bores at present sunk are sufficiently reliable to indicate the presence of more shallow coal with the seam something like 40ft. in thickness.

A limited amount of boring has been carried out on the southern margin of the same basin, and only very incomplete data are available. Indications are promising and warrant further boring to test whether open cut coal is available here also.

Four miles to the north of the Telford Basin further boring has been carried out. This area, known as the Northern Basin, was subjected to a detailed geological examination which fixed the limits of the coal-bearing shales in the two portions of the basin (Lobe C and Lobe D). The discovery of burnt fossiliferous shales (porcelanic shales) on the surface in Lobe D were presumed to be the result of the combustion of a coal seam. Drilling was commenced nearby. Two seams of coal were discovered, the upper one ranging in depth from 30ft. to 40ft. and the lower one being of the order of 20ft. in thickness separated from the upper by about 30ft. of clay and shale. To date (June, 1946), 118 boreholes have been drilled in this lobe. Boring is still in progress to determine the extent, tonnage and composition of the lower seam coal. It must be stated that after a few bores had disclosed the presence of both seams it was decided to test the upper seam first, as the plans of development of Leigh Creek Coalfield as a whole depended on whether this basin was suitable for open cutting.

The results have made it apparent that the whole of the upper seam can be removed by open cutting. To test the quality of the coal and to obtain bulk samples for experimental purposes, a shaft was sunk to strike the shallow coal at the northern extremity of the basin. In May, 1944, this shaft struck coal at less than 16ft. below the surface. Forty tons were raised and sent to Adelaide for drying tests in the drying plant at Osborne. During the period June to December, 1945, the shaft was deepened and 60 tons of coal from both seams were raised for further testing.

The exploration of Lobe C was also carried out during this period. Eight boreholes were sunk to test the quality of the coal, but the results were disappointing. A seam of high ash coal was located, but the continuity of the seam was broken in several places by carbonaceous clay bands, so that further exploration of this field has been left until more time is available to thoroughly explore it. It appears that the quality of the coal in Lobe C is such that it cannot be considered as suitable for marketing, although it may find a use as reserve fuel for local consumption in the powerhouse.

Two important adjuncts to the ground geological search are being utilized on the field. In 1944, the Royal Australian Air Force carried out aerial photography over practically the whole of the area outlined by Government Geologist Brown in 1889. The value of this work was immediately evident in that the rock structure in direction, formation and type of outcrop became apparent. It was found possible to confine the areas of search within comparatively narrow limits, thus accelerating the discovery of coal in the various basins and saving needless expenditure in the sinking of bores which would prove failures.

It is hoped to be able to extend this aerial survey northwards as far as Marree in the hope that some indication will be given of the continued existence of coal-bearing basins. It must be pointed out that no indication exists at the present time that any coal is located in this area. However, it seems reasonable to be optimistic enough to consider that the forest which ultimately formed the coal beds did not exist in just one very small area.

In 1946, the assistance of geophysicists was obtained from the Commonwealth Government. They were utilized in the determination of the margin of the lower seam on the Northern Field. It is considered that their work is sufficiently accurate to be accepted without the necessity of proving this margin by boring all round it. Geophysicists utilize the most technical and scientific method of determining rock masses underground and considerable success has been experienced in other parts of the world from investigations made by them. In the future it is hoped that geophysical examination of other sections of the Coalfield will quickly determine the coal beds and hasten the complete mapping out of the coal deposits.

The results of the investigations carried out permit the assessment of probable coal reserves at Leigh Creek at 380,000,000 tons. The proved amount for open cutting is the present Telford open cut which can be extended to extract over 2,000,000 tons of coal, together with the upper seam of Lobe D of the Northern Basin containing nearly 10,000,000 tons, all of which can be extracted although the overburden in the deepest place is over 140ft. Investigations are being made regarding the removal of the lower seam and it can be classed as a probable open cut proposition of nearly 10,000,000 tons also. No assessment is made of shallow coal areas on the eastern margin of the Telford Basin, although one must be a confirmed pessimist not to accept the fact that at least some portions of this area will prove suitable for open cutting.

The great bulk of the coal is in the Telford Basin where, on the assumption that the seam is 40ft. in thickness over the whole area of the basin, some 360 million tons of coal exist—the quantity that can be extracted depending on the mining methods employed.

It is evident that the search for coal has been so successful that an output of 1,000,000 tons per year from the Coalfield is warranted on the reserves known at the present time. The present programme for continuing the search for coal includes geophysical exploration of the Telford Basin and a detailed survey by boring of the eastern margin where shallow coal is known to exist.

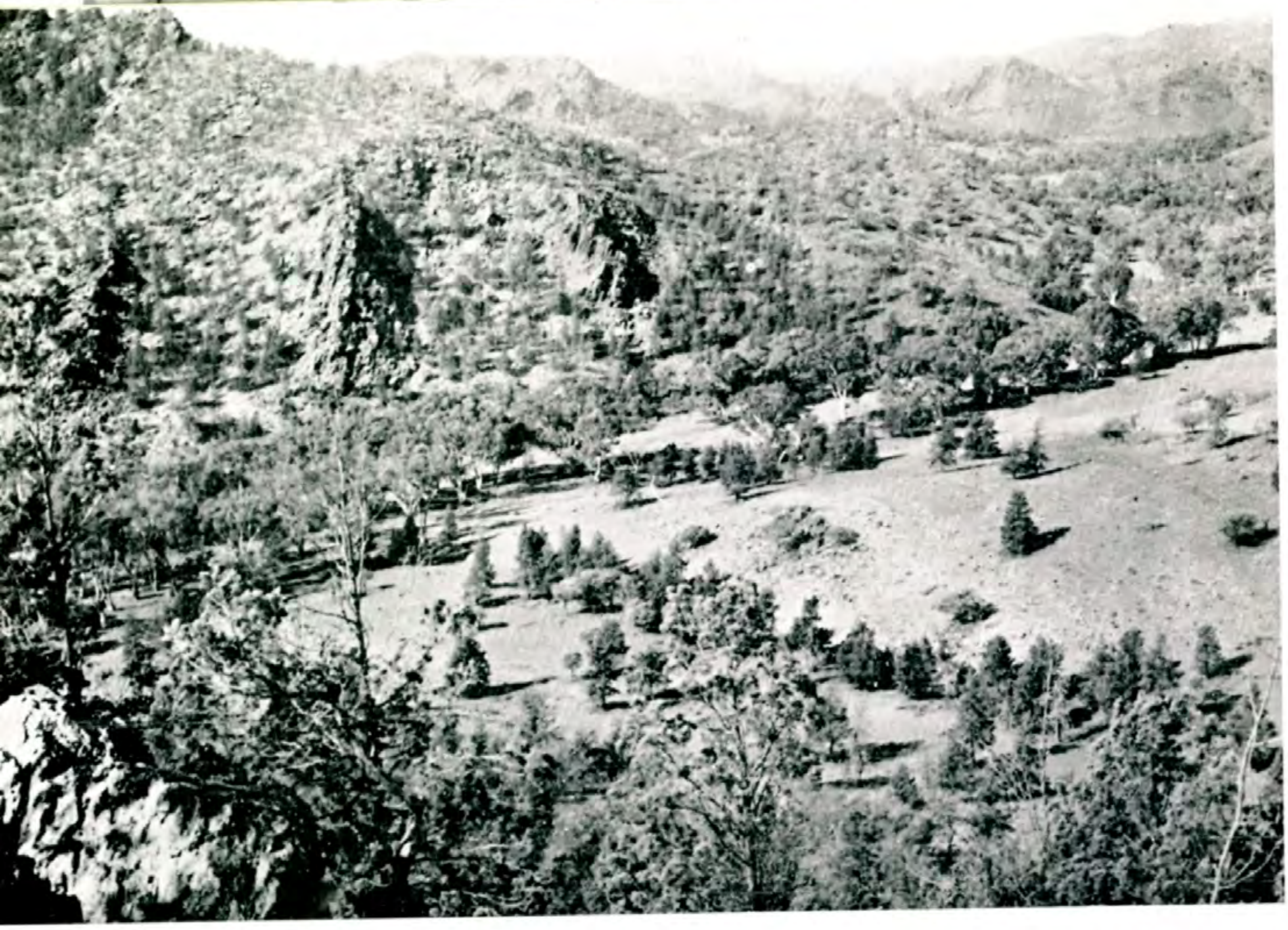


Plate 18.—Sliding Rock.

Plate 19.—Sinking Bore—Sliding Rock.

CHAPTER IV.

THE SEARCH FOR WATER.

The Coalfield lies in a semi-arid climatic zone characterized by a low annual rainfall (Copley 7.64in. for a 60-year period) and a high rainfall variability. The years 1942, 1943 and 1944 provided less than 4in. of rain each year and represent one of the most severe droughts experienced in the Far North. These factors, combined with the general unfavourable character of the topography and the unreliable nature of the pre-Cambrian bedrock, practically eliminate the possibility of surface reservoirs providing large quantities of permanent water on the flood plain unless lined. Therefore the search for reliable water supplies has been limited to the testing of ground water storages and potential dam sites in the gorges of the creeks.

The water supply for the early development of the Coalfield was evidently drawn from local waterholes in Leigh Creek, such as Glen's Gums, together with that obtained from a small well near the mine proper. In drought periods supplies were carted from the Railway dam at Copley. This Railway dam was the field's supply during the first year of the present development.

The search for water commenced with the examination, and testing where a possibility of supply in quantity existed, of every known source of supply within 30 miles of Copley if such supply appeared capable of being harnessed. Particular attention was given to those known underground basins where a bar of impervious rock, such as quartzite, cut across the underground channels carrying the water, damming it back.

The arid nature of the country and the high temperatures prevailing in the summer months are not conducive to the underground storage of water of low salinity. No hard and fast line can be drawn to define the limit of potability of saline water as the total amount of saline matter permissible in a drinking water depends in a great measure upon the nature of the individual salts present. However, it is accepted generally that 100 grains per gallon is the dividing line between "potable" water and "mineral" water, although mineral waters containing up to 200 grains per gallon are utilized for domestic purposes when better waters are not available. Any toxic effects caused by the drinking of mineral waters containing 150 to 200 grains per gallon will be more noticeable in the heat of the summer when larger quantities are consumed.

The Coalfield requirements being for both boiler feed water as well as for domestic and industrial supplies, it was essential that a water supply of low salinity should be obtained. Accordingly the testing of supplies of low salinity, even some distance from the Field, was carried out.

The following table of salinities of various permanent waters in the Copley district includes all the supplies which have been subjected to pumping tests and illustrates the rarity of the occurrence of good quality water near the Coalfield. The figures are arranged in order of decreasing salinity. Figures are also given for tested yields in the cases of the supplies which have been pumped:—

Locality.	Salinity, Grains per Gallon.	Approximate Tested Yield, Gallons per Day.
	Mineral Waters.	
ZM2 Bore, Northern Basin	3,395	
Main Shaft, Telford	2,822	
Western Bore, Q.29	1,619	
Main Shaft, Mountain of Light, near Copley	583	
2. Mundy Water	432	20,000
Bore near Leigh Creek Station	329	
Finke Spring	188	
7. Puttapa Springs	173	
3. Euro Well (and Top Well)	162	22,000
1. Aroona Water	150	6,000
Bore, North Moolooloo	150	
5. Mount Scott Bore	129	7,600
	Potable Waters.	
4. Ajax Bore	100	No supply
6. Sliding Rock Basin	86	Over 150,000

A summary of the testing carried out is as follows:—

1. Aroona Water.

The search for a permanent water supply for the Coalfield commenced with the testing of the Aroona permanent waterhole on Aroona Creek, 4½ miles from Copley, on 2nd November, 1941. After pumping out all the accumulated water the rate of inflow was measured over a period of 11 weeks and found to be 5,760gall. per day. A well was then sunk near the waterhole but was abandoned at 80ft. with the intake amounting to only 2,200gall. per day, less than half the supply in the waterhole. Analyses gave a total salinity of 150.73 grains per gallon and a pH value of 7.5.

2. Mundy Water.

The pumping test at Mundy waterhole on "The Mundy," situated 14 miles north-east of Copley, commenced concurrently with the Aroona one and continued for 10 weeks. The results showed a gradual decrease in the inflow of water into the waterhole as well as a marked diminution in the flow in the northern channel. It is impossible to state a definite figure for the yield as a condition of stability was not established, but a conservative estimate would be of the order of 20,000gall. per day. The salinity of the water is high, being 432 grains per gallon.

3. Euro Well.

This well in Leigh Creek, four miles east of Copley, was tested at the request of the Public Works Committee on evidence submitted by V. C. Hirsch, of Leigh Creek Station, on his experience of its high potentialities for watering large flocks of sheep and herds of cattle in drought years during the early period of the country's pastoral development. Its maximum tested capacity was established at 20,000gall. per day. Top well tapping the same ground water source augmented this yield by only 2,000gall. per day when both wells were pumped concurrently.

4. Ajax Bore.

During the critical period of the Sliding Rock Mine test when large fluctuations in yield were of everyday occurrence, a decision was made to bore a site near the Ajax mine between Copley and Beltana selected by Dr. R. L. Jack for the Commonwealth Railways. Notable successes elsewhere at Brachina, Hookina and Hawker had provided the Railways with ample water to meet all current traffic requirements. The site was not needed by the Railways and suggested to the Government for what it was worth. Boring was carried to a depth of 100ft. and abandoned owing to its failure to tap a supply after groundwater had been intersected at 55ft. The water present was analysed and contained 100 grains of saline material per gallon.

5. Mount Scott Bore.

Situated seven miles south-east of Copley, Mr. L. V. Ragless has a bore yielding up to 10,000gall. per day of water with saline content of only 129 grains per gallon. This yield was for a limited period only, and to indicate whether the supply was sufficient to harness, continuous pumping tests were carried out over the period 16th to the 23rd November, 1943. These revealed that the amount of water available was small, being only 7,600gall. per day. The bore was consequently abandoned.

6. Sliding Rock Mine and Basin.

Following the failure of the Aroona and Mundy tests to develop satisfactory supplies, attention was drawn to wells and bores in the neighbourhood of Beltana. Samples were collected from 27 different underground supplies, including the Sliding Rock Mine.

On the recommendation of the Government Geologist pumping tests were started on 16th June, 1942, on the Sliding Rock Mine. The mine is situated about 14 miles east-north-east of Beltana and is at an elevation of approximately 1,300ft. above sea level.

The history indicates that in 1871 the Sliding Rock Company purchased a mining option from the holders and commenced operations with a small capital. Rich copper ore gave quick profits, but at a depth of 30ft. underground water was first encountered and thereafter continual trouble was experienced from strong inflows. Notwithstanding these the mine continued in production until 1877. At later dates revivals of mining were attempted, apparently the last being by the Tasmanian Copper Company in 1906-7 when a new shaft was sunk. No ore was produced from this shaft and it appears that the ground water caused the abandonment of operations.

Sliding Rock Mine lies in a folded and faulted rock environment and the region is one of marked relief with well-defined water courses. The mine is situated at the point of the outlet of the Sliding Rock Creek from a basin composed of limestone rock into a rather narrow strike valley flanked by steep dipping massive quartzite rock. This valley is the only outlet to an extensive rainfall catchment area east of the mine and it also appears to be the only outlet for the underground drainage.

At the time pumping tests were commenced the water level was only some 14ft. below the ground in the old Cornish lift well of the mine. Pumping tests carried out from the mine shaft encountered considerable difficulties in that silt entered the shaft from the surrounding workings and country, rising considerably in the shaft and blocking the pump suction. The use of a Johnson Screen was tried but no marked success was obtained. It was evident that the quantity of water available was very large but that the presence of the silt would necessitate pumping to a settling tank from which the clear water would be drawn for supply to Leigh Creek.

Upon further examination by the Government Geologist bores were sunk at different spots in the basin. Finally two relatively shallow bores have been harnessed, the combined yields of which are 15,000gall. of clear water per hour with a saline content of only 86 grains per gallon and pH value 7.5.

Every bore was not successful in striking water, but No. 2 Bore, 83ft. deep, struck water at 17ft. and yielded over 6,000gall. per hour. No. 4 Bore over a mile east, struck water at 30ft. below the surface. Boring was continued to 163ft. and the proven supply is more than 10,000gall. per hour. The conservative figure of 15,000gall. per hour has been accepted as the combined yield of the basin.

Notwithstanding continuous and long pumping tests there appears to be no receding of the water level underground and the basin has been harnessed to provide the Coalfield's water supply.

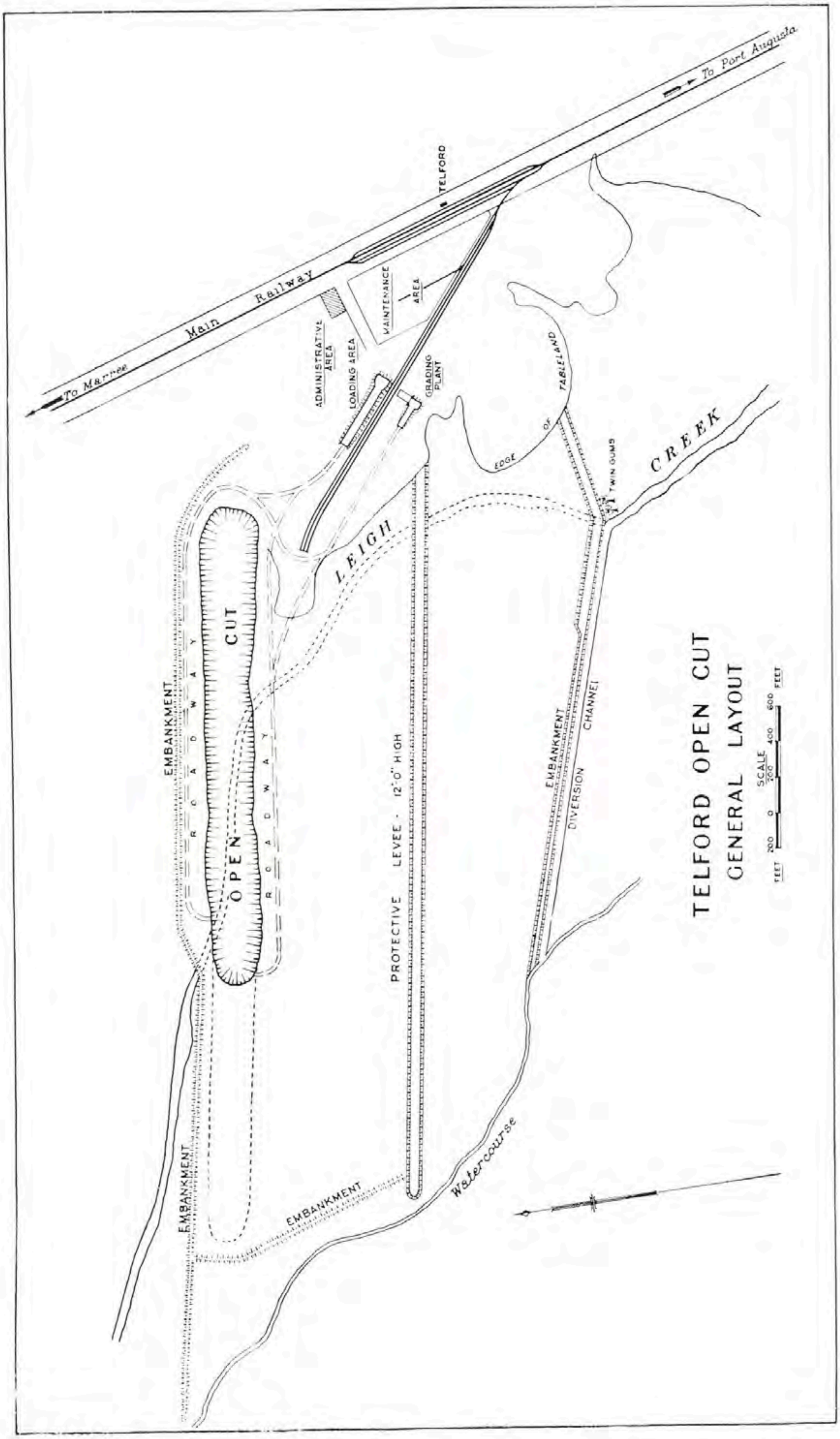
7. Puttapa Springs.

Situated near the route of the pipeline from Sliding Rock to Leigh Creek, Puttapa Springs constitute a small pastoralist's supply, the saline content of the water being 173 grains per gallon. Although the amount available from the existing springs is small, this source of supply has been noted as being worthy of further detailed examination at a later date.

The examination of gorges in the creeks to provide reservoir sites for conserving annual floods has progressed to the extent that examinations are being carried out at the present time on the upper reaches of Leigh Creek near Top Well some four miles east of Copley where a favourable site exists for the construction of a small reservoir of 100,000,000gall. capacity. If successful this water of low salinity will be of great value.

Plate 20.—Open Cut—November, 1944.

Plate 21.—Open Cut—May, 1942.


TELFORD OPEN CUT
GENERAL LAYOUT
SCALE
FEET 200 0 200 400 600 FEET
To Marree
To Port Augusta
Main Railway
TELFORD
MAINTENANCE AREA
ADMINISTRATIVE AREA
LOADING AREA
GRADING PLANT
EDGE OF TABLELAND
TWIN GUMS
LEIGH CREEK
OPEN CUT
ROADWAY
ROADWAY
EMBANKMENT
EMBANKMENT
EMBANKMENT
EMBANKMENT
PROTECTIVE LEVEE - 12'0" HIGH
DIVERSION CHANNEL
Watercourse

CHAPTER V.

MODERN DEVELOPMENT.

Following the discovery of shallow coal at the northern rim of the Telford Basin, the problem of winning the coal was referred to the Engineering and Water Supply Department. That Department had already undertaken a number of large-scale mechanized excavation works and appeared the most suitable department to carry out the development.

The Premier and the Engineer-in-Chief examined possible open cut sites and immediate steps were taken to plan a suitable method for winning the coal. A number of difficulties had to be surmounted. The coal seem was dipping steeply to the south increasing in depth 1ft. for every 4ft. distance to the south. Secondly, the development had to be undertaken during war time when there was a very limited field of mechanical excavators to choose from. As it was urgently necessary to produce coal at the earliest possible date, only plant available in Australia for immediate purchase could be considered. With these points in view it was also necessary that all planning was to be considered as an integral part of a permanent undertaking.

It was realized that the relatively steeply dipping nature of the seam meant that open cutting of the coal over the whole basin was impossible. A large portion was covered by overburden of far too great a thickness to be won by this method. Consideration of the type of overburden to be removed, clay alluvium for the top 10ft. to 12ft., then clay and weathered shale to approximately 20ft. with dense shale below, pointed to the economic possibilities of draglines. The coal seam was approximately 40ft. in thickness and preliminary calculations were made on the basis that overburden to a depth of twice this thickness could be removed to permit the extraction of the coal. Tests on the hard shale showed that relatively little explosives would be necessary as modern draglines are capable of excavating very dense shale owing to its ease of fracture. Two small draglines were available within the Department. A search throughout Australia showed that the number of large machines was very limited. Examination of the characteristics of these machines led to the ultimate purchase of two 2½ cubic yard machines. One of these was a Ruston machine used in excavating the Appleton Dock in Melbourne. During its career it had fallen into the River Yarra, so following its purchase it was completely dismantled and reconstructed. The second machine was a Harman, very similar to the Ruston. It was practically new. These machines, together with the Departmental excavators available, were considered a working unit, able efficiently to open up the Field for coal production.

The study of the boreholes showed that open cutting was possible for more than a mile in length and that in particular the most suitable length for early coal coal winning was contained in a length of 4,400ft. running from close to the Central Australian Railway almost due westwards. This open cut (stripping overburden to a depth of 80ft.) would produce approximately 1,500,000 tons of coal.

However, the adverse progress of the war made it necessary to alter this plan. To produce coal at an even earlier date it was decided to strip overburden to a depth of 50ft. only. The opening up of this narrower cut would give 20,000 tons of coal per 100ft. opened and production could be achieved at a much earlier date, whilst the ultimate widening of the cut stripping to 80ft. of overburden or even more, would not be interfered with at all.

In January, 1943, the first dragline excavator was moved to the Field. At this date the Mines Department were still extracting coal from the new main shaft on the tableland. Their work was completed in March of the same year, and after this date all operations of a productive nature, with the exception of the exploratory shaft on the northern basin, have been carried out by the present management.

Leigh Creek runs across and along the line of the open cut. The creek is dry for the greater part of the year, and in fact only runs when a heavy rain occurs on the catchment area. Floods occur at irregular and infrequent intervals—at times they number three per year, seldom less than one. A fall of half an inch of rain on the catchment area is sufficient to completely fill the creek and bring it down in heavy flood. Nature provides no warning when these floods are likely to occur. In the summer time monsoonal depressions develop very rapidly—the weather is fine to-day, the country is flooded to-morrow, the roads and creeks are bogholes for a week, but all flow ceases within 24 hours, and often the dust blows within a few days of the flood.

The first problem before commencing any open cut was to divert this creek flow and protect the open cut from any possibility of flooding. A line was chosen some 600ft. south of the open cut. It was located sufficiently far south that any extension of the open cut, involving stripping to even 150ft. of overburden, could be carried out within the protected area. To provide immediate protection for the cut, a small dragline threw up a preliminary bank on the line of the main levee, excavating a channel 8ft. deep and 20ft. wide on the outer side of the bank. This channel provided the first diversion to carry floodwaters away. The channel was designed to perform a second function. The flood plain of clay alluvium is of an extremely friable nature, and deep erosion in flood time is sudden and rapid. So the design provided that this temporary diversionary channel should be filled with dense rock and shale from the open cut excavation at the earliest possible date to provide a solid toe for the finished levee and prevent any undermining. Overburden removed in stripping has been carted by motor trucks and dumped to form the present very strong protective levee.

At the Twin Gums, some distance south of the levee, a channel was excavated to lead floodwaters completely clear of the bank. This diversion was continued until it reached a large natural washout which completed the diversion. The washout, over 30ft. in width and 6ft. deep, formed by flood erosion, joins Leigh Creek proper some considerable distance west of the end of the open cut. There is a very large fall northwards of the flood plain, so that considerable scouring has already occurred in the diversion. To accelerate this and to regenerate a channel the size of Leigh Creek proper, the bed of the diversion has been ripped up with a tractor and ripper, and the southern bank has been shattered with explosive charges. Several floods passing through later have eroded all this loose material away so that to-day the diversion is of considerable size. This primary protection also automatically caused the construction of a strong bank across the original channel of Leigh Creek proper at the Twin Gums.

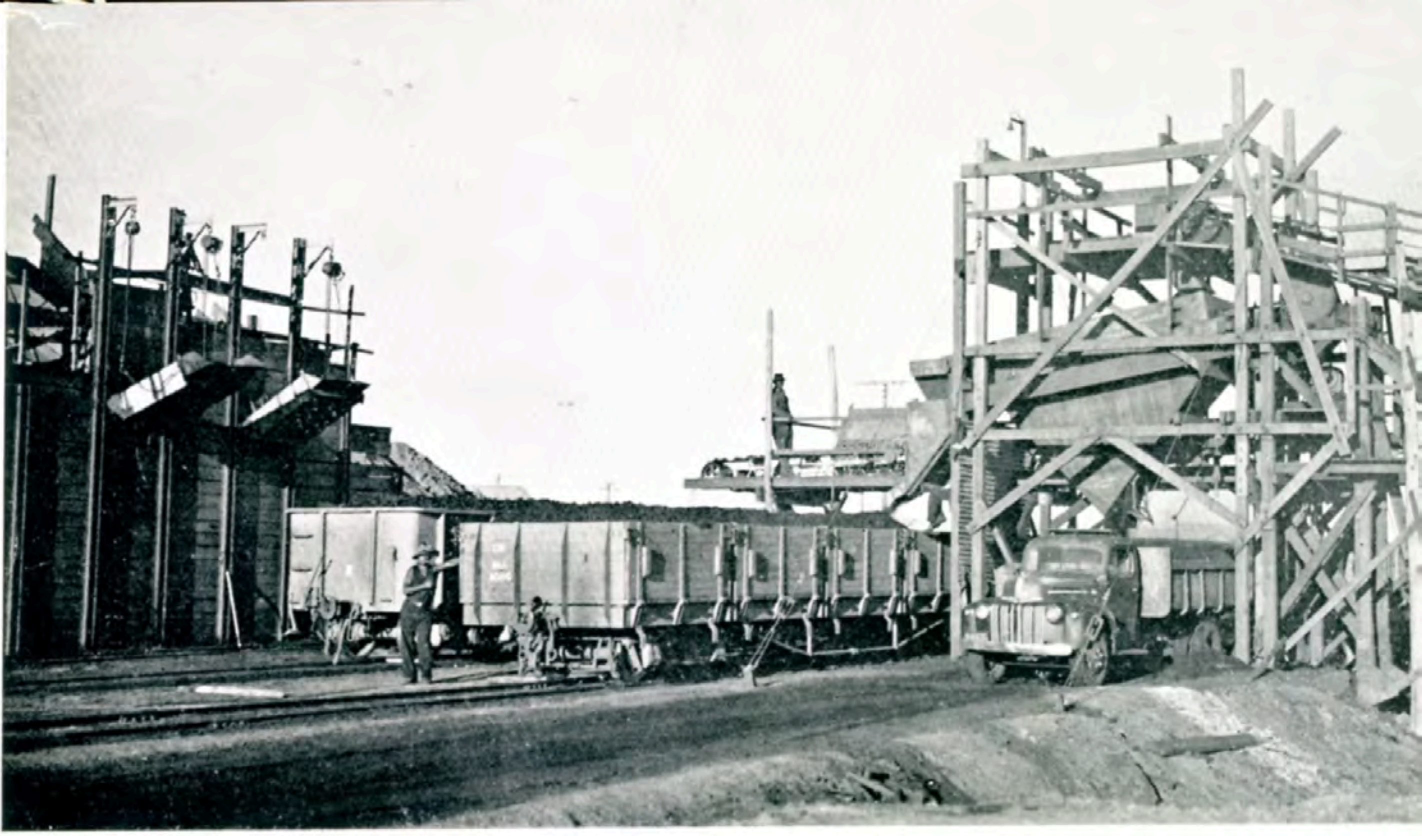
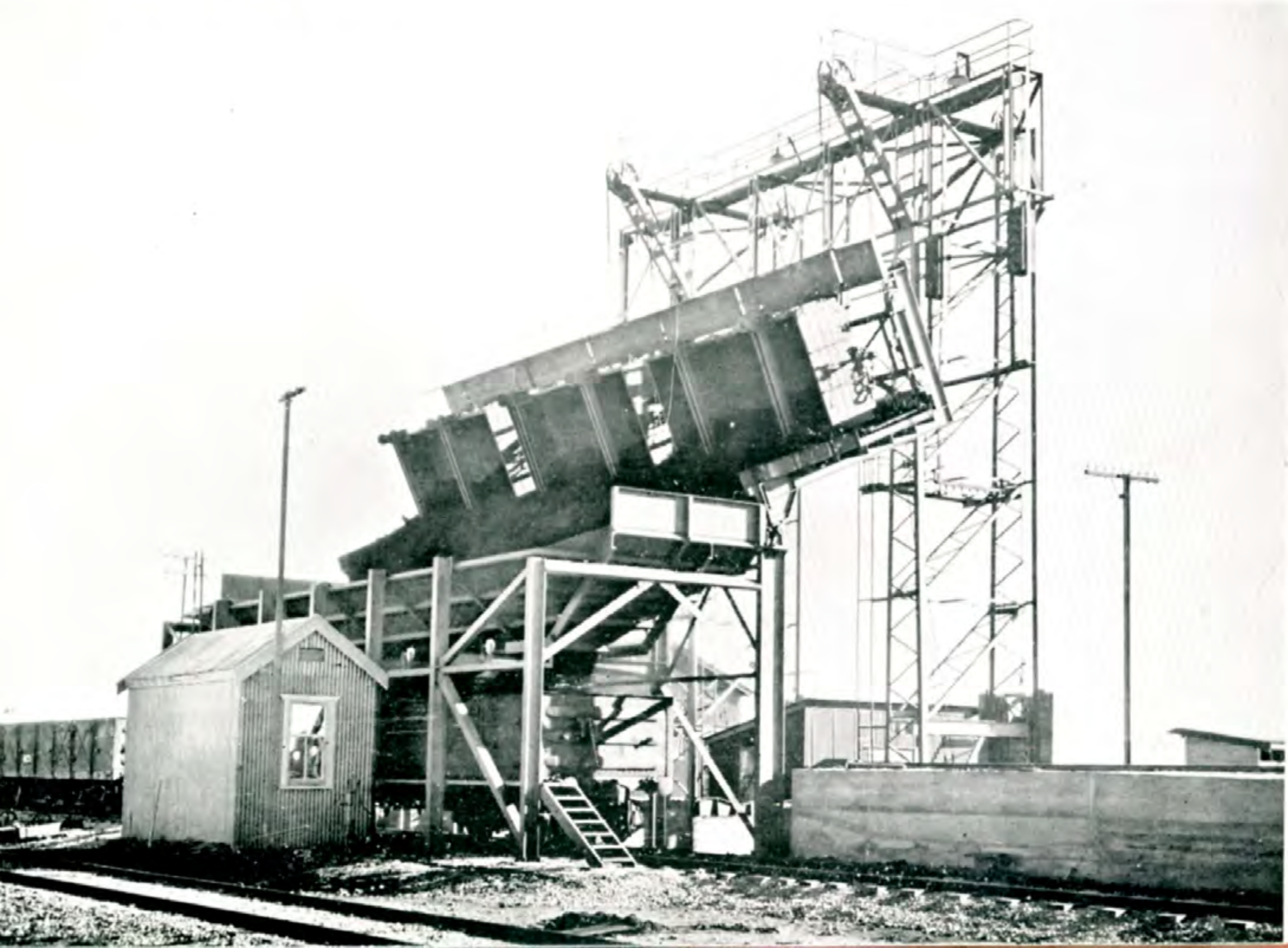


Plate 22.—Loading from Grading Plant.

Plate 23.—Power House and Workshop.

Plate 24.—Tippler, Terowie.

Plate 25.—Tippler, Terowie.



To protect the northern side of the cut the first earth, which would normally be removed in stripping the overburden, was thrown back by the draglines to form a protecting bank. This has been strengthened as material has been available from the cut.

Completed by August, 1943, the protection works permitted active excavation of the large open cut. The top 18ft. of overburden was stripped with draglines, no explosives or loosening of the ground being necessary. Production figures from the machines were good. At the eastern end, however, the tableland, some 20ft. above the flood plain, intruded over the area of the open cut, and dense conglomerate was encountered. This material, often called nature's concrete, was exceedingly tough, and a large amount of blasting was necessary to reduce it sufficiently small so that it could be handled by a power shovel for removal. Fortunately the extent of the intrusion was relatively small.

The first excavation was a box-like hole some 800ft. long by 350ft. feet in width, the material being all removed by draglines operating above ground level. The entire material excavated, with the exception of the small amounts thrown back on the sides to form protective banks, has been carted away by motor trucks to form protecting levees, roadways, loading ramps, and, at a later stage, aerodrome filling.

With the completion of the first box-like cut a ramp was developed from the surface to the floor of this cut. The rough surface of the floor was levelled up with a bulldozer, and the excavators were walked down to commence the second cut and uncover the coal seam. Some difficulty was experienced with the hard shale immediately next to the coal, and a certain amount of blasting proved to be necessary. Great assistance was given by the use of a large ripper pulled by a caterpillar tractor. The ripper breaks up the shale for nearly 3ft. in depth, and the bulldozer pushes the broken shale into position where excavators, either draglines or shovels, load it into trucks easily.

This developmental work has been continued ahead of coal production as the coal extraction has demanded it, so that continuously the first box-like excavation has been extended to the west, then the second stripping has been completed, leaving only a small cover of shale over the coal until coal production has advanced sufficiently close for the coal surface to be cleaned of all impurities.

The actual extraction of the coal is being carried out by dragline excavators standing on the top of the coal seam loading into motor trucks which convey the coal direct to the grading plant.

For the first 21 months all coal mined was supplied to consumers as run-of-mine coal, the only sizing being the breaking of large lumps so that the approximate maximum size piece was 6in. in any dimension. The development of an assured trade soon made it evident that graded coal was necessary to satisfy consumers. Accordingly considerable study was given to the requirements to produce the commercial article necessary. Ultimately a temporary grading plant was constructed and put into operation on the 22nd November, 1945. Here the coal supplied from the excavators is dumped into a large receiving hopper. Pieces greater than 14in. in any dimension are broken to pass through a grid of that size. From this loading hopper a mechanical feeder pushes the coal into a crusher (a single roll coal crusher). Crushed in this manner to a maximum size of 6in., a belt conveyor elevates the coal to a shaking screen which grades it into three fractions. The largest coal obtained is that too large to pass through the top deck containing 1¾in. diameter holes. This is sold as "large screened" or lump coal. The intermediate size which passes through the top screen but does not pass through the bottom screen with $^7/_{16}$in. diameter holes, is sold as "stoker" coal or "small screened," whilst the product which passes through both screens is called "fines" and sold as such. Large screened coal represents 40 per cent, small screened 40 per cent, and fines 20 per cent.

The demand for both large screened and small screened coal is great, but it has been found impossible to sell all the fines produced.

The grading plant discharges all large and small screened coal direct into railway trucks on a very large gravity siding. On this siding all trucks move through the plant with the minimum of work, and the siding is constructed to hold 1,000 tons of coal loaded into trucks on the dead-end side, and to accommodate empty trucks sufficient to hold 1,000 tons on the inlet end. As the fines above orders must be stock piled, the discharge from the grading plant is not above a railway track. All fines are loaded into motor trucks, and those to be railed are loaded from these motor trucks through special chutes. The balance of the fines is carted some little distance away to the stock pile area where it is being held for future sale should the demand exceed the production.

The maximum amount of coal mined in a single fortnight has been 8,741 tons, of which 7,552 tons was railed and 1,189 tons placed in the stock pile. Production at this rate has necessitated 38 coal trains leaving the Field in that period. Coal production from the end of February, 1944, when the first coal was produced, to November, 1945, was 64,526 tons of run-of-mine coal. From November, 1945, to the end of June of this year 61,432 tons have been sold, and the stock pile amount of fines now stands at 10,252 tons. Consequently since production commenced over 136,000 tons of coal have been won from the open cut. During this period the total amount of overburden removed was 639,000 cub. yds. (solid).

The transport from the Field to the consumer is by railway haulage completely. Fortunately the Central Australian railway to Alice Springs passes through the whole coal-bearing area, practically bisecting the Field. The Telford railway station of the Commonwealth Railway system is so conveniently situated to the Telford open cut that the Department's gravity coal siding takes off right in the station yard. The Commonwealth Railway facilities now comprise four tracks together with a large shunting neck. It is interesting to note that the total amount of track laid in the combined Commonwealth and State Railway facilities now exceeds 11,000ft. —over two miles.

Far removed from the Field is another vital link in the chain. The coal is forwarded from Telford to Terowie where a mechanical "tippler" has been constructed by the Railways Department. Here the narrow-gauge trucks are automatically grabbed in this mechanical giant and elevated on to their sides, discharging their load of coal into a large hopper, which in turn feeds the coal direct into the waiting broad gauge gondola truck underneath.

Thus it will be seen that from the time the pegs are placed by the surveyor to mark the boundaries of the stripping area there is no manual handling whatsoever. The whole project has been fully mechanized.

The original intention and design was that the plant could produce 4,000 tons per week of run-of-mine coal on single shift production. The temporary grading plant was designed to yield 2,500 tons of graded coal per week, it being anticipated that a considerable demand for run-of-mine coal would continue. However, the graded product has been so superior that run-of-mine coal is no longer demanded, and the temporary equipment provided and installed is maintaining an output approximately 50 per cent greater than the design.

As the Field developed, so facilities for efficient maintenance of equipment became necessary. The conditions in the Far North are harsh. So far as machines are concerned the dust problem is a serious one. Whilst all roadways used are watered wherever possible dust is present and abrasion of cylinders and wearing parts is much greater than in more favourable climates. A large maintenance area has been laid out. In it, store buildings for the necessary spare parts and materials required to keep the Field running, have been erected—petrol and oil stores, bulk stores, cement, wire rope, plant, etc. A carpenter's shop, a paint shop, and a large workshop have been constructed. As the development of the Field took place primarily in war-time, the majority of these buildings have been transferred from other projects, and are of galvanized iron. However, a large workshop building mainly of concrete, which also contains an air-conditioned electricity supply power house, has been designed and erected. Modern lathes, drilling machines, presses, a welding shop, a hydraulic hoist, and all the machinery necessary for the overhaul of machinery, have been installed.

The power house, an air-conditioned section of the building, houses two diesel engines and alternators producing the power necessary to run the machinery on the Field. Wherever possible all machinery is electrically operated, although at the present all excavators are diesel powered. Two of these, each weighing over 80 tons, are 2½ cub. yd. machines. The two smaller ones, weighing 25 to 30 tons each, are of ¾ cub. yd. and 1 cub. yd. capacity. The power demands are growing, so that a third diesel generating set has been purchased, and is now being installed.

With the erection of the drying plant steam turbo-alternators will be installed and Leigh Creek coal fines will be the fuel used to generate the Field's electricity. The diesel sets will only take such week-end loading as is necessary when the steam plant is not in commission. All excavators will be altered to be electrically powered and the fullest possible use of electric energy will be made in all equipment.

Administrative offices have been erected near the maintenance area, these being portable offices transferred from construction undertakings. One of the buildings is in use as the Leigh Creek Post Office.

To supply the Field with water from the Sliding Rock area pumping plants have been installed on two bores in the basin and a pipeline constructed 25 miles to the Field. The fall is so great that break pressure tanks have been erected at the top of Emu Range and at the Mountain of Light near Copley. The water is delivered from the pumps into a 250,000gall. tank at Sliding Rock and fed to a 1,000,000gall. reinforced concrete storage four miles from Leigh Creek by a main 6in. and 8in. in diameter. A large main supplies the Field from this storage. Besides reticulating the town the maintenance area is serviced and a complete fire protection system provided for the open cut by a water main running on each side with hydrants and fire hoses at frequent intervals.

Future development of the Field is being planned following the visit to America of the Engineer-in-Chief (Mr. H. T. M. Angwin) and the Chief Mechanical Engineer, South Australian Railways (Mr. F. H. Harrison). In addition to the present Telford open cut, Lobe D of the Northern Basin is to be developed on a large scale. (A comparison of these two seams is contained in Chapter VII.). It is probable that a very large stripping dragline excavator with a boom nearly 200ft. in length and a bucket taking nine tons of material at a bite will strip the overburden from the coal seam. Large draglines will excavate the coal. This will be transported to a drying plant where the coal will be processed and railed to consumers as steam dried coal containing approximately 12 per cent of moisture.

Contracts have already been allotted for two 40,000 lb. per hour boilers to deliver steam at over 400 lb. per square inch pressure and for the first eight autoclaves or steamers in which the coal will be processed. The extensive research carried out on the pilot drying plant at Osborne indicates that the time required for drying a batch of coal will be approximately 130 minutes. The raw coal will be crushed and the fines will be screened out. Part of the fines will go to the boilers as fuel and the remainder either delivered against orders or discharged to the stock pile. The screened coal will pass through bunkers to the autoclaves. These will be operated in pairs in such a way that when one has been charged with coal it will be preheated by the admission of steam released from the other until the pressures are equalized. After equalization saturated steam at about 400 lb. pressure will be admitted and the coal steamed under full pressure for perhaps 45 minutes. Water expelled from the coal together with condensed steam, will be drained off. The pressures will then be reduced by equalizing with the other autoclave which, in the meantime, has been refilled with raw coal. The treated coal will then be dried by evacuation before being discharged to a conveyor. It will then be screened into large screened, stoker and fines, loaded into railway trucks and forwarded for sale.

The present programme visualizes that in a few years the Field will be producing at the rate of 13,000 tons of raw coal per week, equivalent to 8,000 tons of dried coal. With the advent of new plant specially selected for its work, acceleration of the Field's development may be expected. An output on 1,000,000 tons per year (or even more) may be foreseen.

CHAPTER VI.
LEIGH CREEK TOWN.

When modern development commenced at Leigh Creek the area was uninhabited. The nearest town was Copley, six miles away, connected by a bush track. The first equipment was carted by a donkey team to the old mine shaft. There around the ruins of the old mine buildings the first tented camp was laid out. Water was carted from Copley by a Caterpillar tractor and trailer. Following the successful drilling and the planning of the open cut this camp doubled and then trebled its size. It was soon clear that the camp site would be in the middle of the railway siding required for coal loading. So, concurrently with open cut development a planned programme, comprising the design and layout of a town, the construction of buildings within that town and the provision of administrative and maintenance facilities, has been carried out.

The building programme demanded the design and construction of houses for married officers and employees, modern living quarters and messing accommodation for single employees, all in the town area. For those employees not lodging in the Men's Hostel, a permanent tented camp had to be erected. The town design provided space for all these requirements. A central shopping area was designed to serve the needs of the population, reserves were provided for a school, for public buildings, for a hospital and for recreational facilities. An oval was laid out.

Designed to accommodate a total population of approximately 1,000 people, development is being controlled by buildings being erected within the areas serviced by public utilities. If and when the time arises that an extension of the town becomes necessary, a further "unit cell," similar to that in the original design, can be laid out adjacent to the present town.

After considerable investigations into the different building materials available and having regard to the extreme climatic conditions, the choice was made of hollow concrete blocks as the building medium. A suitable site for a factory was located, a factory designed and erected, a block-making machine installed and over 150,000 blocks have been manufactured, the equivalent of approximately 1,000,000 building bricks.

Twelve dwellings have been completed together with a Single Men's Hostel accommodating 40 men in single rooms, a large mess block with three dining rooms capable of seating 150 men, and two hospital buildings. Four army huts have been converted into garages, store-rooms, and a temporary community hall. Current contracts provide for the erection of four asbestolite cottages with the idea of trying out another building medium, in addition to a large number of concrete block buildings. This latter contract provides for the building of 17 dwellings, staff quarters, single women's quarters, a power laundry, a school and a toilet room. Even this extension will not be sufficient to meet the growing demands for accommodation from married employees, and consideration is being given to the provision of further dwellings.

Certain features warrant explanation. Monotony in appearance of dwellings is being overcome by the adoption to date of 14 different designs and by varying the building alignments. In all new contracts the concrete block walls are being painted light colours ranging from cream to sandstone. Internally modern bathrooms and kitchens are provided—coal burning stoves being one feature.

Plate 26.—A.I.M. Hostel.

Sr. Brook.

Plate 27.—Single

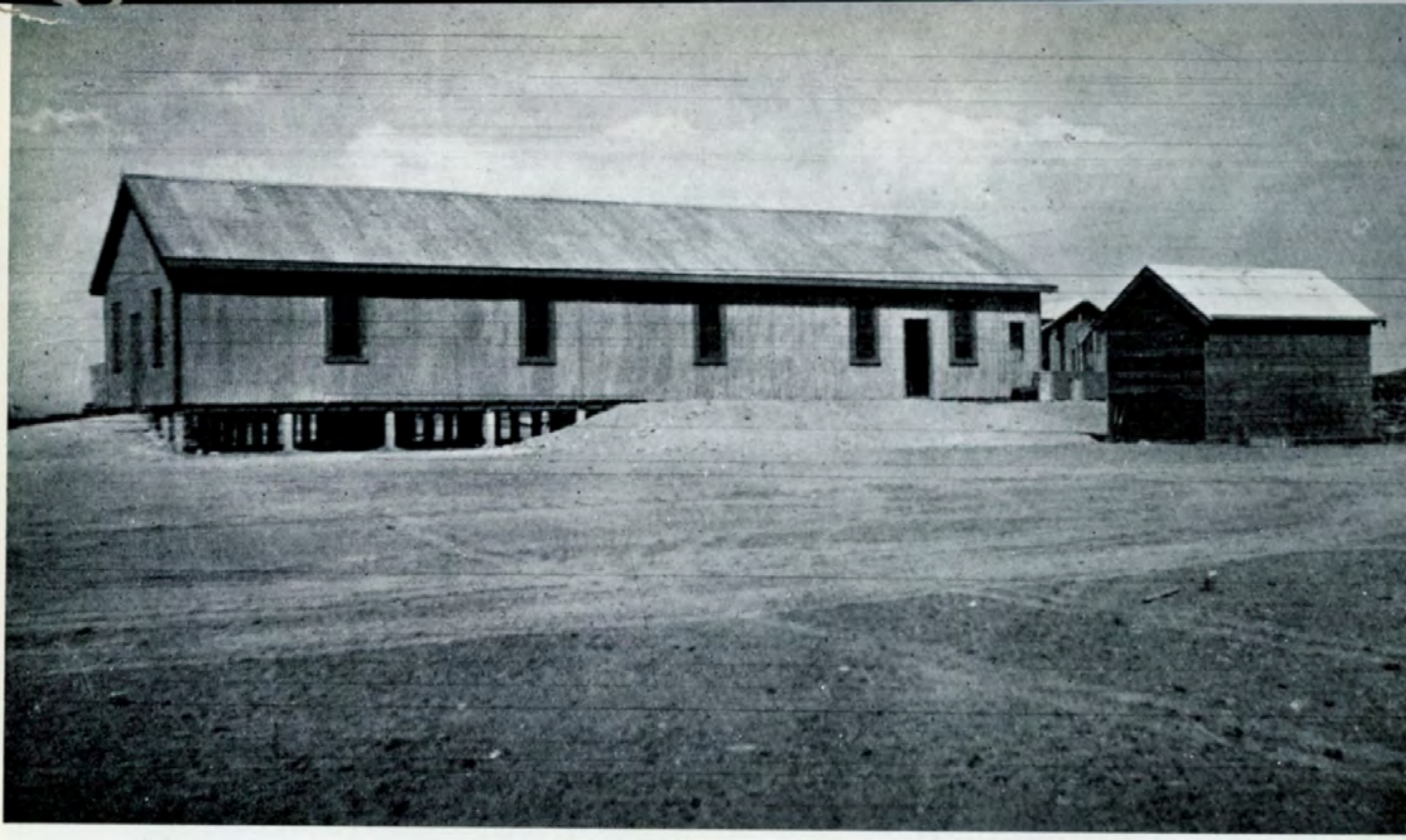


Plate 28.—Bulk Store.

Men's Hostel.

The Single Men's Hostel houses every man in his own bedroom. There is a built-in wardrobe in each bedroom. Two large recreational rooms, one in each wing, cosily furnished, cater for the men's leisure hours. A most spacious billiard-room fully equipped is incorporated in the building. A committee is responsible for the care of the latter and is repaying the cost of the table as surplus funds become available.

The sanitary section includes hot and cold showers and hand basin facilities from an electrical hot water system. A small laundry is attached.

The mess building contains a modern kitchen, store-rooms, a 100 cubic foot refrigerator, and three dining rooms.

Operation of mess and Hostel is in the hands of a caterer—operating under contract whereby he supplies meals to an approved standard in the mess. He also makes all beds in the Hostel daily, dusts and cleans all rooms, and changes linen and towels. He launders all household linen and a generous amount of personal apparel for each occupant. The Department supplies all furniture, bedclothes, linen and towels in the Hostel, and all equipment in the mess. To carry out his duties the caterer employs a staff of 10.

The two hospital buildings comprise an isolation block of two wards, and a first-stage hospital. Ultimately intended as nurses' quarters, it now houses two wards as well as the two sisters staffing the hospital. The buildings, erected by the Government, were handed over to the Australian Inland Mission to be run as a hostel in their organization. As such it is linked with the Flying Doctor network operating from Broken Hill. Already a number of emergency cases have been flown to Leigh Creek Hostel.

The nearest resident doctor is at Hawker, 105 miles away. By a special arrangement he attends once a week at Leigh Creek. A medical fund system (heavily subsidized) entitles all employees and their families to medical care for the sum of one shilling per week per wage earner. Serious cases are taken by ambulance to Hawker and the medical benefits cover attendance at this hospital also.

The power station in the administrative area provides electric energy to all buildings in the town.

The water supply from Sliding Rock is connected through the street reticulation mains and a complete sewerage system with modern treatment works has been installed. It is proposed to construct bitumen roads in the town and maintenance area in the immediate future.

The most modern town in existence in this State, Leigh Creek has the honour of being the first town outside the metropolis to have these amenities and in particular a complete sewerage system.

An airfield has been laid out approximately a mile and a half north of the town. Two graded earthen runways, each just under one mile in length, have been constructed. To accomplish this it was necessary to fill one large depression or creek bed on the line of the north-south runway. Approximately 200,000 cubic yards of overburden from the cut were used for this purpose. This creek was diverted east of the aerodrome by cutting through a hill south of the airfield. The runways are 600ft. in width, of which the central 150ft. is graded for aeroplanes to take off or land, the two outer strips being for taxi-ing purposes. The airfield has been offered

Plate 29.—Building Construction.

Original P.O

Plate 30.—Administrative Offices, 1946.

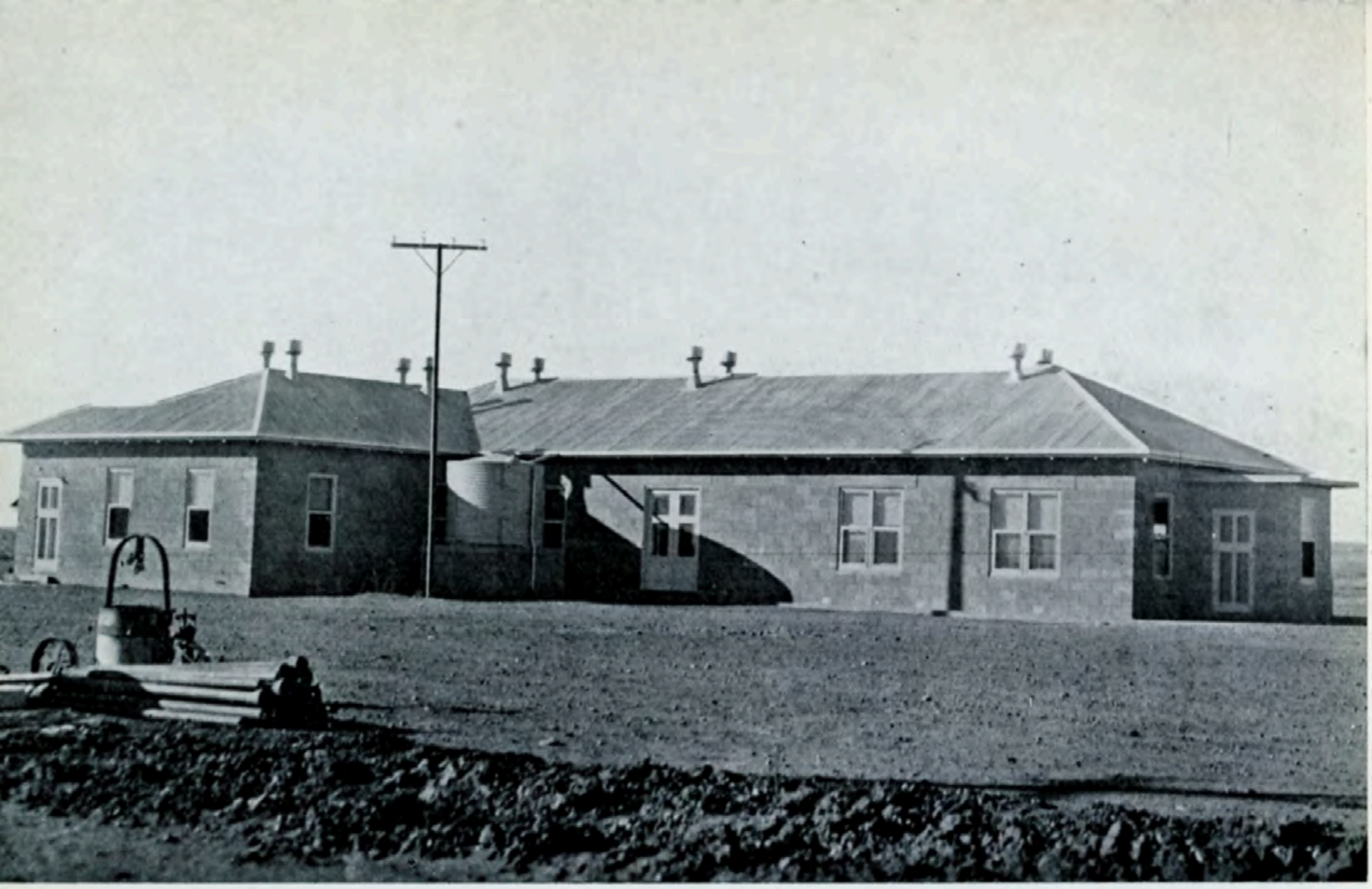


Plate 31.—Mess Block.

Still feeding in '60s

Plate 32.—Second Street, Leigh Creek Town.

to and accepted by the Commonwealth Government. Money has already been provided on the Commonwealth Estimates for the construction of hard-surfaced runways.† When this is completed the north-south air route to Darwin will be altered so that Leigh Creek will be a stopping place. The Commonwealth intend to equip the airfield with night lighting facilities and to install radio direction finding beams. They propose to station two officers to operate these beams, and under an agreement with the Civil Aviation Department two houses are being built in the town to house these officers.

To assist the community in the development of civic life a small community building has been placed entirely at the disposal of the townspeople. Dances, concerts, card parties and club meetings are already held there. Materials have been provided for voluntary busy bees to construct a cricket pitch on the oval and a tennis court in its reserve so that recreational facilities shall be available to all. Keen rivalry already exists between Leigh Creek and the surrounding centres of population regarding their supremacy in the sporting arena. Cricket, a winter game in the North, is played in a very tense atmosphere at times.

The tableland on which Leigh Creek town is laid out is treeless and mostly covered with gibbers or "walk-about" ironstone. To improve the appearance of the town a considerable amount of work has been carried out in testing trees for their suitability to the district and in the actual raising and planting out of selected varieties. The first three years of development were during the worst drought the Far-North has experienced. Many failures occurred. However, a limited amount of success was achieved. This has rewarded the Department adequately for its endeavours. In the maintenance area a considerable number of young Athle tamarisks are showing some 6ft. of growth, whilst in the administrative block native myrtle and salt bush are thriving. A number of householders have obtained trees and already the town is showing green patches where formerly only brown earth showed. Experiments are now being made in the raising of a considerable number of arid climatic trees from seeds. It is considered by experts that these trees will have most chance of succeeding at Leigh Creek (see appendix (1) herewith). One of which great hopes are being entertained is the Wild Apricot, a pittosporum indiginous to the district. It grows some 15ft. high, has very attractive weeping foliage and in the autumn is covered with yellow seed pods in appearance similar to very small apricots. If expectations are realized these will be the first trees used for street planting. Oleanders, lagunaria and aleppo pines have been planted out, and appear to be acclimatizing themselves.

The road is hard, the odds great, but no success will be sweeter than the sight of green trees at Leigh Creek.

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† The State has now been asked to carry out this work immediately at an estimated cost of £40,000 (July).

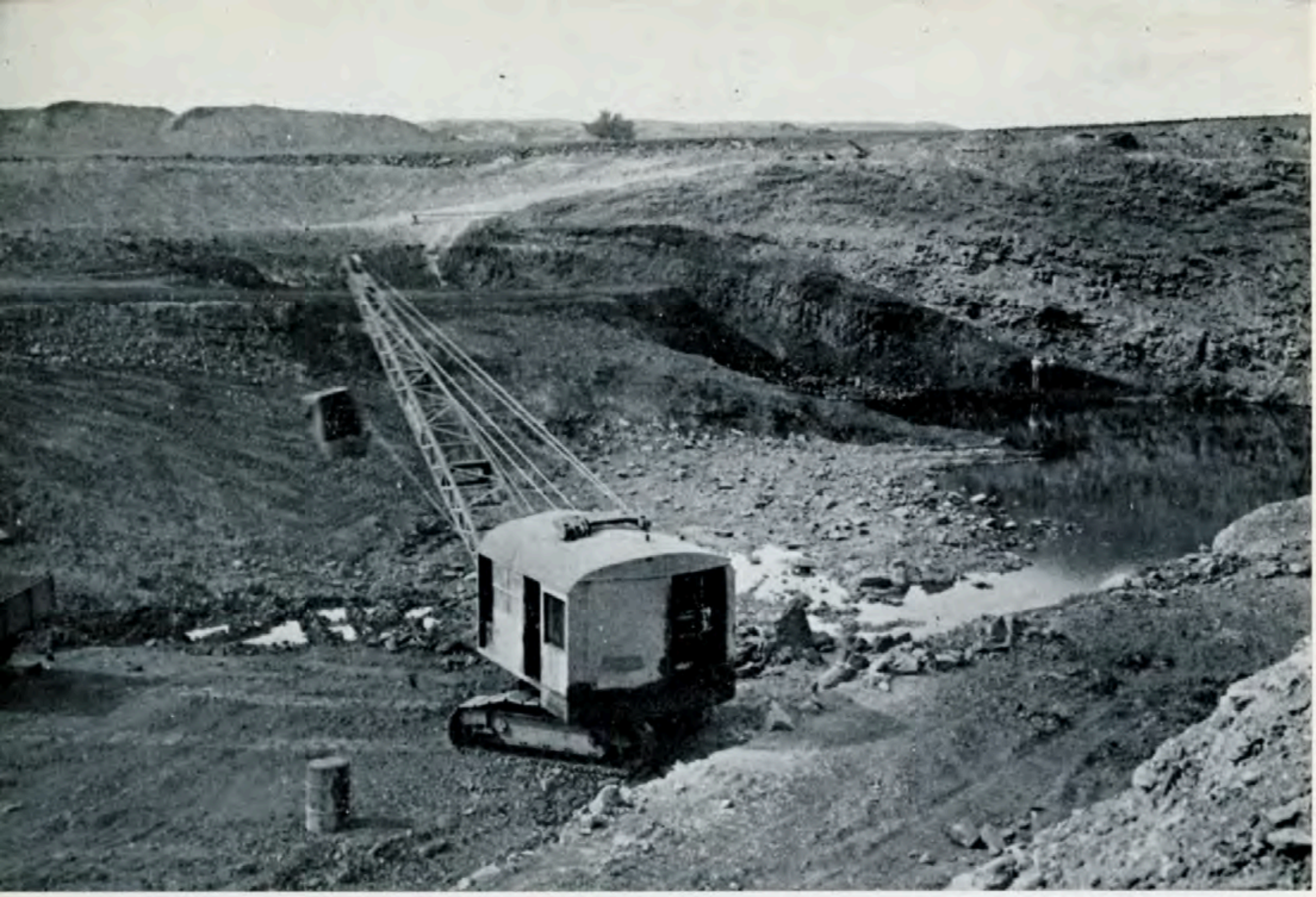
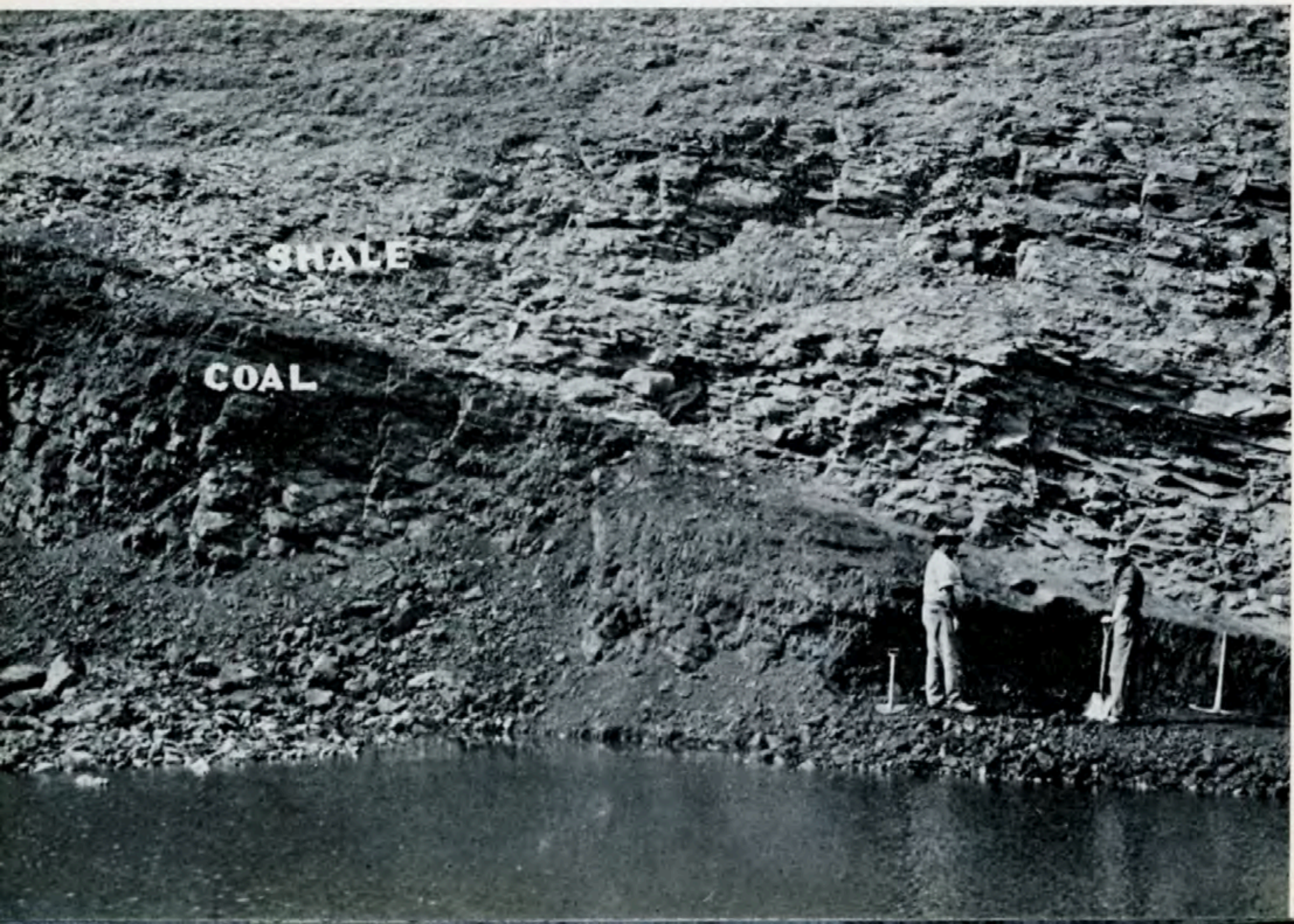


Plate 33.—Eastern End of Open Cut.

Plate 34.—Close Up—Eastern Wall Showing Slope of Coal Seam.



CHAPTER VII.

THE COAL.

A TECHNICAL CHAPTER.

According to our present knowledge some 2,000,000,000 years have passed since the earth's crust first solidified. The oldest geological formations were devoid of coal. It was not until carboniferous times that the first great period of coal formation began, but from such time onwards probably it has never ceased.

The great coalfields of the world originated in the carboniferous period. They lie in a broad belt stretching around the world almost in a great circle. They probably originated when the earth's climate changed and a new monster vegetation appeared and flourished in a rich virgin soil. The climate, if not sub-tropical, was probably equable. Swamps were plentiful, the humidity of the air was greater and the plant life was rank and luxuriant. No flowering trees grew. The original forests were probably composed of the simpler type of vegetation such as giant ferns, mosses and grasses growing 50ft. to 60ft. high. To this era belong the major anthracite and bituminous deposits of the world.

The Leigh Creek deposits, however, belong to a later era when the vegetation of the world was not nearly as rank. It is probable that the grasses and ferns were materially smaller. The trees were changing character and were becoming more like the modern forest giants. The geological period is known as late Triassic. Geologists place its age as 150,000,000 years by the radio active scale.

The actual formation of most coal deposits has probably occurred upon the site of the original vegetable growth. The necessary conditions would be a dense forest growth in swampy areas (estuarine or in great inland swamps) together with such oscillations in level as are known to have occurred during the carboniferous era. During the period of subsidence the rotting vegetable debris would be overlaid with layers of water-deposited sands and clays, which, on re-elevation, would provide a suitable soil for the renewed vegetable growth. Some coalfields, however, undoubtedly owe their origin to enormous masses of vegetable debris brought down from higher levels and deposited either in deltas or in landlocked seas or lakes. In considering any coal deposit it is interesting to realize that it has been estimated that the South Wales Coalfield in Great Britain took 640,000 years to form and also that in that field it took 1,000 years to form the bed that is to-day 3ft. of coal.

The word "coal" itself comes from a widespread root meaning black. Taggart states:—"It is impossible to give an accurate comprehensive definition of coal. Coal is normally considered a mineral, but in reality it is a black or brown rock-like combustible substance composed principally of carbon compounds with hydrogen, oxygen and nitrogen. It is known that any given piece of coal represents a stage in a long series of complex transformations that start with dying and decaying vegetable matter and end as carbon. The vegetable matter has suffered slow decay and consolidation at or below water level, followed by further consolidation and changes due to the pressure and heat incident upon deposition of overlying strata and subsequent elevation and folding. These processes have been continuous and of varying intensity through many geologic ages up to the present time, so that coal is found in all stages from the growing plant to pure coal. The coal material in these various stages has different compositions and physical properties and widely different degrees of usefulness. Accordingly the term 'rank' is used to indicate an approximate place in the range of coals to specify the qualities of any particular type under review."

Leigh Creek coal is ranked as sub-bituminous coal Type C, or Group 12 coal in the classification scale proposed by the Standards Association for Australian coals. It is not a brown coal. Its rank places it in the ascending scale above wood, peat, brown coal and lignite in that order, and below sub-bituminous Type B, sub-bituminous Type A and then in ascending order the bituminous coals of which cannel coal is the lowest member. The coals of equal rank found in Australia are the Waterpark Creek deposits in Queensland, the Benwerrin deposit in Victoria and the soft Collie coals of Western Australia. There are higher ranking sub-bituminous coals in Australia, in particular at Collie in Western Australia and Blair Athol in Queensland. The Australian ranking scale places the dividing line between bituminous and sub-bituminous coal on a moisture content basis. Any coal whose inherent moisture content is above 12.5 per cent is placed in the sub-bituminous range or in the lower rankings if applicable. The "fuel ratio" which is the ratio of percentage of fixed carbon to percentage of volatiles, fixes the "groups" in the type, the highest rank being given to coal with best "fuel ratio." In the group the highest rank is given the coal with the lowest ash content, and so rank is determined, firstly by moisture content, secondly by fuel ratio and finally by ash content.

Leigh Creek coal (as known to-day) is contained in three basins, the Southern at Copley, the Central or Telford Basin and the Northern Basin containing Lobe C and Lobe D.

Little is known about the Southern Basin. Numerous minute seams with clay bands in the single bore sunk indicate poor quality coal with extremely high ash content.

Telford Basin has one very thick seam of high ash content coal and no clay bands.

Proceeding north, Lobe C of the Northern Basin contains clay bands and is considered unmarketable but of probable value as a local fuel reserve for power house use on the Field. Lobe D has two seams, the upper of low ash content coal and the lower of medium ash content. Farther north in the unexplored flood plain extending to the Great Artesian Basin at Marree can we hope to find still better coal—very little ash and possibly higher rank? Only time will tell.

The properties of coals vary in every seam on every field. Leigh Creek is no exception. Even in particular seams we may say that every cubic inch is slightly different from every other cubic inch. To quote figures of properties of a coal we must have samples very carefully taken from large masses of coal, and many such samples, to record a true "average" coal for the seam under review. It cannot be too highly stressed that samples obtained from single lumps or from one small parcel are valueless and often misleading.

The properties of the commercially valuable seams of Leigh Creek coal (as known to the present time) are condensed at the end of this chapter. A general description of the seams shows:—Firstly, the Telford Seam.—This coal, as mined in the open cut (and omitting the soft marginal coal, which is discarded) is dull black in colour. The seam is approximately 40ft. thick. The coal has no defined cleavages excepting in the numerous lustrous bands in the upper part of the seam where cubic pieces are common. The coal has a high ash content and the seam shows many minor changes of colour from top to bottom apparently as the ash changes. The coal cannot be cleared by treatment as all ash is inherent. The seam is ranked as Group 12d in the Australian scale, the specific gravity in the raw, 1.45, which increases to 1.60 when steam dried to 12 per cent of moisture. The "fuel ratio" is 1.38 and the sulphur content is very low.

Secondly, the Upper Seam of the Northern Basin, Lobe D.—This seam varies from 30ft. to 40ft. in thickness. It is a deeper black colour than the Telford coal and is slightly softer. Its moisture content is higher. It has no defined cleavages and the ash content is relatively low. No cleaning to reduce the ash content is possible as the ash is again inherent. The specific gravity is 1.40 raw, increasing to 1.45 when steam dried. The "fuel ratio" is 1.40 and the sulphur content is low. Australian ranking places it in Group 12b.

Thirdly, the Lower Seam of the Northern Basin, Lobe D.—This seam, of the order of 20ft. in thickness, is separated from the Upper Seam by some 30ft. of clay and shale. The outstanding differences between it and the Upper Seam are in ash content and percentage of sulphur. The ash is intermediate between Telford and Upper Seams, and inclusions of pyrites have shown some astonishingly high sulphur percentages. Sufficient information is not yet available to make a really accurate determination of the sulphur content.

Leigh Creek coal, as explained, is a hydrous coal, the moisture content *in situ* ranging between 30 and 40 per cent in the different seams. In common with all other hydrous coals it disintegrates on exposure to the air, prolonged exposure causing it to lose a considerable amount of moisture during the process. The loss of moisture from the surface of the lump of coal causes a shrinkage in the coal matter. Differential stresses are set up resulting in the slacking of the coal. Conversely when rain falls on any dried surface of the coal it causes unequal expansion and further slacking. This property has been an obstacle to the sale of this type of coal throughout the world.

Following the 1914-18 war the Germans found it necessary to develop their brown coal and lignite deposits. Considerable research was carried out with a view to improving the condition of the coal and making it more suitable for ready sale. The late Professor Hans Fleissner, of Austria, introduced a process for drying lignite with high pressure saturated steam in 1927. He believed that the uneven shrinking of the coal and consequent disintegration could be prevented by controlled removal of water. His process proved successful and a number of plants were installed in Germany, Austria and Czechoslovakia to process the lignites. Research indicated that the action of high pressure steam on a lump of lignite produced the following effects:—A considerable portion of the inherent moisture was expelled in a fluid condition, the coal matter shrank and the product on drying out did not absorb moisture from the air nor disintegrate unless subject to the influence of overhead rain. It was considered that the process really appeared to advance the rank of the coal, although the removal of the moisture by steam drying caused little alteration in the analysis of the dry ash free coal. The Fleissner process was patented by an Austrian company and apparently designs for different plants were prepared by this company. The latest information deals with the development of a plant at Ponholz in the Oberphalz region of Lower Germany. A German report states that the majority of the water could be separated in the liquid state and that Fleissner succeeded by subjecting the coal to saturated steam at 150 to 250 lb. pressure. The water is not expressed by the high pressure as might be supposed, but the separation is due to the heating of the coal. The water which has to be removed is in the capillaries, *i.e.,* in the fine canals between the solid coal particles. According to Dr. Rosin the walls of these capillaries exert a certain pressure on the water in them which acts against the viscosity of the water. If this decreases as a result of the higher temperature from the presence of steam, water passes out of the narrow canals. At the same time there is a simultaneous shrinking of the coal without disturbing its lumpy form. The high pressure steam is exhausted from the vessel containing the coal and a further amount of water is removed from the coal by the actual evaporation from the lumps. The product is cooled and is ready for the market. It is considered that the moisture content remaining in Leigh Creek coal after processing will be approximately 12 per cent. During the process the coal suffers a certain amount of degredation and the final product is slightly softer than the raw coal. Testing carried out to determine the shatter index, which is really a figure based on how much of the coal retains its sizing after being dropped, shows that while Newcastle coals give a figure up to 95, and raw Telford coal 87.5, the dried Telford coal is reduced to 81.0 for material between 2in. and 3in. in size. The figure for the Northern coal is 77 after drying. The product is of much higher calorific value due to the water removed. The calorific or heating value of Telford coal is increased to 7,760 B.T.U.'s per lb., an increase of nearly 31 per cent whilst Upper Seam Northern Basin coal improves to 9,400 B.T.U.'s per lb., an increase of over 33 per cent.

Thus drying improves stability against slacking, reduces moisture content, and greatly improves burning qualities. In the case of Leigh Creek coal the actual freight saving by not transporting the moisture removed is very considerable.

"AVERAGE" PROPERTIES OF LEIGH CREEK COAL.

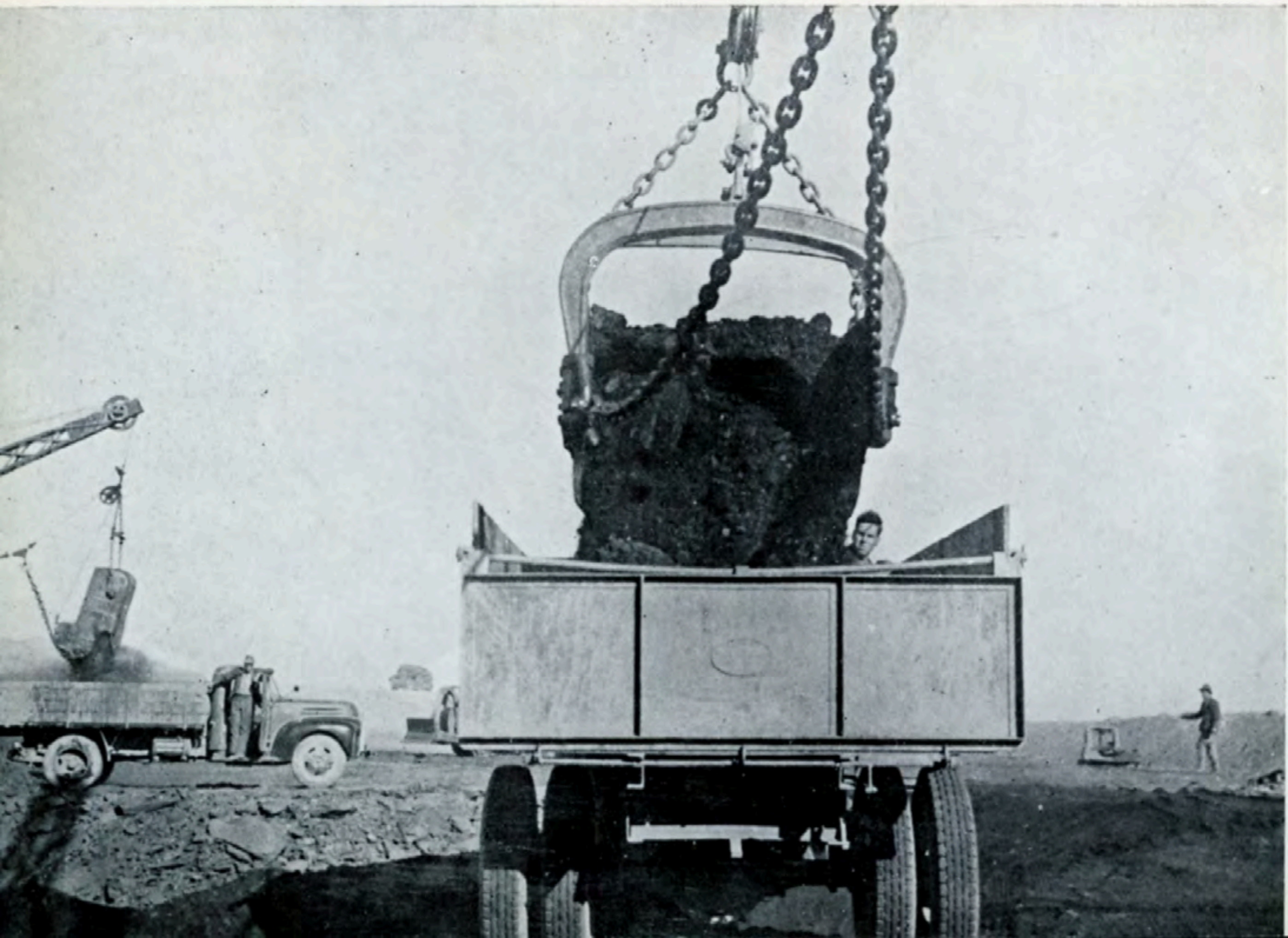
	Telford Basin Open Cut Seam.	Northern Basin Lobe D.	
		Upper Seam.	Lower Seam.
1. Proximate Analysis—			
Moisture (as mined)	32·7	38·0	35·82
Volatile Matter (as mined)	21·6	22·67	22·08
Fixed Carbon (as mined)	29·9	31·84	29·81
Ash (as mined)	15·8	7·49	12·29
2. Gross Calorific Value—			
As Mined, B.T.U. per lb.	5,940	7,050	6,400
12% Moisture, B.T.U. per lb.	7,760	9,400	8,700
Ash and Moisture Free, B.T.U. per lb.	11,530	12,930	12,330
3. Sulphur Content	less than 0·25%	0·6%	3·3%
4. Shatter Index—			
2in.–3in. Raw	87·5	—	—
Dried	81·0	77·5	—
5. Specific Gravity—			
Raw	1·45	1·40	—
Dried	1·60	1·45	—
6. Fuel Ratio— *i.e.,* $\frac{\text{Fixed Carbon \%}}{\text{Volatile \%}}$	1·38	1·40	1·35
7. Rank (as in Australian Scale)	12d	12b	12c

Plate 35.—The Premier (Hon. T. Playford) Examining Coal Face.

Plate 36.—Digging Coal.

Plate 37.—Loading Coal, Open Cut.

Plate 38.—Loading Coal in Open Cut.



CHAPTER VIII.
THE UTILIZATION.

Two questions arise concerning utilization of Leigh Creek coal. They are, how? and why?

Dealing with the first, Leigh Creek coal does not possess all the properties one normally thinks about in coal, but neither does any other coal. Different coals have different spheres of usefulness. Anthracite, the highest grade of coal known, is of no value for gasmaking. High volatile bituminous coal is not very suitable for domestic use and so on.

The raw Leigh Creek coal supplied to-day, graded into three classes, is at the present time fulfilling a vital role in keeping South Australian industries going. The large screened coal, consisting of lumps 2in. in size and more, is becoming a very popular household fuel. Burning in a grate which has good draught it produces a slow-burning fire of very pleasing appearance and with practically no smoke. Providing the fire is lit with a small amount of wood under the coal so that proper ignition is obtained, excellent results can be had by filling the grate with the coal allowing plenty of air spaces and then not touching the fire unless the ash blankets the red coals. With the serious shortage of firewood over the last few years and with no prospect of this supply increasing, the field for consumption of raw lump coal is a large one.

Much lump coal is also being used during the present coal crisis mixed with Newcastle coal on the railway system of the State. Additionally, in boilers which are hand-fired and accustomed to using large-screened Newcastle coal, material success has been achieved by the use of Leigh Creek coal.

For boilers using stoker size coal mechanically fired, numerous successful tests have been carried out with the small-screened Leigh Creek coal, and in the Municipal Tramways Trust's power house at Port Adelaide practically the entire load has been carried on this fuel assisted by coke breeze and a small amount of oil.

Where boiler equipment has not been designed so that it is necessary to use the highest grade Newcastle coal, substitution of Leigh Creek coal has enabled industry to carry on where many times recently it would have been in serious difficulties. Fines are being utilized by the cement manufacturers in their plants and there are now over 190 consumers using raw coal in its different grades.

Use of the dried coal has been limited to experimental work. The Railways Department have driven large locomotives with it, the I.C.I. plant at Osborne has provided some excellent figures for efficiency, and it is confidently anticipated that when a dried fuel is available many more industrial plants will use the coal.

According to our present knowledge briquetting is rather difficult. Experience throughout the world appears to indicate that only the low rank woody structure lignites will briquette without a binder. The main purpose of briquetting is in the utilization of the fines produced and separated at the grading plant which would otherwise be a waste product. It is anticipated that sales of fines to cement companies and to power plants operating on pulverized fuel will absorb a considerable proportion of the fines produced at Leigh Creek, but that a certain percentage will be unsaleable unless transformed into a more attractive product. Briquetting achieves this object. Briquettes serve a very useful purpose on the market being of uniform size and quality and generally free of any fines and dust usually associated with coal. They are clean to handle for domestic purposes and of convenient size for storing and handling. Considerable experiments have been carried out both with and without binders on Leigh Creek fines. The drawback to the use of binders is the cost involved in the binding material. Parcels of coal have been forwarded to America for investigations by one of the largest firms specializing in the manufacture of briquetting equipment. Research is still being continued in South Australia and it is hoped that a satisfactory briquette will be evolved.

Utilization for gasification is the subject of research at the present time. The normal methods of town gas production use only the very volatile bituminous coals of northern New South Wales. Supplies are by no means plentiful, the distribution is very uncertain and it is hoped that gasification of Leigh Creek coal, probably by a different type of plant from that operating with New South Wales coal, will enable the State to produce both industrial and town gas from the local fuel. Serious efforts are being made at the present time to utilize the Victorian lignites for this purpose, and arrangements have been made for testing Leigh Creek coal along similar lines.

The problem of hydrogenation of coals is receiving considerable investigation in many parts of the world. The lower grades of coal appear very suitable and investigations will be undertaken to determine the re-actions of Leigh Creek coal. Commercial application of any hydrogenation process is uncertain, but the information obtained by the research may lead to developments not thought of to-day.

In considering the full utilization of Leigh Creek coal, there does not appear any process at the present time whereby coke can be formed and consequently until such a process is devised this coal cannot be used for the manufacture of coke so widely used in industry, and the State will remain dependent upon New South Wales for this product.

The second question, why should industry use Leigh Creek coal?—The coal is of much lower heating value than Newcastle coal and demands a different technique in its combustion. No better proof of the absolute necessity for the development of the Field can be afforded than the record of the past few years in respect of the coal supplies imported from New South Wales to satisfy the demands of power plants, railways, gasworks and industry generally. The minimum quantity of coal to be held in order to ensure that these demands can be met without interruption is a tonnage that will last for four or five weeks. Yet this amount has been available only for a few weeks since the latter part of 1942. On some occasions recently the complete cessation of some services has been avoided by the timely arrival of shipments when only a few days', and even hours', supply remained. At the present time the quantities of coal received from New South Wales are not sufficient to meet the weekly requirements of all kinds and the deficiencies are being made up by coal brought by rail from Leigh Creek. Had the latter supplies not been available many hundreds of men would have lost their employment, production would have been curtailed, country centres would have been deprived of transport facilities and many sections of the community would have suffered serious monetary losses as well as inconvenience.

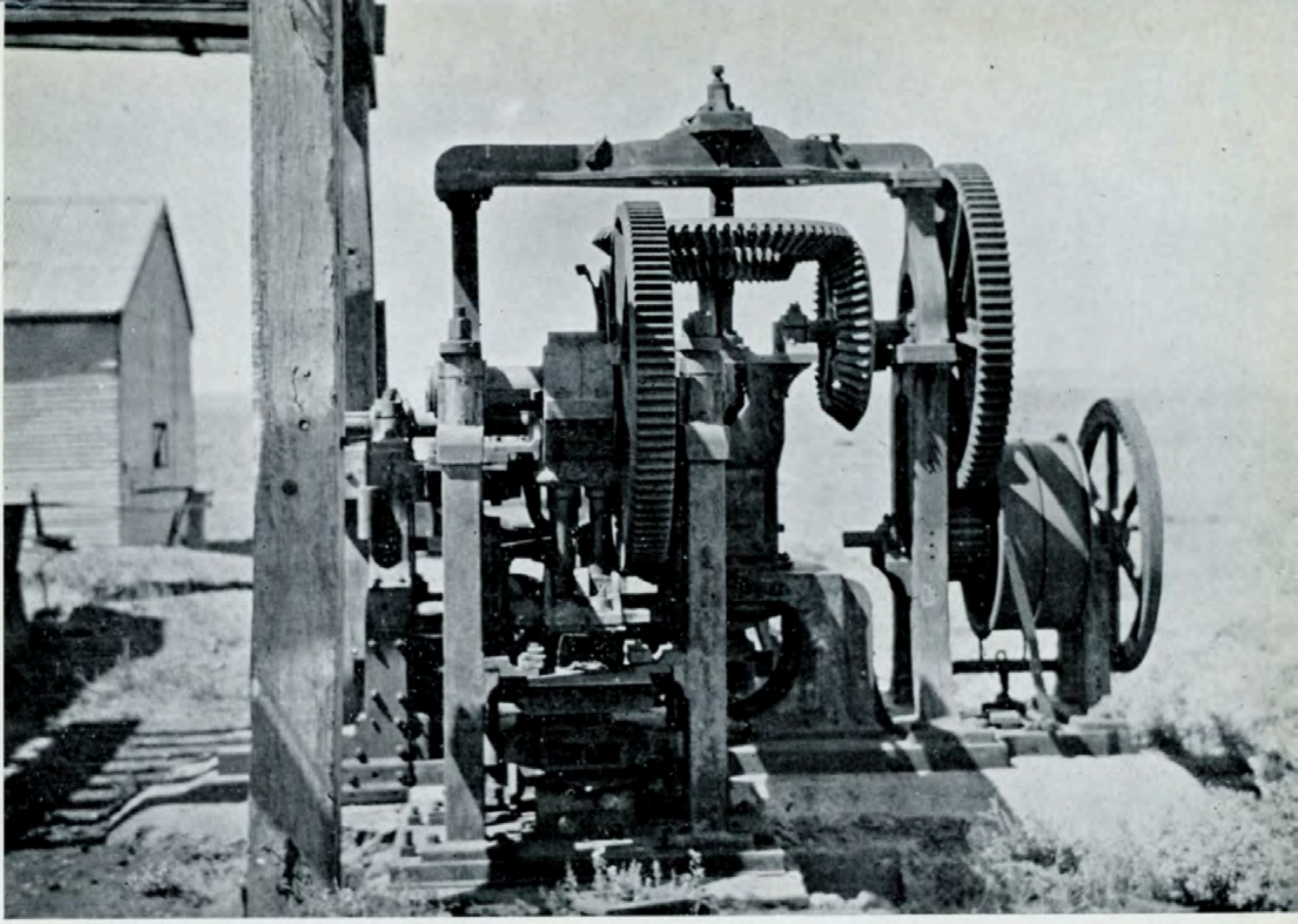


Plate 39.—Briquetting Machine, 1894.

Plate 40.—Grader Making Aerodrome, 1945.

Plate 41.—Loading Gravel, Leigh Creek.

Plate 42.—Conglomerate Overburden—Open Cut.

The earlier reluctance to use Leigh Creek coal is disappearing as one consumer after another finds that he can, by slight modifications in former practice, turn this coal to good account and maintain his output.

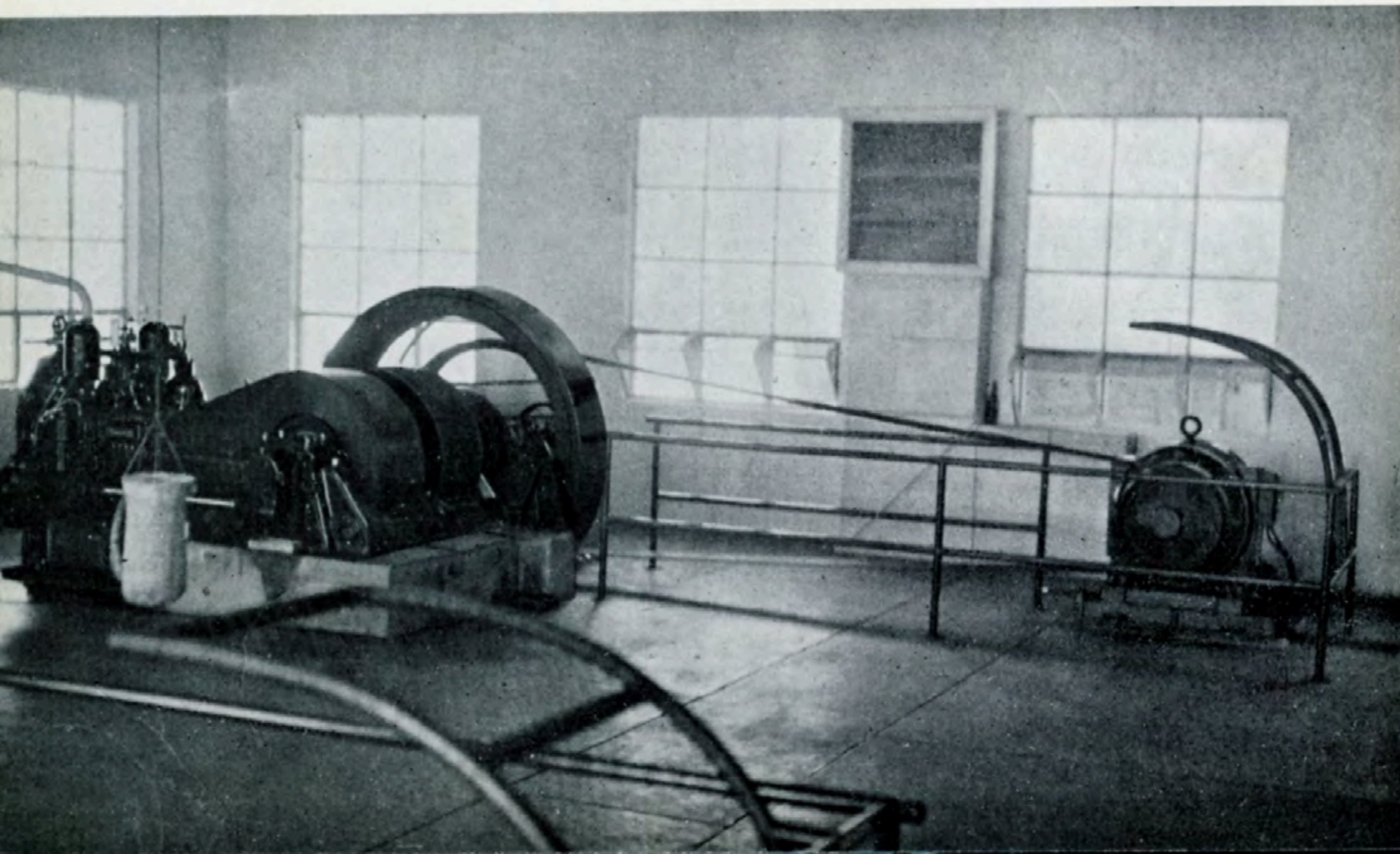
Every trained observer who has endeavoured to interpret the coal problem in New South Wales returns to his home State with the firm conviction that the chaotic condition of the industry generally cannot be rectified within any short period of time. It is evident that the total output from the Eastern Coalfields will not be sufficient to fully meet the needs of industry. The figures for consumption of coal are rising every year, and with the anticipated production for the year 1946 falling short of all requirements by at least 1,000,000 tons, observers from other States are recommending rapid devolopment of fuel resources in their home States.

The development of lower grade coal deposits even when easily accessible, has always met with considerable opposition from those users who are disinclined ever to alter their daily routine. The history throughout the world shows that low grade coal deposits have had to fight for their existence, but their national value has nearly always been realized and their development has been continued.

The advantage to South Australia of fostering the development of Leigh Creek can be illustrated in two ways. Firstly, continuity of employment by utilization of the local fuel, and secondly, establishing of an industry which involves the payment of, say, £500,000 or more per year in wages and services. The industrial progress of our community is entirely dependent upon heat, light and power being available to the extent wanted and at the time wanted. Leigh Creek can assist materially to this end.

Plate 43.—Motor Fleet, 1946.

Plate 44.—Power House.



APPENDIX I.

ECHOES OF THE PAST.

Extract from "Hansard," 13th June, 1893.

Mr. Scherk asked the Treasurer:—

"Is it the intention of the Government to take steps to introduce Leighs Creek coal in the Government Departments where practicable?"

The Treasurer replied:—

"The Government will endeavour to pay every regard to the Leighs Creek Coal Mine so far as is consistent with proper consideration for the interests of those supplying firewood."

Mr. Foster asked the Commissioner of Public Works (Mr. Holder):—

"In view of the great improvement in Leighs Creek coal would he have the fire bars altered in one of the locomotives so that a fair test might be obtained which could not be done now owing to the excessive blast in the present fire bars."

The Commissioner of Public Works promised:—

"To see that no unfair advantage was given in the comparison between Leighs Creek and any other coal, and the Government would do everything to fairly test the qualities of the local article."

Extract from "Hansard," 11th July, 1907.

Mr. Allen asked:—

"1. Who was the original discoverer of the Leigh Creek Coal Mine?
2. Was there a bonus offered for the discoverer?
3. If so, what was the amount?"

The Commissioner of Crown Lands replied:—

"1. Mr. Drew Williams, jnr., claimed to be the original discoverer.

2. A bonus has been offered from time to time under the provisions of the Native Industries Encouragement Act No. 30 of 1872 for the discovery of a payable coalfield, coal to be of marketable value (equal to the coal used by the South Australian Railway Department). Payment was to be in sums of £1,000 for the first 1,000 tons of marketable coal raised at the pit's mouth.

The lease issued to the Leigh Creek Coal Company provided that the lessee shall not be entitled to claim or receive any reward now or hereafter to be offered by the Government for the discovery of a payable coalfield.

3. £10,000."

Extract from "Hansard," 15th September, 1908.

The Hon. J. G. Bice asked:—

"1. Has the option to purchase held by the Leigh Creek Coal Mining Company expired?

2. If so, what has been done in regard to the coalfield?"

The Chief Secretary replied:—

"1. Yes.

2. It has been reserved excepting 40 acres held to 30th June next when that will be reserved."

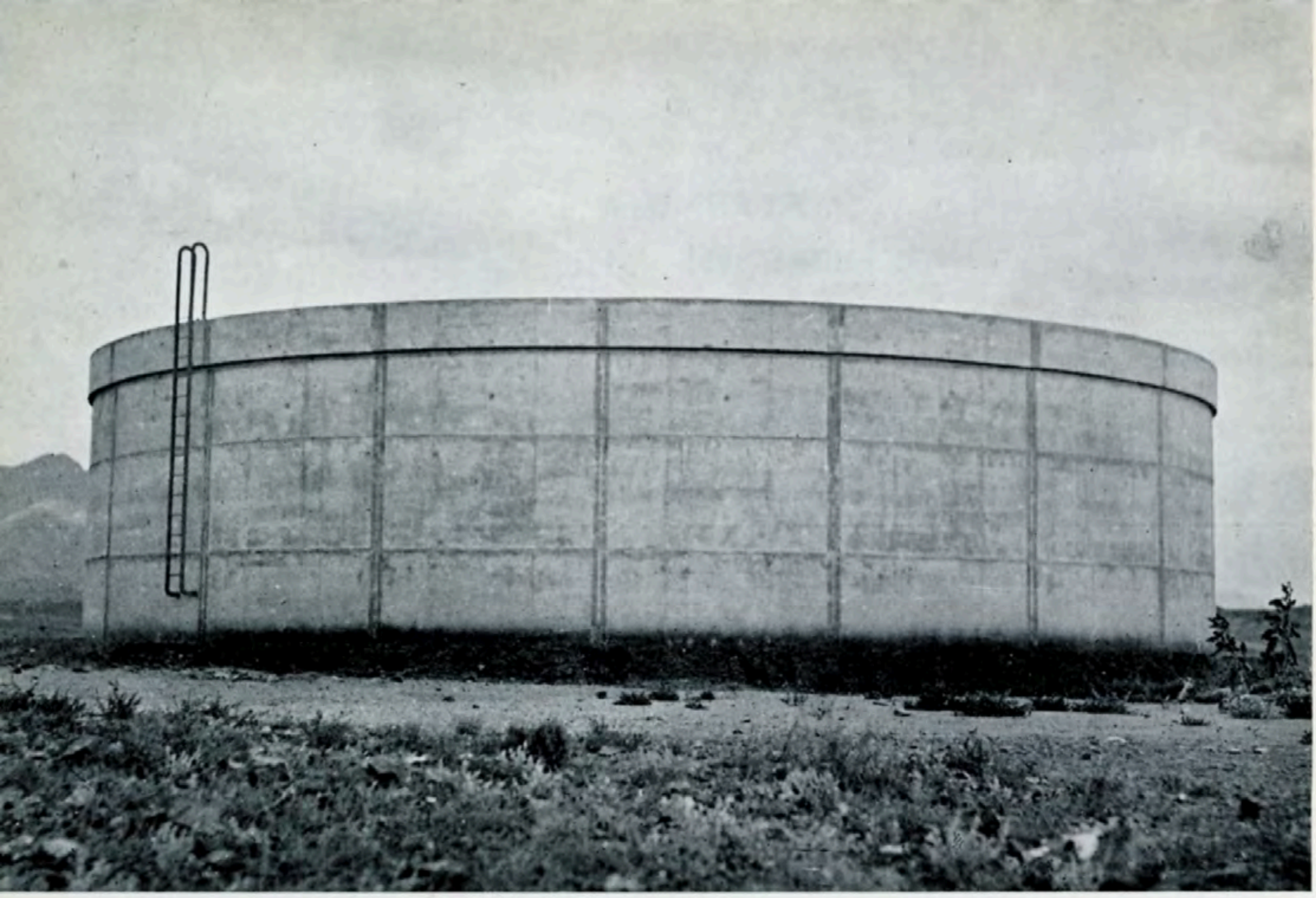
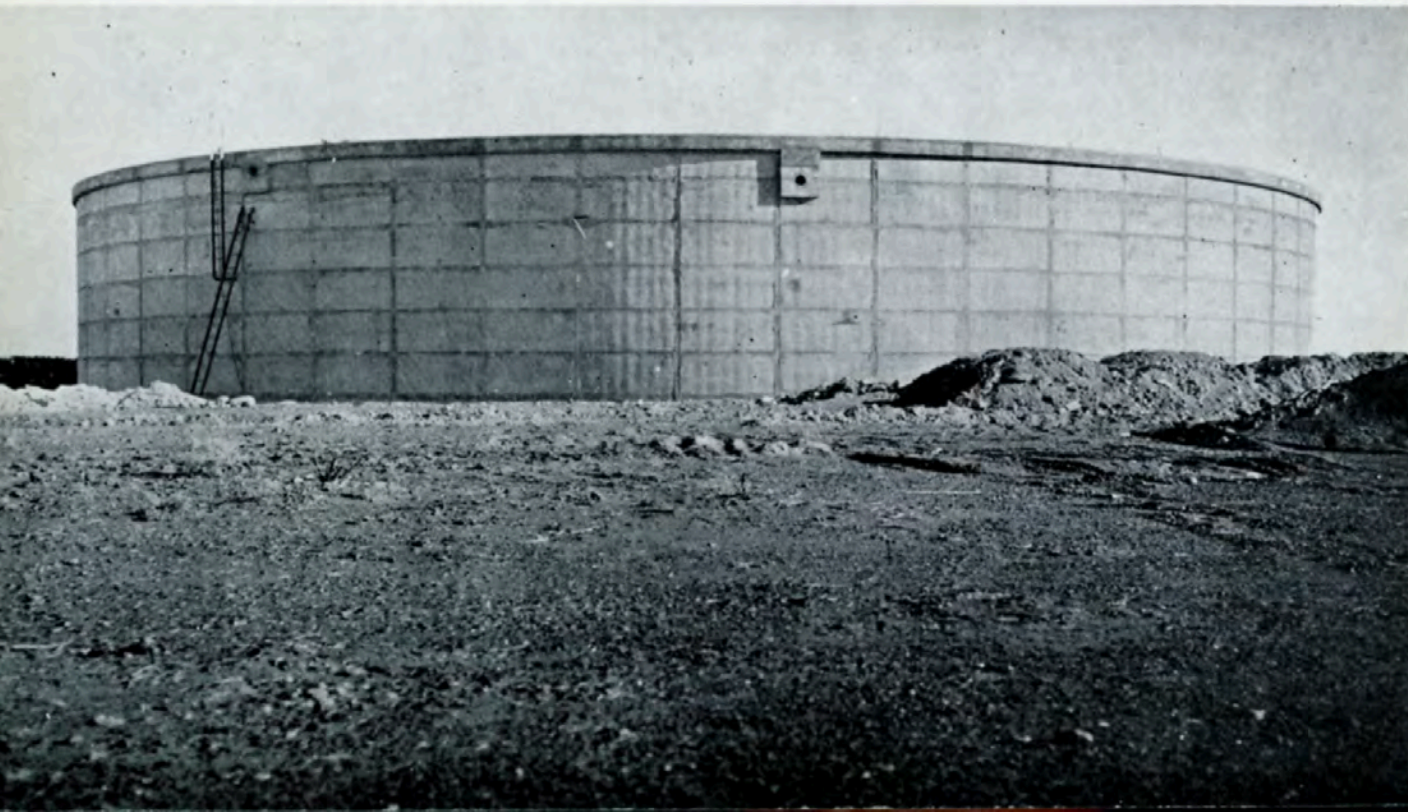


Plate 45.—250,000 Gallon Tank—Sliding Rock.

Plate 46.—One Million Gallon Storage—Leigh Creek.



APPENDIX II.

TREE CULTURE.

Geographically, Leigh Creek Coalfield is located in "the arid region." This region covers a large portion of Western Australia, South Australia, and a small amount of western New South Wales. It lies too far south to be benefited regularly by the north-west monsoon winds and too far north to be much influenced by the westerlies in winter. The rainfall is very erratic. The average rainfall figures do not tell the whole story, for one year may have rains much above average and be succeeded by several exceptionally dry years. A marked feature of the region is the very high range of temperature, *i.e.*, the difference in the monthly averages. Copley, six miles from the Field, is the nearest Weather Registration Station, and its figures may be accepted for Leigh Creek. Copley has an average of 7.64in. of rain per year over a period of 60 years. However, the average rainfall from 1916 to date is only 6.84in., indicating that the period earlier than 1916 had a much higher average rainfall. During the last six years the annual Copley rainfall has been:—1940, 2.13in.; 1941, 6.79in.; 1942, 7.11in.; 1943, 3.69in.; 1944, 2.79in.; and 1945, 9.41in. The average monthly figures making the average annual rainfall are:—

Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
.60	.59	.64	.56	.92	.99	.44	.61	.59	.46	.56	.68	7.64

This distribution is totally at variance with that of any normal climate and indicates that certain years have yielded rains only in the summer, others only in the spring, autumn or winter, and that therefore the actual rainfall in any year merely occurs in a few isolated months. July is the coldest month of the year and is over 30deg. colder than January or February—the hottest months.

The soil of the tableland upon which Leigh Creek town is being developed is a heavy reddish boulder clay covered with "walk-about" ironstone or gibbers. The top soil is some 18in. in depth and under this the clay has hard bands of gypsum, conglomerate, pipe clay and gravels of differing thicknesses in irregular lenticles at varying depths.

The tableland is at an elevation of approximately 650ft. above sea level and the cross-fall is great (up to 1 in 150) and rain penetrates very little into the soil. There is practically no natural vegetation and water erosion soon becomes serious. There are, however, numerous sink holes or crab holes which very rapidly absorb all rain running into them, otherwise soakage is extremely bad.

It was evident that conditions for tree culture were not promising. The psychological value of green trees in a desert and the actual beautification of the area were reasons for immediate consideration of the problem.

The first step was the inspection and identification of trees thriving or struggling in the district, and all pastoralists' gardens were examined. The trees found were:—

Species.	Local Name.	Location, Etc.
Euc. camaldulensis (syn. *rostrata*)	Red Gum.	Widespread in gravel creeks.
Myoporum montanum	Myrtle.	Widespread, but cultivated.
Heterodendron oleifolium	Bullock Bush.	In hills on edge of creeks.
Eucarya acuminata	Quondong or Native Peach.	Widespread.
Cas. lepidophloia	Black Oak.	Widespread.
Schinus molle	Pepper.	Widespread.
Ceratonia siliqua	Carob.	Cultivated.
Myoporum platycarpum	False Sandalwood or Sugarwood.	Widespread.
Nerium—various	Oleander.	Cultivated.
Tamarix articulata	Athle.	Cultivated.
Acacia Victoriae	—	In creeks.
Acacia tetragonophylla	Dead Finish.	Widespread.
Melaleuca glomerata	White Barked Ti Tree.	In creeks.
Rhagodia nummularium	Old Man Saltbush.	Widespread.
Rhagodia hastata	Ruby Saltbush.	Widespread.

The reputation of the Athle tree led to the planting of a number of cuttings from the Mount Serle trees, and these were the first trees tried at Leigh Creek. Further investigations were made in New South Wales, and the Forestry Commissioner, Mr. Swain, had an investigation made by one of his Divisional Officers who submitted the following report:—

"*New South Wales Forestry Commission.—The Climatic Index.*

MTCM° 46° — 55° Lowest rainfall months occur in Spring—Summer Seasons.
MTHM° 72 + Mean Annual Rainfall less than 8 inches.
HOMOCLIME Zone No. 7/8·6a.

Name of Station	Temperature		Months 48° +	Rainfall				
	MTCM °F.	MTHM °F.		Months Below		Lowest Monthly		Mean Annual Inches
				200 points	150 points	Points	Season	
Leigh Creek, S.A.	51·1	82·2	12	12	12	48	Sp.	7·76
Dakla, Egypt . .	55·0	87·0	12	12	12	0	—	0·00

The most suitable species climatically for planting at Leigh Creek are:—

1. Those native to the climate.
2. Those growing in the homo-clime.

Among 1 are:—

Euc. polycarpa (Bloodwood).
**Euc. rostrata* (River Red Gum).
Cas. lepidophloia (Belah).
Callitris glauca (White Cypress).
Callitris verrucosa (Mallee Cypress).
Pittosporum phillyreoides (Butter Bush).
Myoporum platycarpum (False Sandalwood).
Heterodendron oleifolium (Western Rosewood).
Acacia aneura (Mulga).
Acacia sentis.

Group 2 includes:—

Salvadora persica (Arak) edible berries.
Capparis decidua (Tondob) (ornamental red flowering).

Plate 47.—Bulldozer.

Plate 48.—Open Cut Excavation.

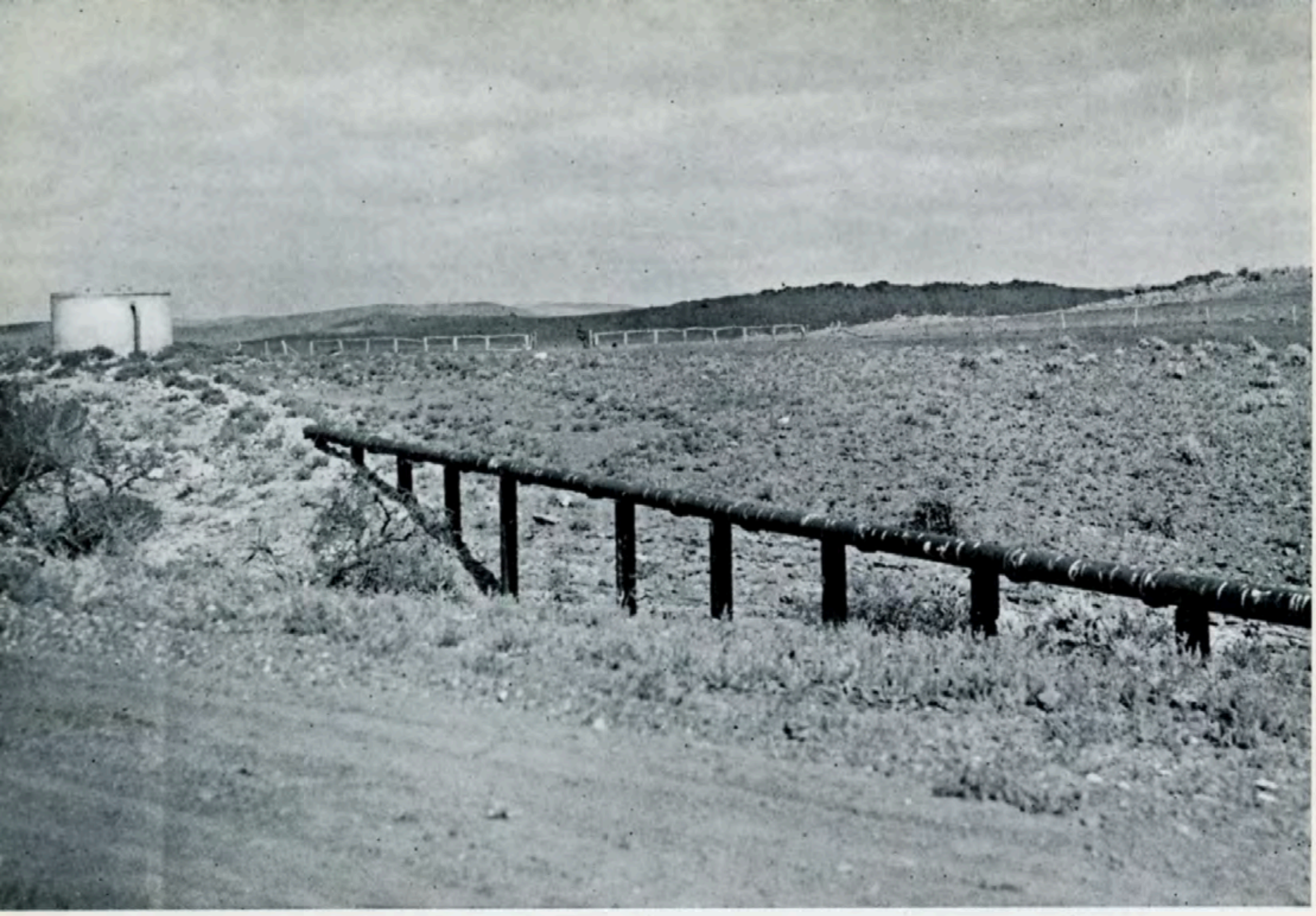


Plate 49.—Pressure Tank on Pipeline, Emu Range.

Plate 50.—Pumping Station, No. 2 Bore, Sliding Rock.

Tamarix articulata (native name Athle in Sudan). (*T. aphylla*) syn.
Zizyphus spina-christi (jujube) edible fruit.
Acacia arabica (Kikar) produces gum arabic.
Acacia totilis.
Phoenix dactylifera (Date Palm).
*2nd *Salix safsaf* (Willow).
**Populus euphratica* (useful timber) (from India).
Tamarix dioica (grows even in saline soil, good binding plant) (from India). The latter should also be worth trying.

NOTE.—*For moister or irrigated sites.

W. A. W. DE BEUZEVILLE, Divisional Officer."

A dozen of most of the trees in Group 1 were forwarded from New South Wales and a small nursery was erected to house the trees pending their acclimatization. The majority arrived in open ended steel tubes. The tubes were removed and the trees planted in tins. Unfortunately, weather conditions and the drought proved too much for the great majority of the trees and very few have survived. It was noticed that the use of Sliding Rock water, which contains 86 grains per gallon, made marked saline deposits on the soil in the tins. This practice of planting in tins is one widely adopted in Broken Hill, but the conditions at Leigh Creek have not been suitable for its adoption and it has now been abandoned.

For the year following the arrival of plants from New South Wales most reliance was given to the Athle trees and an increasing number were planted. It has now been found that the most satisfactory method is to plant the cutting in the open ground in the position in which it is to grow, the ground having previously been deeply tyned by using the rooter and tractor. A strip some 9ft. in width is loosened and the cutting planted in its correct position in the middle of this loosened ground. Athle trees are being planted 15ft. apart at Leigh Creek. To conserve the soil moisture no branches near the ground are being cut and it has been noticed that the root action of the tree is to send out surface feeders some 9in. below the ground in all directions very quickly. The trees are watered once a week in the early stage, this decreasing to once a fortnight later. It is hoped that ultimately they will not have to be watered more than once a month, a fully grown tree getting some 8gall. to 10gall. of water.

The assistance of the State Department of Woods and Forests was also sought and an examination of the area by a forestry officer was made. He confirmed the views that conditions were difficult for tree culture and recommended consideration for the growing of trees in this order:—

Rhagodia nummularium—Old Man Saltbush.
Myoporum montanum—Myrtle.
Tamarix articulata—Athle.
Acacia ligulata.
Acacia Victoriae (syn. *Sentis*).
Schinus molle—Pepper.
Casuarina lepidophloia—Black Oak.
Prosopis jugelifera—Mesquite.
Myoporum insulare—Boobialla.
Acacia acuminata—Raspberry Jam Tree.
Nerium, various—Oleanders.
Brachychiton diversifolia—Kurrajong.
Ceratonia siliqua—Carob.
Lagunaria Patersoni.
Eleagnus angustifolia—Russian Olive.
Tamarix gallica—Pink Tamarisk.

Gleditsia triancanthos—Honey Locust.
Pittosporum phillyreoides—Wild Apricot.
Capparis Mitchelli—Wild Orange.
Myoporum platycarpum—False Sandalwood.

At a later date, native trees and shrubs were taken to the Waite Research Institute for identification, and the assistance of Miss C. Eardley was sought to ascertain, from her wide botanical knowledge, the trees which she considered most suitable. Whyalla was visited on several occasions to consult with the authorities responsible for the tree planting in that town. Both Mr. J. Goode, from Whyalla, and Miss Eardley consider that arid climate native trees are the best proposition, and the following list given by Miss Eardley is approved by Mr. Goode:—

Acacia Sowdenii—S.A. Myall.
Myoporum platycarpum—False Sandalwood.
Euc. Dundasii—Dundas' Blackbutt.
Euc. Le Soueffii—Le Soueff's Blackbutt.
Heterodendron oleifolium—Bullock Bush.
Cassia Sturtii.
Acacia Oswaldii—Oswald's Wattle.
Acacia notablis.
Schinus molle—Pepper.
Pittosporum phillyreoides—Wild Apricot.
Acacia salicina—Broughton Willow.

Through the generosity of the Waite Research Institute seeds of practically all these trees have been made available and have been planted at Leigh Creek.

It is intended to concentrate on these trees of the arid regions. In particular, *Pittosporum phillyreoides* is recommended by every authority, and some beautiful specimens have been seen in the district. It is hoped that a considerable number will be available this year for planting out and that they will form the first trees used in street planting. The various Acacias, particularly the Broughton Willow, are also to be tried out.

Additionally to the native trees thriving at Whyalla, considerable success has been obtained in planting out the following varieties:—

Ficus hillii.
Ficus australis.
Lagunaria Patersoni.
Pinus halepensis—Allepo Pine.

Both the *Lagunaria* and the Allepo Pine have been tried out at Leigh Creek and the results are encouraging. It is not proposed to attempt to plant the *Ficus* out until further knowledge is available of the number of frosts on the Field, as this species will not stand heavy frost.

For the guidance of those interested in tree culture in arid climates where the water is of fairly high salinity, the following list is given of trees in the order in which it is considered they can be grown:—

Myoporum montanum.
Tamarix articulata.
Pittosporum phillyreoides.
Lagunaria Patersoni.
Rhagodia, various.
Nerium, various.
Casuarina lepidophloia.
Acacia salicina.
Acacia Sowdenii.

Plate 51.—Telford Railway Station, 1946.

Plate 52.—Coal Away.