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Glen Davis Oil Shale Works
by Ross Mainwaring

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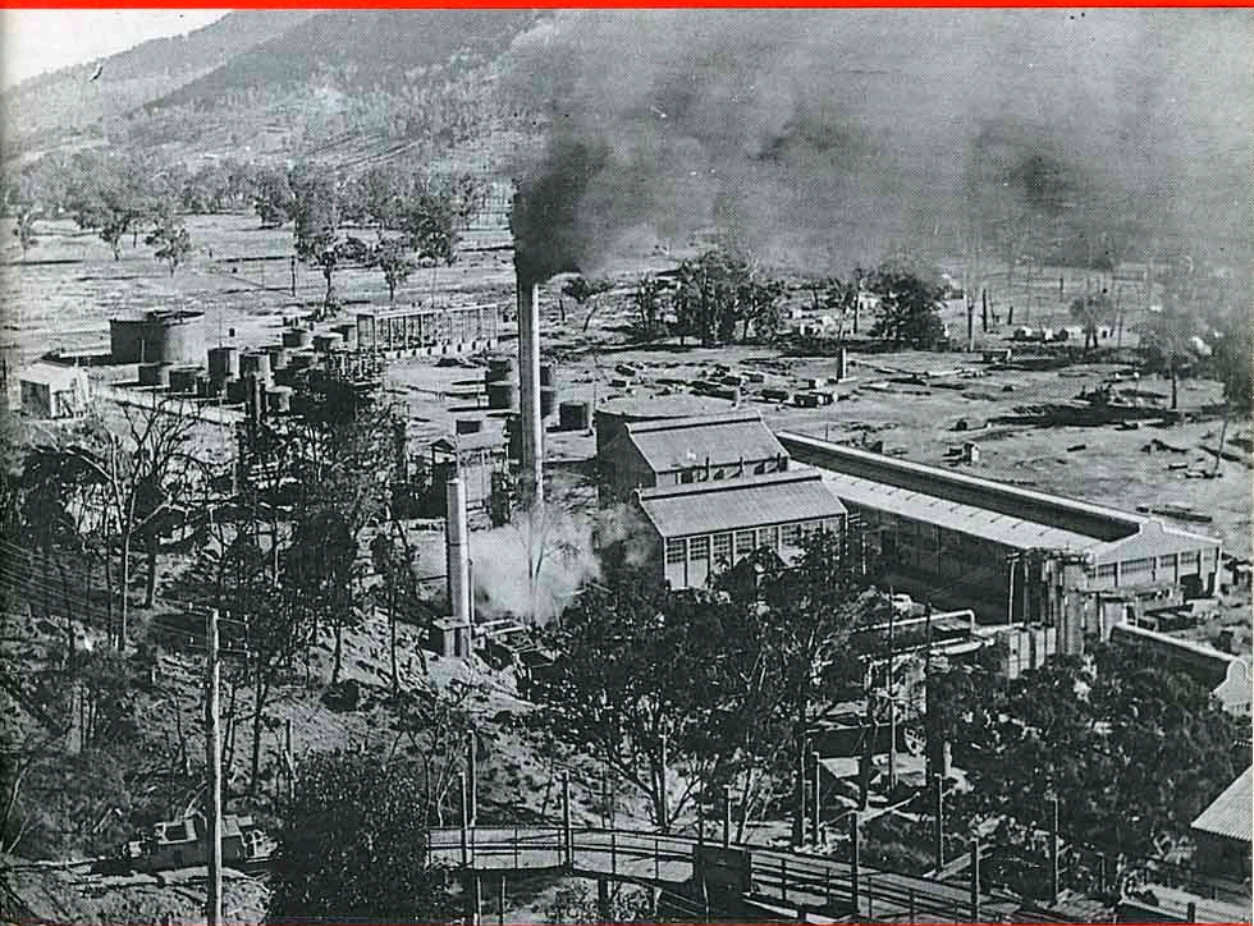

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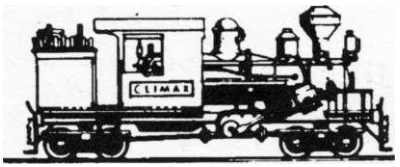

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EDITORIAL

The refining of petroleum products from oil shale at Glen Davis in N.S.W. from 1940 to 1952 was one of Australia's more interesting industrial and mining ventures.

The enterprise was scarcely an overwhelming technical or mining success but it did provide employment in a recession as well as supply petroleum products to the war economy. Several innovations in mining and electric tramway traction were trialled at Glen Davis and it deserves a special place in history.

In this two part article Ross Mainwaring chronicles the political, social and tramway history of the Glen Davis oil shale works.

Norm Houghton

GLOSSARY OF MINING TERMS

Bord and Pillar: method of working in which roadways (bords) are driven through the solid shale or coal in such a manner as to form pillars of a required size to support the overlying strata.

Darg: output of ore arbitrarily fixed by contract miners as constituting a day's output per man.

District: area in the mine workings mainly isolated by barriers from the next district.

Drift: tunnel cutting across the bedding of the strata -also known as a 'cross measure drift'.

Elevating Conveyor: a portable electrically powered conveyor used for loading mine cars from shuttle cars.

Flat: marshalling area for full or empty mine cars.

Gate end panels: electrical connection panel for trailing cables for loading machines usually at the 'gate end' or haulage road into the panel.

Goaf: an area from which the ore has been removed and the roof allowed to fall.

Heading: an excavation driven at or near right angles to the bords and proceeding in the direction of development.

Longwall advancing: a method of working coal or shale by which the mineral is extracted in one working along a continually advancing face.

Longwall retreating: a method of working in which haulage roadways and airways are driven to the boundaries of the holding then a longwall face is established which 'retreats' back towards the shafts or tunnel.

Mercury arc rectifier: an electrical machine for rectifying or converting AC current to DC current. It has no moving parts and is most efficient with voltages in excess of 600 DC.

Naptha: inflammable, volatile oil produced by distillation of organic substances.

Panel: a portion of the mine workings mainly isolated by barriers from the next district.

Putter: an electric winch fitted with a cable drum and steel cable for moving mine cars when loading.

Shuttle car: a pneumatic tyred vehicle used for transporting shale or coal from the loader to the mine cars. It is equipped with a conveyor for unloading the shale in a forward direction. Glen Davis shuttle cars were battery powered.

Spotting: the placing of mine cars at the loading machine by a locomotive in preparation to being loaded with shale.

Toe: heaving or lifting of the floor caused by pressure of overhead strata upon the pillars.

Torbanite: a form of Sapropelic coal formed from plant debris such as algae, spores, pollen grains and plankton. Complex chemical changes from Kerogen, the oil producing constituent of oil shale.

Cover Photo: *An early view of the refinery, circa 1940. The power station's chimney is belching black smoke. A G.E. trolley loco is visible at the lower left on the surge bin line.*
Photo: Mr. M. Davis Collection

GLEN DAVIS GIL SHALE WORKS

by Ross Mainwaring

INTRODUCTION

In the state of New South Wales from 1865 to 1952 there were numerous examples of the mining and refining of kerosene shale on a commercial basis. These concerns were based at Mount Kembla, Hartley Vale, Joadja, West Katoomba, Airly, Torbane, Murrurundi, Newnes and Glen Davis.

One of the larger and more successful of the shale mines and refineries was at Newnes near Lithgow that operated from 1906 to 1934. The Newnes oil distillation works was very much an on-off operation that opened and closed repeatedly due to competition from imports, mining difficulties and capital shortages.

The Federal Government took an interest in the Newnes oil works from 1931 as both an employment creation measure and as an encouragement to domestic oil production. The government supported the efforts of the new owners, the Shale Oil Development Committee Limited, but by March 1932 this company had folded.

The Federal Government then called tenders in April 1932 for new operators at Newnes but no long term scheme eventuated. This set the pattern for the next four years until finally in May 1936 the Federal Government announced it would nationalise the Newnes operation and, together with the New South Wales state government, inject new capital into a joint private enterprise venture. To this end Sir Herbert Gepp,[1] prominent industrialist and Consultant on Development to the Federal Government, approached Mr George Davis, founder of Davis Gelatine Pty Ltd. Davis, later to be knighted, was recognised for his entrepreneurial skills in the rehabilitation of the ailing Cockatoo Dockyard in Sydney which he took over from the Federal Government. In this instance Davis replied that his company would refrain from tendering, but should no satisfactory tenders be forthcoming, he would be prepared to discuss the matter further. No satisfactory tenders materialised.

Towards the end of 1936 Senator A.J. McLachlan, then Minister for Development, arranged to discuss the Newnes project with Mr Davis, during which great confidence was expressed as to the project yielding a satisfactory return on capital. The Senator put forward a very persuasive argument that Mr Davis should investigate and proceed with Newnes on National grounds. A letter of offer on the shale business setting out terms was forwarded to the Minister; it was accepted and Federal Parliament ratified the agreement on 16 September 1937.

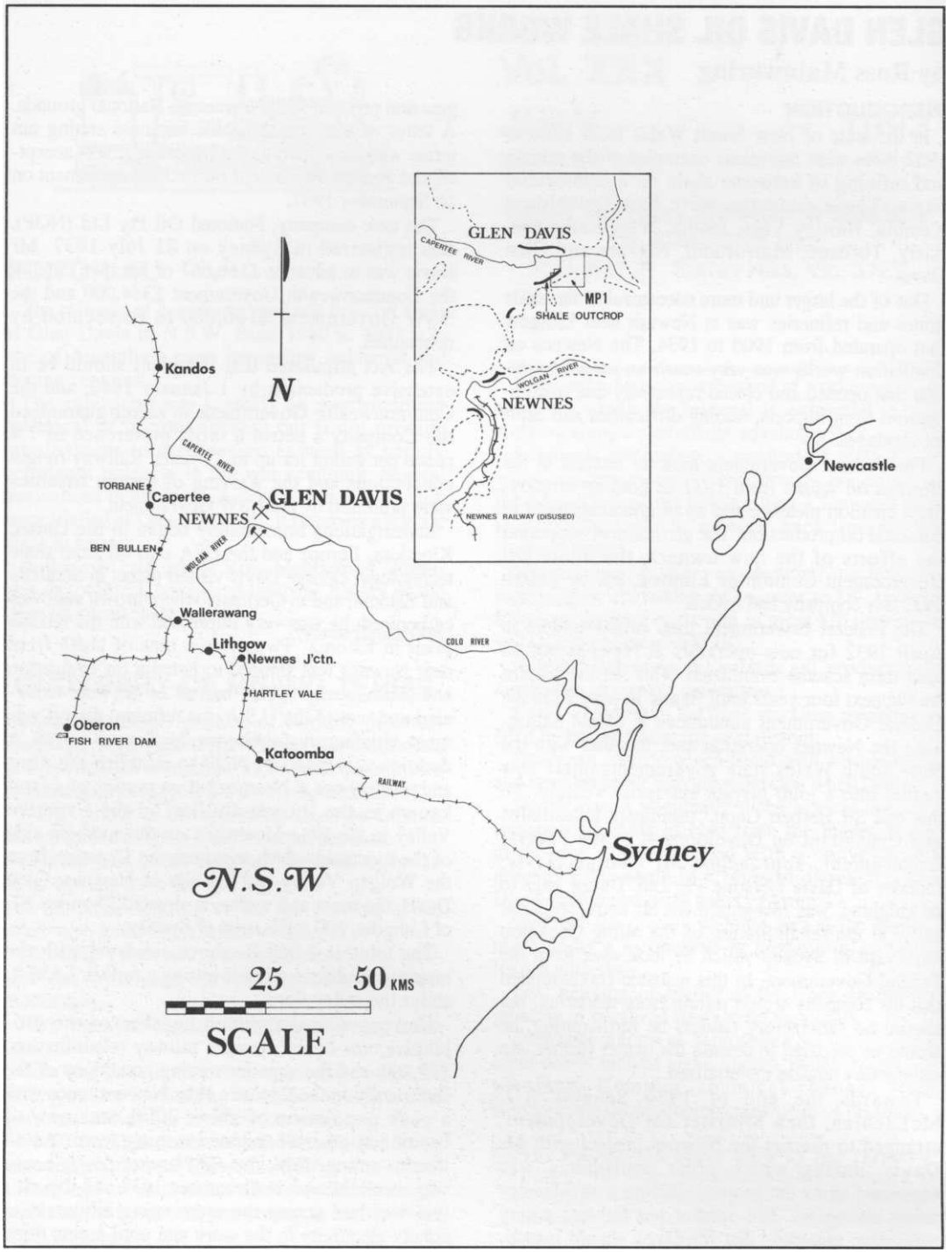
The new company, National Oil Pty Ltd (NOP), was registered in Sydney on 21 July 1937. Mr Davis was to advance £166,667 of his own capital, the Commonwealth Government £334,000 and the NSW Government £166,000 to be secured by debentures.

The Act stipulated that the plant should be in extensive production by 1 January 1940, and the Commonwealth Government in effect guaranteed the Company's petrol a tariff preference of 7.4 pence per gallon for up to 25 years. Railway freight concessions and the waiving of certain royalties were promised by the NSW Government.

Investigations immediately began in the United Kingdom, Europe and the USA into oil from shale technology. George Davis visited plants in Scotland and Estonia, and in Germany where brown coal was carbonised; he was very impressed with the Kivioli plant in Estonia. Twenty-five tons of shale from near Newnes was shipped to Estonia for evaluation and subsequently twenty barrels of oil were recovered and sent to the U.S.A. for refining; the oil was most satisfactory for the production of petrol. A decision was made by NOP to establish the plant and refinery not at Newnes but on portion of a farm known as the 'Lower Gullies' in the Capertee Valley in the Blue Mountains on the southern side of the mountain which separates the Capertee from the Wolgan Valley and the site of Newnes. Glen Davis, the town and works, is situated 26 miles NE of Lithgow, 100 miles west of Sydney.

The town is 1,060 ft. above sea level with the majestic sandstone cliffs towering a further 1,650 ft. above the valley floor.

Newnes was abandoned because of the prohibitive cost of the Newnes railway rehabilitation, £73,260, and the superior mining conditions of the shale seam on the Capertee side. Newnes, once with a peak population of about 3000, was now to become another abandoned mining town. As an interim arrangement, the old Newnes power house was reconditioned in December 1938 and a power line was laid across the intervening mountain to supply electricity to the work site until a new three



storey power house was provided. It was equipped with two John Thompson boilers and electrical generating plant having an output of 1500 kw. Dismantling of the old retorts at Newnes for re-erection at Glen Davis began in April 1939. Amenities for the employees in the new township of Glen Davis eventually included a golf course, swimming pool, bowling green, tennis courts, school, shops, a cinema and a hotel fitted with a 100 foot long bar.

The company erected cottages for its officials and a 300 bed single man's hostel. However living conditions in the early days were substandard. Mr Hamilton Knight (Member for Hartley) described them as a 'disgrace to civilisation'. In March 1941 a 'Community Advancement Society' was formed to assist prospective home buyers to purchase a dwelling. The population in 1947 was 1600 people.

THE SHALE MINE (known as National Shale Mine)

The seam of oil shale, or torbanite, outcrops on the Southern talus slopes of a narrow gorge, and occurs within the permo-carboniferous coal measures. It was estimated that the area bounded by the outcrops had a potential crude oil content of some 2,000 million gallons.

The rich main seam assayed between 120 to 150 gallons of crude oil per ton of shale, and varied from a seam thickness of 5 ft down to a workable minimum of 2 ft.

Immediately above the torbanite is a seam of white clay, varying from 6 ins. to 24 ins. in thickness and this separates the rich main seam from a thin seam of semi-carbonaceous shale containing some 20 gallons of crude oil per ton. In contrast to the resilient torbanite this carbonaceous shale readily breaks down when exposed to the weather.

Right to left: Mr. Alex Mair, the premier of N.S. W.; Mr. Harry Dalziel, Mine Manager and Mr. George Davis standing on a General Electric loco at the portal of M.P. 1, 1940
Reproduced by kind permission of the Earth Exchange, Sydney.

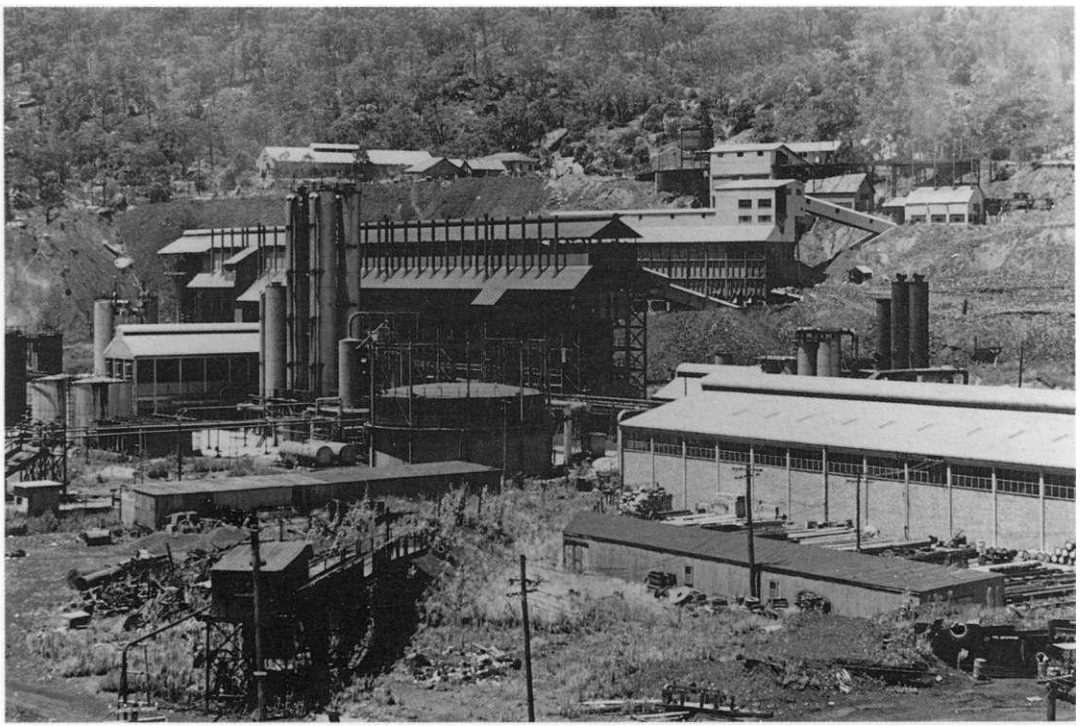
When NOP commenced mining operations in July 1938 it was decided to recondition the old MP1 prospecting tunnel which had first been driven in 1888 then extended early this century by the Commonwealth Oil Corporation of Newnes. This tunnel was driven in the thicker portion of the shale seam which thinned in each direction. The tunnel was 12 ft wide by 5 ft 6 ins high.

Mr Harry Dalziel, previously Under-Manager of the Lithgow State Mine, was appointed manager of the shale mine on 1 July 1938 on a salary of £1,000 a year.[2] He commenced to re-timber, widen and clear the tunnel of falls so it could be used as the main intake airway and transport road. A temporary single rail line using 45 pound rail was laid down to carry four ton side tipping skips pulled by horses. Stone was manually loaded into these skips, of which there were ten in number, hauled outside and tipped into a gully.

Consideration was given by Dalziel to drive the MPI tunnel through the mountain to the Wolgan River so an adequate water supply for Glen Davis could be maintained. The distance was three miles and was estimated to take four years to complete but failure of the Wolgan River during a severe drought aborted this idea. MPI ultimately reached 4,362 ft in length.

The Manager's proposal to work the shale was by extraction along orthodox Longwall principles, with roadways in the goaf using skips of one ton capacity running to a gauge of 2 ft. By this method capital expenditure would be considerably reduced and enough faces opened up to supply the proposed retort requirements of 700 tons of shale per day.

Following discussions with Mr Bill Sheeler, Engineer in Charge, and George Davis, it was decided to introduce up to date mechanical mining equipment, though Dalziel pointed out that more time and money would be required to bring the mine into full production. Mechanised shale mining was a new field altogether, requiring careful evaluation of contemporary coal mining equipment. An



Glen Davis: the refinery and retorts are in the foreground while the shale mine is high above on the talus slope behind. The majestic sandstone cliffs look down upon the enterprise. Circa 1951. Reproduced by kind permission of the Earth Exchange, Sydney.

inspection was made of a Jeffrey coal loading machine in use at Abermain No 2 Colliery near Cessnock. It was agreed that a similar unit be purchased to trial.

Mine development proceeded quickly with three parallel back headings being driven to MPI, along with development of 1 and 2 West and 1 and 2 East districts.

On the surface a bathroom, 72 inch Sirocco ventilation fan, explosive magazine and battery charging house were built. The bathroom was fitted out with 60 hot showers and a laundry with electric washing machines.

It was intended to extract the rich main seam only using Advancing Longwall principles and to this end two 'Sullivan' 9X Longwall cutters were purchased along with a Jeffrey 29U Arcwall cutter for driving headings.

Development in 1 and 2 SE headings was by hand using the small skips as far as the main gate where the shale was loaded into larger mine cars. Retreating Longwall was used on the east side but work was soon discontinued because of the thinning shale seam and adverse haulage gradients.

Longwall working of the main seam only was found unsatisfactory because of the difficulty in controlling the roof and after a bad fall in 1 West this method of extraction was stopped in December 1940. Mining practice was then modified to recover the upper inferior seam, known locally as the 'Greys', and to reject the intermediate clay band, the 'Whites'. With the resulting increase in the working height, Bord and Pillar working was adopted. This practice was to be seriously questioned in future years. Two new panels were laid out on the west of the main heading, Nos 7 and 8 West. These panels eventually extended some 50 chains westwards and were 15 chains in width. The pillars so formed were 40 yards by 21 yards. Bords were about 8 yards in width.

The use of coal cutters was soon discontinued because of the large percentage of fines these machines produced and the inability of the retorts to handle same. These fines represented a loss of some 8% to 9% of high grade shale over the total seam thickness. A further problem was the difficulty in handling the very large blocks of shale, in which form the shale was won at the face after cutting and firing.

Shot holes 8 ft deep were drilled with 415 volt 'Siemens Schuckert' 2.5 hp hand held drills. The shale was shot from the solid or 'grunched' by simultaneous electric shot-firing. The Jeffrey L400 loading machine fell into disfavour as it was unable to handle large blocks of shale and was sold to Kandos Colliery in October 1940. With the discontinuance of machine mining NOP sought the assistance of BHP Pty Ltd, so the services of Mr George Hindmarsh, Supt of AIS Collieries, were kindly made available in a consulting capacity. He visited the mine in May 1940 but he was unsure what method of working to adopt and even one year later he had not made up his mind.

In early September 1941 Mr Dalziel resigned his position and was succeeded by Mr John Daniel Bowdler on 23 September 1941.[3]

THE REFINERY AND PIPELINE

The oil extraction process used at Glen Davis varied in detail from time to time as developments were tested but it basically conformed to the methods described below.[4]

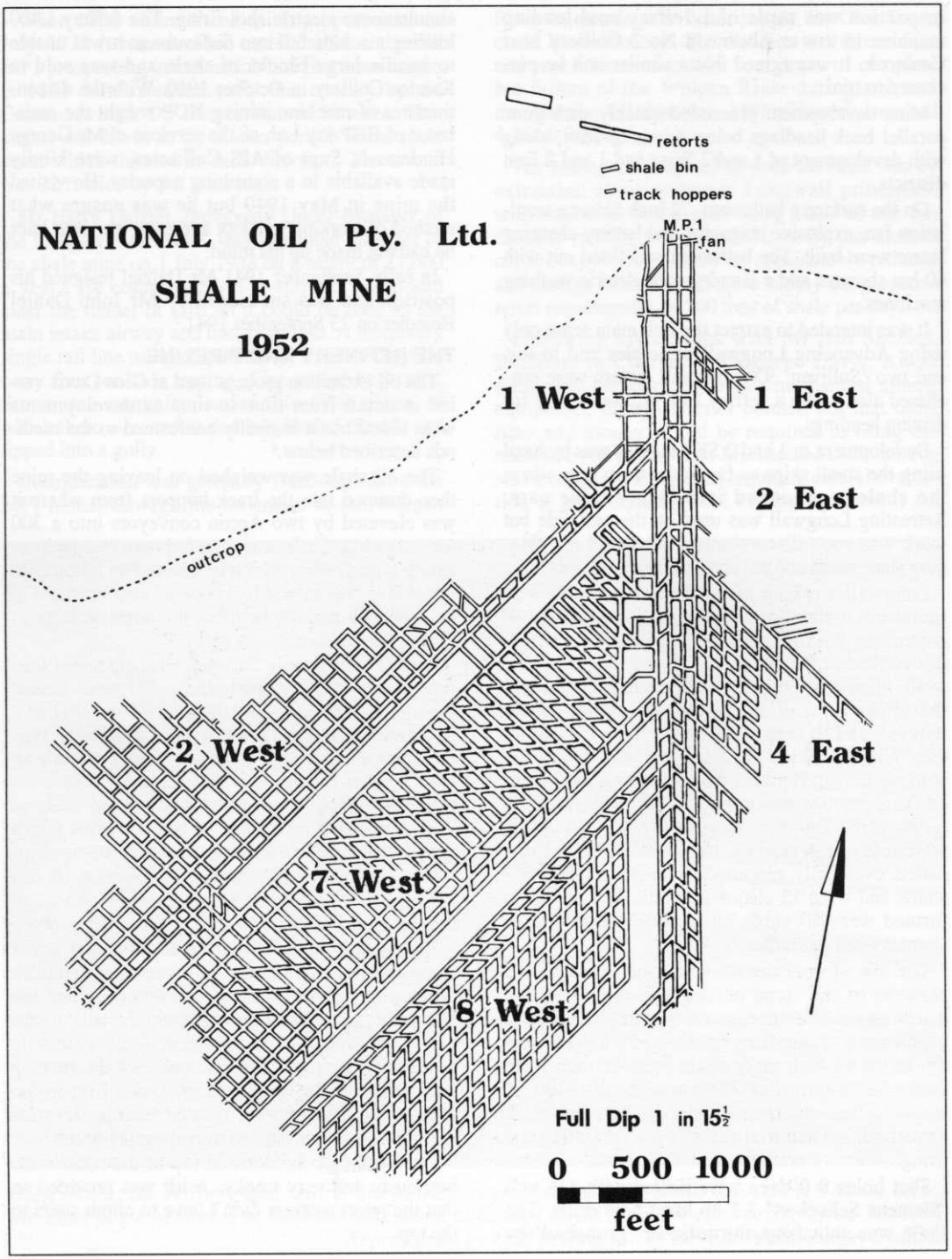
The oil shale was weighed on leaving the mine then dumped into the track hoppers from where it was elevated by two Apron conveyors into a 300 ton surge bin. Shale was then fed onto two reciprocating plate feeders which in turn fed an apron conveyor five feet in width. This was also intended to be used as a picking belt, but the acute scarcity of labour restricted its use as such.

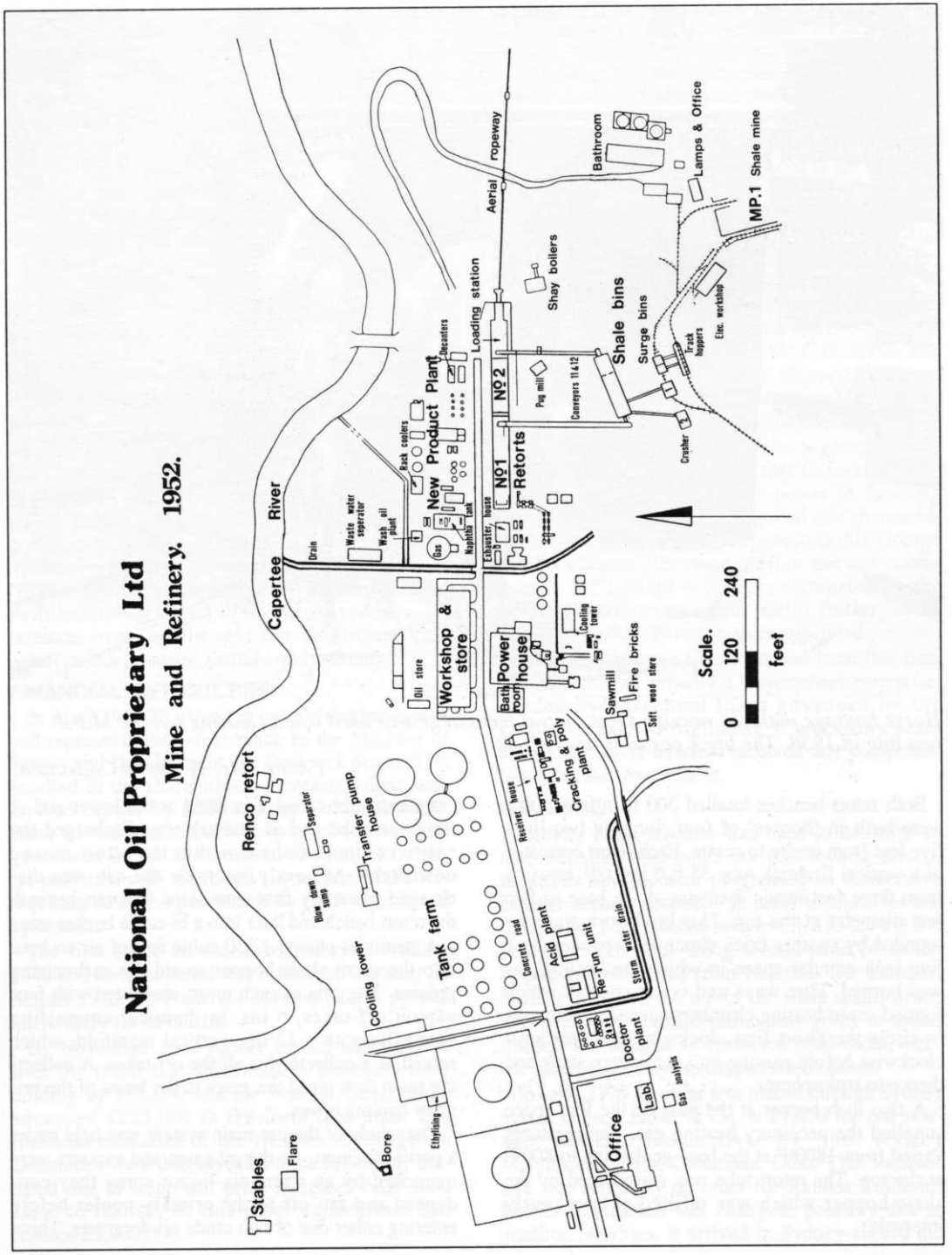
A Ross rolls grizzly then passed shale larger than five inches into the crusher; smaller sizes passed through the screen to join the crushed material as it left the crusher. The 'Pennsylvania' single-roll type crusher was capable of passing 195 tons of shale an hour. Further Ross rolls grizzlies and a Taylor gyratory type secondary crusher then passed shale of half inch to five inch size to a belt conveyor which in turn delivered to a 2,240 ton capacity storage bin.

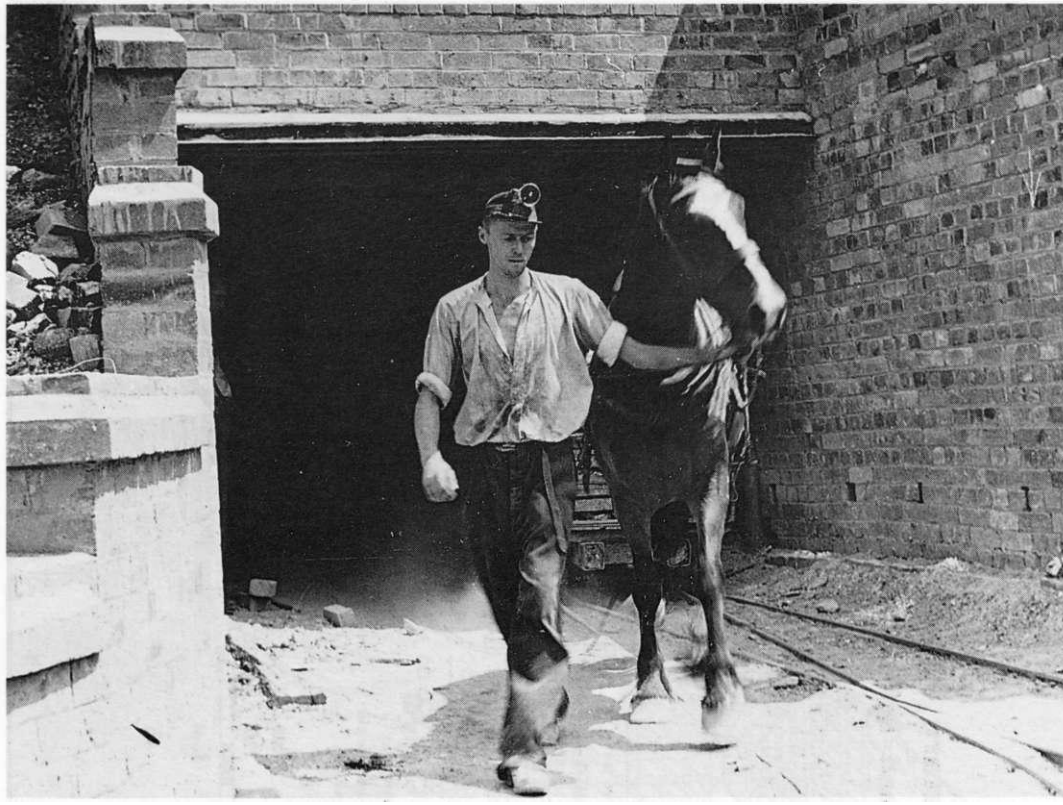
Four men worked in the crushing section on day and afternoon shifts over a five day week. About 70 tons was crushed per man shift.

Shale was withdrawn from either the storage bin or shale stockpile and elevated by a conveyor to the top of the retorts. A weighing machine recorded the weight of the material passing along the belt. At the top of the retorts the shale was fed into a steel lip bucket conveyor which was capable of discharging into any one of the shale bunkers. This conveyor also transported ash from the residue bunker elevators and which was also used to start an empty retort.

The working conditions on top of the retort were hot, dusty and very smoky. A lift was provided so that the retort workers didn't have to climb stairs to the top.







Horse haulage with old wooden skips on two feet gauge was used when clearing out the M.P.I heading in 1938. The brick portal is newly built.

Photo: Mr. M. Davis Collection.

Both retort benches totalled 300 ft in length and were built in 'houses' of four, forming two lines five feet from centre to centre. Each retort consisted of a vertical firebrick tube 35 ft 6 ins. tall, tapering from three feet inside diameter at the base to two feet diameter at the top. This brickwork was surrounded by another brick structure, separated by a five inch annular space in which the heating gas was burned. Flue ways and cover courses which formed seven heating chambers cause the hot gases to circle the retort first clockwise and then anti-clockwise before passing into a chimney stack and thence to atmosphere.

A two inch burner at the base of the flue space supplied the necessary heating gas. Temperatures varied from 1800°F at the base graduating to 800°F at the top. The retort tube was surmounted by the shale hopper which was refilled at two hourly intervals.

An extractor screw was fitted at the lower end of the retort tube and as this ash was discharged the entire column of shale within the retort moved downward. At hourly intervals the ash was discharged manually first into skips that ran beneath the retort bench and later into a bi-cable bucket way.

A steam jet passed 1,350 cubic feet of air an hour into the spent shale hopper to aid the carbonising process. The side of each retort was fitted with four vapour off-takes, 6 ins. in diameter connecting externally with a 12 ins. vertical manifold, which served as a collector for all the off-takes. A collecting main then piped the gases to the bases of the primary cooling tower.

The whole of the gas main system was held under a partial vacuum. As the oil gases and vapours were quenched by an ammonia-liquor spray they condensed and ran off to the primary cooler before entering either one of two crude oil decanters. These

decanters separated the crude oil from sludge emulsion, ammonia liquor and solid matter. The crude oil was then pumped through a hot-water separator to remove residual material. From here the oil gravitated to a 72,000 gallon capacity working oil tank then pumped to either one of 1,200,000 gallon oil storage tanks. The oil was removed as required as charge stock for the refinery, where the petrol was refined by the Dubs process. Octane rating of the unleaded motor fuel ranged from 63 to 65.

The petrol was pumped as required to the storage tanks at Newnes Junction via a pipeline 30 miles to the south and at an elevation of 3503 feet on the main Western Railway line. The 3 ins. diameter steel pipes were thermit welded together; total cost was £54,000. Working pressure was about 1600 psi and when completely full the pipe contained 49,350 gallons of petrol. When petrol was not being pumped the pipeline was filled with water. Two staff, Messrs Richards and Grimshaw were employed on horse patrols to watch for any leakage.

Bulk pumping began on 23 June 1941. From the pipehead at Newnes Junction the petrol was distributed by rail to the towns of the Central West of NSW; it retailed for 2s 8d a gallon in Lithgow. Pool Petroleum distributed the finished product. By products were Cresylic acid (for disinfectants), oil coke (carbide), butane, pentane and solvents.

FINANCIAL DIFFICULTIES

In April 1940 NOP was in need of further capital and representations were made to the Minister of Supply and Development, Sir Frederick Stuart. This resulted in the shareholders increasing their subscribed capital by 50% and the Commonwealth Bank advanced £250,000 by way of an overdraft guaranteed by the Government. Because of technical problems with the retorts the section of the Act requiring extensive production by 1940 was waived by consent.

The first crude oil was produced on 2 January 1940 and the first petrol was refined on Tuesday 20 August 1940. Sir Frederick Stuart officially opened the refinery six days later.

By November 1940 further capital was required with the result that shareholders increased their holding by £75,000 and the Federal Government advanced £225,000 in the form of a loan. The financial estimates of the Newnes Investigation Committee were thus revealed to be hopelessly outdated due to wage and price increases NOP now came to realise. At this point expenditure had reached £1,300,000.

Not long after a change of Government in 1941, the new Minister for Supply and Development, Mr John Beasley, sought an assurance from Sir George Davis as to the security of the Commonwealth's investment in the project. The Minister's subsequent dissatisfaction led to the Board of NOP being overturned, and the company placed in the hands of Government Nominees. The joint Managing Directors, Sir George Davis and Mr A.E. Cooper were replaced by Mr L.J. Griffith (ex BHP and APM) at the urgent request of the Prime Minister, Mr John Curtin. Mr John Spence (formerly NSW Auditor General), another Commonwealth Director, was appointed to the Board, and the two previous shareholder's representatives, Mr C.C. Davis and Mr Norman Frazer, retired. The restructured Board came into being from the 1 January 1942 with Sir George Davis as Chairman of Directors.

At the AGM of National Oil in September 1942 the shareholders were briefed that their company's representatives had very little power in directing company policy so it was suggested that shareholders should refrain from re-appointing Sir George and Mr Cooper. This was agreed to and as a consequence Mr Edward J. Kenny, nominated by the NSW Government and Mr Keith Butler, as an Honorary Federal Director, were appointed.

Mr Kenny became Chairman and from this time the concern was virtually a Government enterprise, funded by unsecured loans advanced by the Commonwealth Government. It was many years before the Davis interests received any compensation from the Government.

HAULAGE

Initially horse traction was used in the mine to haul out shale and muck but this became uneconomic as development progressed so locomotive haulage became desirable. In order to allow for this the floor of MPI heading was levelled to lay a 3 ft 6 ins. gauge rail track using second hand 60 lb flat bottom rail recovered from Newnes. The transport heading followed the dip of the shale seam, which was about 6%. Consideration was given to diesel traction but because of restricted head room, electric locomotion became the preferred option.

In early 1939 an order was placed through Sydney agents Gibson Battle & Co. at £1,030 for one storage battery locomotive by the Jeffrey Manufacturing Co, Columbus, Ohio. This locomotive was originally on order for Kandos Collieries but its destination was changed, possibly due to wartime priorities. It arrived in Sydney aboard the

OHIO BRASS

O-B Detroit Trolley Clamps

Forms 1 and 2 Clamps

Will meet ordinary requirements for straight line suspension. Clamp is 1⅞ inches high.

Form 1—Length 4 Inches
For ⅝-inch Stud Bolt

Catalog Number	Code Word	Description	Net Wt. Lbs. per 100
13407	afeit	Bronze, for No. 6 to No. 1 Inc. Round Wire	40
8912	afepa	Bronze, for 0 Round Wire	43
8914	afeny	Bronze, for 2-0 Round Wire	46
8917	afeoz	Malf. Iron, Galv., for 0 and 2-0 Fig. 8 Wire	54
8920	afeqa	Malf. Iron, Galv., for 3-0 and 4-0 Fig. 8 Wire	57

Form 4 Clamps

Intended especially for supporting trolley wire on curves where, because of severe side strains placed on wire, a clamp of extra length is required. End jaws, 2½ inches long; overall length, 10 inches; overall height, 2 inches.

Made of malleable iron, hot-dip galvanized.

Catalog Number	Code Word	Description	Net Wt. Lbs. per 100
8973	afello	For 2-0, 3-0, 4-0 Fig. 8 and Grooved Wire; ⅝-Inch Bolt	100

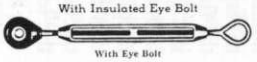
Can be furnished with ⅝-inch boss.

O-B Insulated Turnbuckles

Use—For dead-ending trolley and feeder wires in mines and industrial plants.

Material—All insulation is made of O-B Dirigo Composition, the same as used on O-B Hangers and Composition Strain Insulators. Turnbuckle bodies are made of Fleeto malleable iron; uninsulated eye hook bolts are forged of steel. All metal parts are hot-dip galvanized.

With Insulated Eye Bolt



With Eye Bolt

With Hook Bolt

Design Features—Equipped with Insulated Eye Bolt on one end, ⅝-inch uninsulated eye or hook bolt on other end. Diameter of opening in Insulated Eye Bolt, ⅝ inch; in uninsulated eye, 1⅝ inches.

Catalog Number	Insulated End	Uninsulated End	Opening Inches	Net Wt. Lbs. per 100
4206	Insulated Eye Bolt	Eye Bolt	6	330
13205	Insulated Eye Bolt	Eye Bolt	12	500
18804	Insulated Eye Bolt	Hook Bolt	6	330
18803	Insulated Eye Bolt	Hook Bolt	12	500

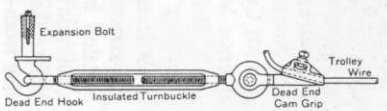
O-B Trolley Wire Dead-End Hooks and Cam Grips

No. 14630

Dead-end Hook No. 14630 and Cam Grip No. 14794, together with insulated turnbuckle and expansion bolt, provide an effective means for dead-ending trolley wire in mines.

Assembly is made as shown in the sketch below. Trolley wire is not kinked and may be used over again. Set screw, acting on cam with teeth that bite into wire, securely holds trolley wire.

No. 14794 Patented



Catalog Number	Code Word	Description	Net Wt. Lbs. per 100
14630	aexao	Dead-End Hook, Malleable Iron, Hot-Dip Galvanized	175
14794	aexes	Dead-End Cam Grip for 2-0 to 4-0 Round, Grooved and Fig. 8 Wires	168
16713	aexix	Dead-End Cam Grip for 6-0 Round and Grooved Wire	170

O-B Type H Mine Hangers

550 Volts

For insulating trolley and feeder wires in mines and industrial plants. These hangers are attached to timbers by means of ⅝-inch lag screws.

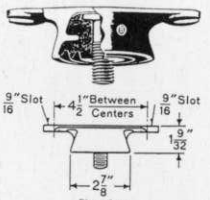
All hangers listed on this page are made of the same high quality materials, varying only in size and weight.

Lugs for lag screws project far enough from the body to permit easy installation of screws.

Hanger shell is made of malleable iron into which stud bolt is molded with Dirigo Insulation under hydraulic pressure. Both shell and stud are hot-dip galvanized. Top of stud is effectively insulated from hanger shell by a disc of built-up mica.

All hangers have ⅝-inch studs.

Type H-4 Hangers

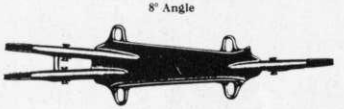


Dimensions

Catalog Number	Code Word	Std. Pkg.	Net Wt. Lbs. per 100
13175	aeilo	50	130

O-B Type D Trolley Frogs

8° Angle



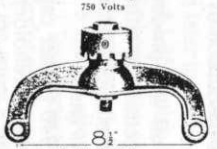
With Short Cam Tips

Length over all, 28⅛ inches.

Catalog Number	Code Word	Description	Net Wt. Lbs. Each
Right-Hand Frogs—8°			
13382	ahecn	For 0 Round Wire	12
11890	ahedo	For 2-0 Round and Grooved Wires	12
11891	aheep	For 3-0 Round and Grooved Wires	12
11892	ahefr	For 4-0 Round and Grooved Wires	12
11893	ahegs	For 2-0 Fig. 8 Wire	12
11894	aheht	For 4-0 Fig. 8 Wire	12
Left-Hand Frogs—8°			
13383	ahejv	For 0 Round Wire	12
11895	ahekw	For 2-0 Round and Grooved Wires	12
11896	ahelx	For 3-0 Round and Grooved Wires	12
11897	ahemy	For 4-0 Round and Grooved Wires	12
11898	ahenz	For 2-0 Fig. 8 Wire	12
11899	aheoh	For 4-0 Fig. 8 Wire	12

O-B Type D Single and Double Curve Hangers

750 Volts



No. 2048—Double Curve

Ample clearance is provided for all standard trolley wheels and harps.

Holes for span wire are ⅜ inch in diameter.

All metal parts are hot-dip galvanized.

Catalog Number	Code Word	Description	Net Wt. Lbs. per 100
2045	afver	Single Curve Hanger, ⅝-Inch Stud	247
2048	afvgy	Double Curve Hanger, ⅝-Inch Stud	335

Can be furnished with ⅝-inch stud.

O-B Miami Section Insulators

750 Volts

Used with quick break or safety switch for sectionalizing trolley circuit. Trolley wire is held by three set screws.

Wood block is seasoned hickory impregnated and varnished. End castings are made of bronze.

Runner piece is hard wood impregnated and varnished, and is easily replaced.

Feeder lugs are drilled for 2-0 to 4-0 solid or stranded wire.

Boss is tapped for ⅝-inch stud.

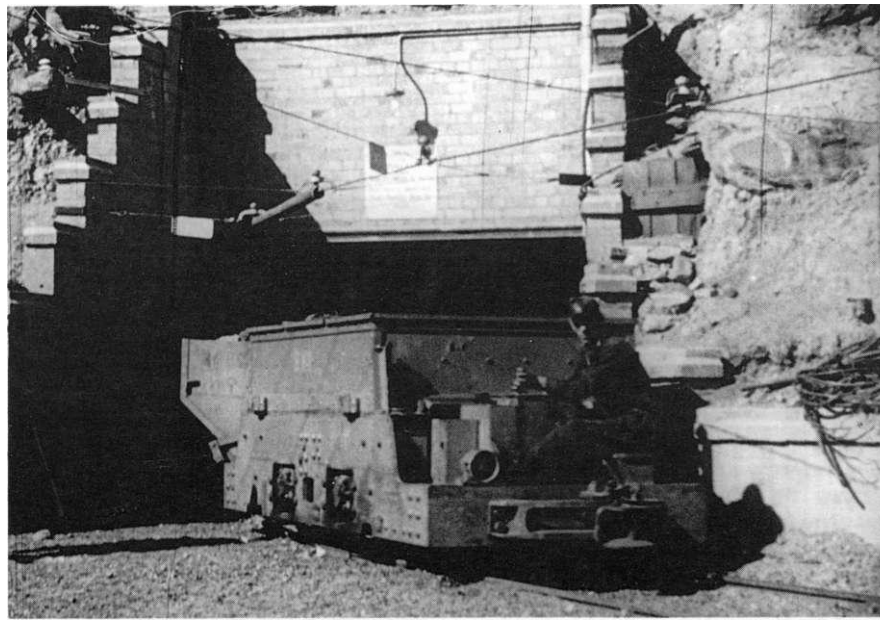
Length over all, 29¾ inches. Height, 5 inches.

Set screws, ⅜ x ⅞ inch.

Catalog Number	Code Word	Description	Net Wt. Lbs. Each
5805	agtzu	For 0 Round Wire	7
5806	aguby	For 2-0 Round Wire	7
5807	aguew	For 3-0 Round Wire	8
5808	agudx	For 4-0 Round Wire	8
5809	agury	For 0 Fig. 8 Wire	7
5810	agufz	For 2-0 Fig. 8 Wire	7
5811	aguga	For 3-0 Fig. 8 Wire	8
5812	aguhb	For 4-0 Fig. 8 Wire	8
5813	aguic	For 2-0 Grooved Wire	7
5814	agujd	For 3-0 Grooved Wire	8
5815	aguke	For 4-0 Grooved Wire	8
5804	agulf	Runner Piece	-

Fig 1

RMS '91



The Jeffrey storage battery loco arrives at the surface with a load of shale. Photo: George Hicks Collection.

'City of Manchester' on 17 July 1939.[5] The chassis weight of the unit was 15,000 lbs and it had a drawbar pull of 2,500 lbs. The maker's series number was 8126. The loco storage battery was an Edison 80 cell type, supplying 110 volts to two MH88 traction motors rated at 40 hp.

On 14 September 1939 a second order was placed with Sydney agents John Carruthers & Co for two 'Mancha Hercules A' storage battery locomotives at £1,653 each. Mancha is a division of the Goodman Manufacturing Co, Chicago, Illinois.

The first Mancha locomotive arrived in Sydney aboard the 'Niagara' on 16 December 1939 followed shortly after by the second aboard the 'Aorangi' on 12 January 1940. The Mancha chassis weight was 12,000 lbs. It is believed that these two Mancha locomotives were the first of this manufacture in NSW to be fitted with two traction motors of 40 hp each. Enquiries were also made about Atlas storage battery locomotives which were manufactured in England. A suitable unit weighing 9 tons, Atlas type 'B' with two 12 hp motors was quoted.

At that time NOP preferred US manufacturers because of faster delivery times. An example of this was the 22 weeks shipping time including freighting from the United Kingdom as opposed to only 8 weeks from the USA. As NOP had a deadline to adhere to this consideration was of the utmost importance.

The Jeffrey locomotive was placed in service by August 1939 while the first Mancha entered service on 13 February 1940 followed shortly thereafter by the second.

An initial charging period of 15 hours was necessary to charge the locomotive batteries but as the charging facilities were limited, this time had to be spread over several days.

In 1940 the tonnage of shale won from the mine was inadequate to meet retorting demands so the Jeffrey loader was brought to the surface in May. The mine cars were loaded by this machine from the old Commonwealth Oil Corporation's shale dump then pulled by a locomotive a short distance into MPI, the points reversed, and then the set was propelled to the surge bin.

THE TROLLEY WIRE SYSTEM

In mines with steeply dipping seams such as at Glen Davis, adverse haulage gradients are unavoidable and in these cases an electric haulage system enjoys advantages over storage battery locomotives. The chief advantage is the elimination of wear and tear on the batteries themselves, although

an operating disadvantage is that an electric trolley wire system can only be used in a main intake airway in a coal or shale mine because of gas explosions triggered by arcing between the trolley shoe and contact wire or between the locomotive wheels and rails.

NOP acquired two very old General Electric 8 ton electric locomotives from the Sulphide Corporation plant at Cockle Creek near Newcastle. These ancient machines, builders numbers 2989 and 2990 of 1909 were a product of the General Electric Co, Schenectady, New York.[6]

One locomotive was given the road number 4 when in possession of the new owner and the Manchas were numbered 1 and 2 but other numbers are beyond recall by former staff. The specifications were model type LM-101-1-1. Two General Electric type 77, 25 hp 250 volt traction motors were fitted. Draw bar pull was 2,500 lbs at 7 mph. The two units were purchased for main line haulage in the heading and the battery locomotives used for wheeling from the face to the flat. The General Electric locos were trialled in early April 1940 and then put to work hauling shale from the dump to the surge bin.

On 6 October 1939 Australian General Electric Ltd furnished NOP with a quotation for trolley wire as supplied by the Ohio Brass Co of Mansfield, Ohio.[7] (See Figure 1). The price per pound was 10s 6d with a total weight of 1,801 pounds.

An AC to DC converter was supplied by the Commercial Electric Co of Sydney and operated on 2300 volts with a rating of 177 hp. It was capable of charging four locomotive batteries simultaneously or only one battery when the trolley wire was switched on. Two other motor generator sets were used to charge locomotive batteries and safety lamp batteries.

In January 1940 a start was made on erecting the overhead wire installations. Trolley wire, because it carries a potentially lethal current, is required by law to be protected by guards if under seven feet in height. The timber guards as originally erected were spaced nine inches apart and attached to roof timbers by angle iron. This arrangement did not satisfy the Mines Department Inspector, Mr Kirk,[8] so Hoi Frith, NOPs electrical engineer proposed the following alterations so as to afford better protection for both the employees and the electrical system. He decided to fix a lining of galvanised plate from inside the guard to extend down below the timber from either side and close the gap, leaving only sufficient room for the wooden trolley pole to reach through to engage the wire. This lining extended the entire length of the section, insulated from earth and adjacent sections. Each section had its own individual protection. Three sections were planned, each with its own cubicle for the protection equipment.

Suitable push buttons were provided for testing purposes. The voltage between the guard and earth was not to exceed 20 volts. In the event of the trolley wire falling from its insulated support, it would make contact with the metal guard, thus actuating the differential relay coil, causing the trolley wire to immediately become isolated. For this arrangement to be reliable, another differential relay, with a maximum voltage of 20 volts, would be fitted between the guard and earth. In the event of the guards becoming earthed, the trolley wire would again be automatically isolated.[9] A borostatic device was fitted in the fan house so that if the ventilation fan failed, the trolley wire feeder would be automatically isolated from the motor generator set. These criteria became standard for all future trolley wire installations of the earth return type in NSW collieries. Red pilot lights indicated that the trolley wire was alive. Mr Stan Grimshaw and Stan Thorpe erected the trolley wire under the direction of the electrical engineer.

On the surface wooden poles were erected to hold the wire, which out in the open did not require guards. Two strainer wires were attached to the pole and after the contact wire was clamped in position, turnbuckles on the strainers would position the trolley wire as required.

The support wires were attached to an Ohio Brass Double Curve hanger onto which an 'O-B' Detroit Trolley Clamp was screwed from beneath. On curves a clamp of extra length was used to give more support to the contact wire. These clamps were made of galvanized malleable iron. At points the trolley wire frogs were usually hung off four poles for extra stability.

The copper trolley wire was very stiff and tough so it was no easy job to erect after being unrolled off its drum.

To lay out the wire in the main heading, a string line was first stretched out, then a chalk line drawn. It was important to align the track properly and have it fairly level.

Half inch diameter holes were hand drilled four inches into the stone roof and fitted with wooden plugs to which the insulators were attached. If the road was undulating larger diameter wooden plugs were used to overcome the extra tension that was

placed on the wire. It took about ten minutes to hand drill a hole.

Pre-tensioning of the wire was done with chain blocks and this tension would very according to the dip in the road. When adequate tension was achieved the screws on the trolley clamp were tightened to firmly secure the Figure 8 wire.

The trolley wire was placed on the left of the rails in all locations in the mine except up in 8 West, where it was changed over to the opposite side to avoid the bords.

Eventually the wooden guards were replaced by pressed sheet metal types fitted with a strengthening rib. They were about ten inches high and were made in the Company's workshop. The timber was far too easily damaged in derailments or falls of stone.

When a new section of wire was erected it was fully tested before the power was switched on, then the insulation was bridged between the old and new sections to check that the circuit was satisfactory.

The isolation piece between sections, of which there were three, was an 'O-B' Miami Section Insulator. It was 29⅝ inches in length; the momentum of the locomotive would carry it beneath this gap with no difficulty but accompanied by much arcing if the controller was still notched out.

One result of the electrification of the haulage road was the need to drive a new travelling road for the miners, known as the right back heading.

In late March 1941, the General Electric locos began working in the tunnel. Glen Davis shale mine was the first pit in NSW to use an electric trolley wire system of haulage in 1940. Dalziel intended to place the General Electric locos into regular service immediately upon the arrival of the new mine cars as the distances for the Jeffrey loco to travel were now becoming too great for haulage efficiency.

Two dead end shunts were driven either side of the main heading near 4 East and it was intended that the battery locomotives would haul the mine cars from the faces to this point to change over with the trolley locomotives for the pull to the surface.

After the General Electric locos had entered service it was decided to fit a gathering cable reel to increase their versatility. This device was a drum mounted on top of the loco onto which approximately 100 yards of electric cable was wound. If a battery loco needed assistance to push a set up one of the steep headings, the driver of the trolley loco would clamp the end of the cable onto the trolley wire to supply power to the loco. The trailing cable was manipulated into a grooved timber wedge which was anchored by a piece of chain to a prop. This device was also sprung to absorb any shocks as the cable played out. Upon pulling down the trolley pole, assistance could then be offered for only the length of the cable. On the way back the cable would automatically retract onto its reel. The insulated clamp was then removed, the trolley pole put back up to the wire then the locomotive could continue on its way. The cable reel was built in the machine shop.

It was found that the original trolley wheels affixed atop the poles were not compatible with the guards, so the blacksmith, Norm Howe, made new trolley shoes. He was supplied with 3/8 in thick copper plate which he bent into a groove and hammered round. A fitter then filed it precisely to shape. The first two shoes were experimental and proving successful set the pattern for further production. (See Figure 2).

The wooden trolley pole was of Oregon and was made in the carpenters shop. These poles often broke in derailments so spares were kept on hand. To keep the shoe in contact with the wire the poles were sprung and were clipped down when not in use.

At 9.50 pm on Thursday 2 April 1941 a serious smash occurred on the main haulage road when a battery locomotive with six full mine cars collided with six empty cars being pushed in. After this smaller car sets were then run so that loco drivers had more control on the downgrade.

As of January 1942, eight locomotive drivers, two adult shunters and five youth shunters were employed on the haulage.[10]

ROLLING STOCK

At the opening of the mine, ten 4 ton side tipping skips were ordered from two Sydney engineering firms, Tullochs Phoenix Iron Works Pty Ltd and Messrs C.S. Archer who evenly divided the order of June 1939.[11] These skips were intended for a gauge of 2 ft but wiser counsel prevailed and the decision was made to alter this to 3 ft 6 in to allow for bottom unloading arrangements.

Tenders were called for the supply of 30 mine cars in October but in order to ensure shale production as quickly as possible, J. & A. Brown Abermain Seaham Collieries Ltd supplied on request 12 five ton cars from one of its mechanised northern coal mines.

NOP ordered a further 12 cars from the same source in May 1940. The only difference was that

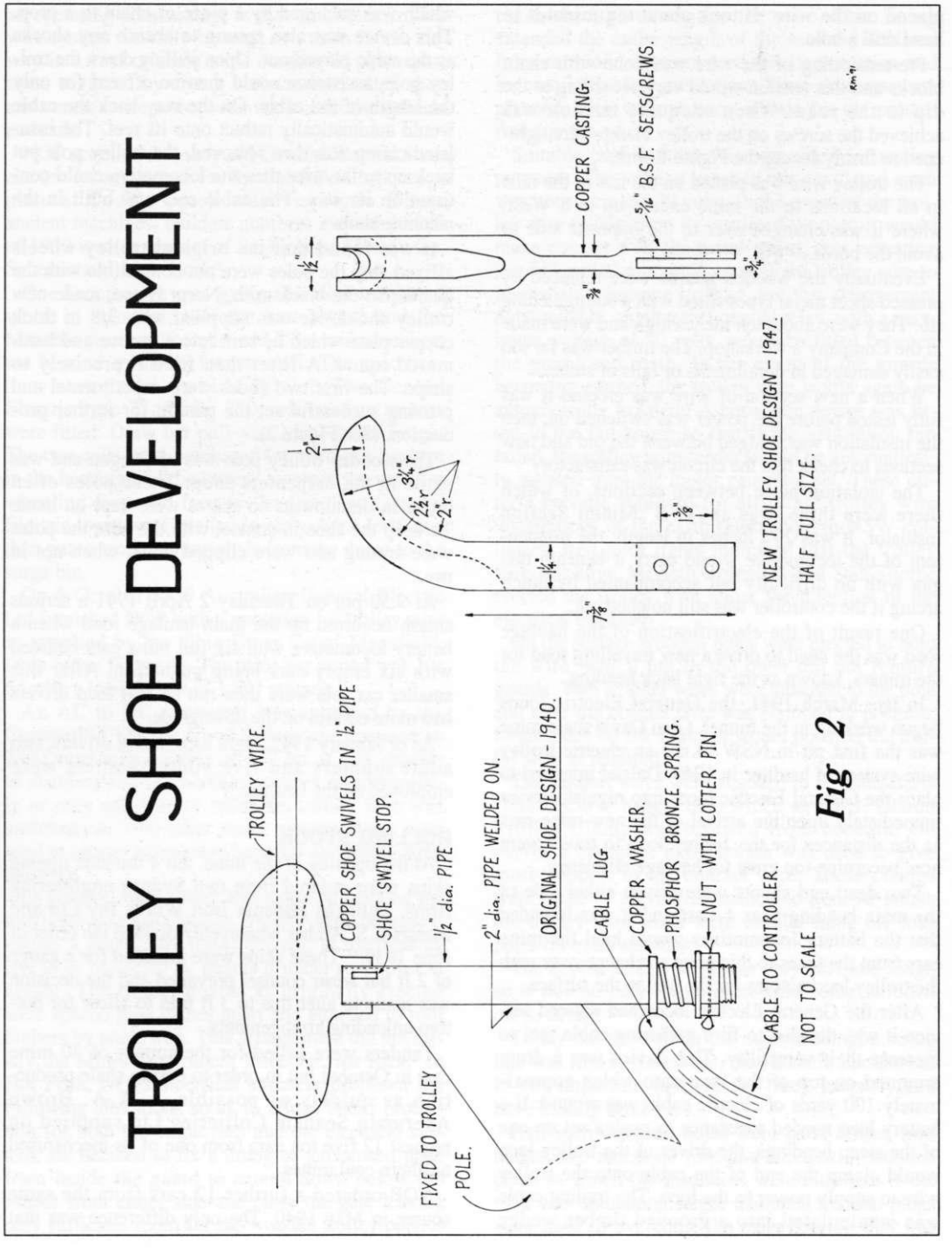


Fig 2

One of the "tram" locos with a load of shale arriving at pit top. Mr. Tony Blackman is the driver.

Photo: George Hicks Collection.

these cars were six inches lower, making for a capacity of 4.5 tons. This was more suited to the conditions at Glen Davis due to the limited height of the shale seam. The cars were of the standard company design, using pressed steel plate for the body, unsprung roller bearing axle boxes, brakes and three doors on the bottom which could be closed automatically.

Harry Dalziel encountered difficulties with the weighing of the cars when they were coupled together as a set. The weighbridge, built by Australasian Scale Co. was designed to weigh one car at a time but it was found that an error of 10%, or up to 9 cwt, in favour of the mine was occurring. It seems that the coupling on the preceding car was bearing down on the car on the weighbridge. The manager suggested that wider female couplings were needed to allow more vertical play.

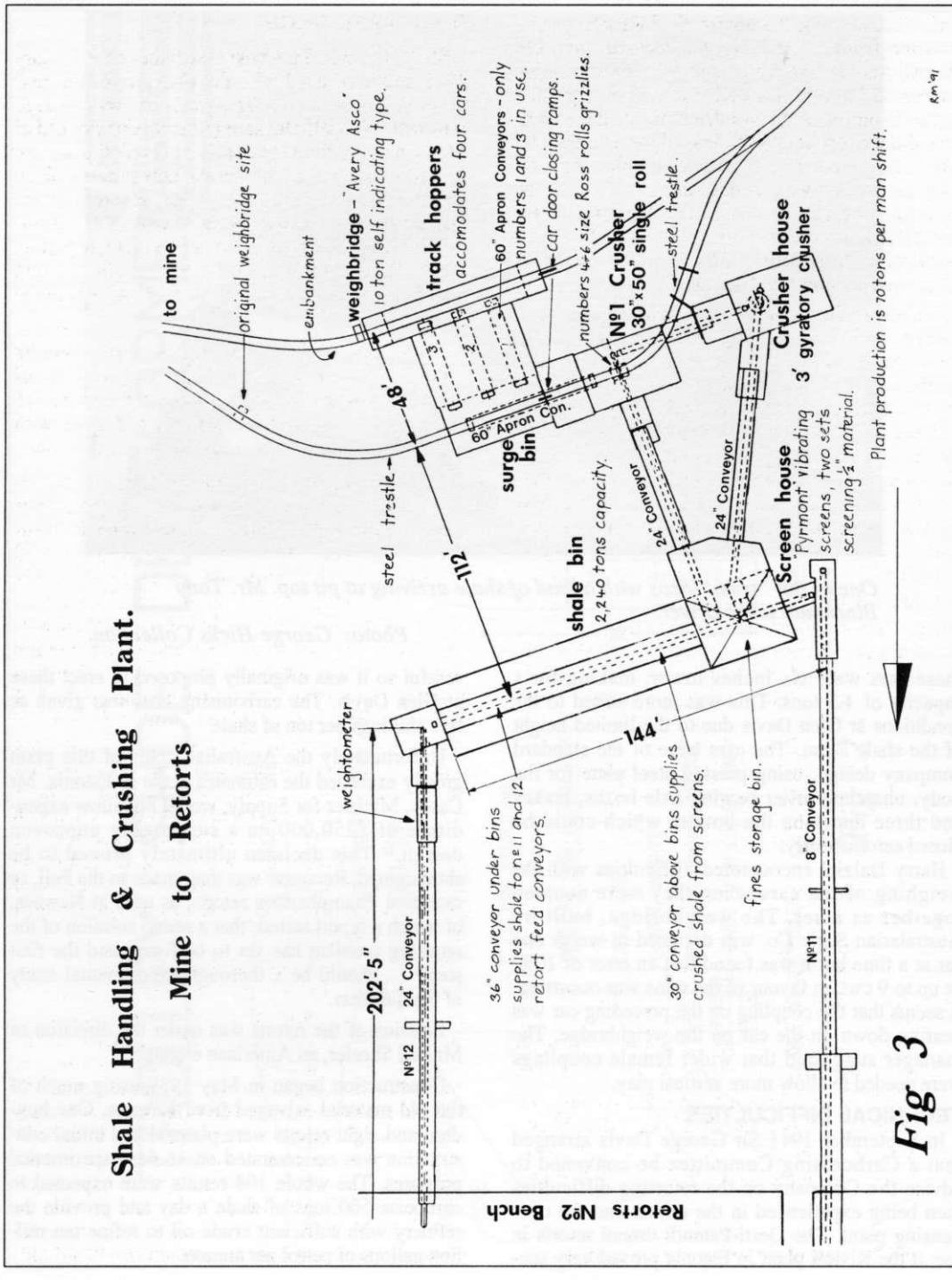
TECHNICAL DIFFICULTIES

In September 1941 Sir George Davis arranged that a Carbonising Committee be convened to advise the Company on the retorting difficulties then being experienced in the retorts and the condensing plant. The Oesti-Patendi tunnel retorts in use at the Kivioli plant in Estonia proved very successful so it was originally proposed to erect these at Glen Davis. The carbonising cost was given as five shillings per ton of shale.

Unfortunately the Australian costs of this plant greatly exceeded the estimates made in Estonia. Mr Casey, Minister for Supply, would not allow expenditure of £250,000 on a supposedly unproven design.[12] This decision ultimately proved to be shortsighted. Recourse was then made to the Fell, or modified Phumpherston retorts, as used at Newnes, of which a report stated 'that a sound solution of the retorting problem has yet to be found and the first step[13] .... should be a thorough experimental study of the question.'

Erection of the retorts was under the direction of Mr Bill Sheeler, an American engineer.

Construction began in May 1939 using much of the old material salvaged from Newnes. One hundred and eight retorts were planned and initial construction was concentrated on 16 for experimental purposes. The whole 108 retorts were expected to carbonise 500 tons of shale a day and provide the refinery with sufficient crude oil to refine ten million gallons of petrol per annum.



Mr Sheeler, with the approval of George Davis, departed from the relatively successful multiple external gas off-take design and substituted a single perforated internal gas collection pipe. The idea was to avoid mechanical difficulties in the expansion of the retort brickwork around the external off-takes. This modification was a complete failure. Sixty four retorts were built to this modified design but at Sir George's request in October 1941, multi side off-takes were installed in the last house of four retorts. Construction of the second bench of 44 retorts was temporarily deferred.

Shale was first charged to eight retorts on 1 January 1940 and 20 retorts were in service by April. The results were disappointing and it was found that the retorts could not handle shale fines below a half inch size. The condensing system as designed by Mr Sheeler was useless and as a consequence the scrubbing and naptha recover plant could not handle the gases effectively. This situation was forced upon NOP because 'the improvised plant could not be regarded as anything more than a temporary expedient to serve until capital could be made available for properly designed equipment'.

Of Mr Sheeler, Sir George commented[4] an excellent erection engineer, but his knowledge of shale and shale gas proved to be very much below the standard that could be rightly expected from his credentials'. It was not surprising that Mr Sheeler resigned at the end of 1940 and Mr F.W.J. Belton, Engineer of the Christchurch gasworks, was appointed in his place on 31 December 1940.

Mr Belton intensively tested the four side off take retorts and found they were far superior to the others as well as being able to carbonise fine shale. In the last month of 1941 the experimental retorts made 543 gallons of oil as against only 180 gallons from the as built types.

The Carbonising Committee delivered its report on 4 November 1941 and recommended:[14]

(1) a reversion to the Fell design for all 108 retorts as a 'grave mistake had been made in changing the design of the retorts when they were erected at Glen Davis.'

(2) provision of an entirely new gas cooling and naptha recovery plant, the New Product Plant.

(3) An investigation of water storage and supply schemes to allow for a supply of 750,000 gallons a day.

(4) The installation of an additional two boilers and a review of the power station capacity.

RECONSTRUCTION

Mr Griffiths and the new Board met on 7 January 1942 and proceeded with the planning of the new plant and equipment. An agreement was entered into with Woodall-Duckam (Australasia) Pty Ltd of Melbourne for the preparation of detailed plans for the reconstruction of the retorts, new product plant, ash and shale handling equipment. Because of the war situation it was considered necessary to continue oil production during the reconstruction period, which though undesirable was thought prudent mainly for social reasons to retain employees in the valley.

From the site of the new product plant, opposite the retorts, the removal of 10,000 cubic yards of spent ash was put in hand. It was estimated that 15 months were required for design work alone with fabrication work to be done by outside contractors.

Troubles began almost immediately. Woodall-Duckham needed six draftsmen but only three were made available then two were subsequently withdrawn by the Department of Supply and Development. The first orders placed in May 1942 were only accorded a Bl priority classification so construction was considerably delayed. Labour was extremely difficult to procure and retain. Design work for the crushing and screening section was transferred to Alluvial Mining Equipment Ltd of Sydney to ease some of the workload. A further disruption was the visit to Glen Davis of the Australian Shale Oil Mission comprised of three US authorities on mining, shale carbonisation and oil refining.[15] Mr V.V. Jacomini was head of the mission which arrived on 10 December 1942 and stayed for five days. Jacomini recommended that oil production be further increased by the erection of additional retorts, preferably of the US Renco design of which he was the designer.

The mission's report was tabled in federal parliament on 16 February 1943 before the House of Representatives Parliamentary Standing Committee on Public Works and it was agreed that a Renco retort should be trialled. The one and only unit in Australia was purchased from Mudgee Shale Oil Pty Ltd for re-erection at Glen Davis. Other prerequisites for US assistance were full mechanisation of the shale mine, mechanised pillar extraction and the working of three shifts. It was hoped to increase oil production to 39,200,000 gallons annually with an expenditure of £4,500,000. The Commonwealth Government baulked at this amount so US aid did

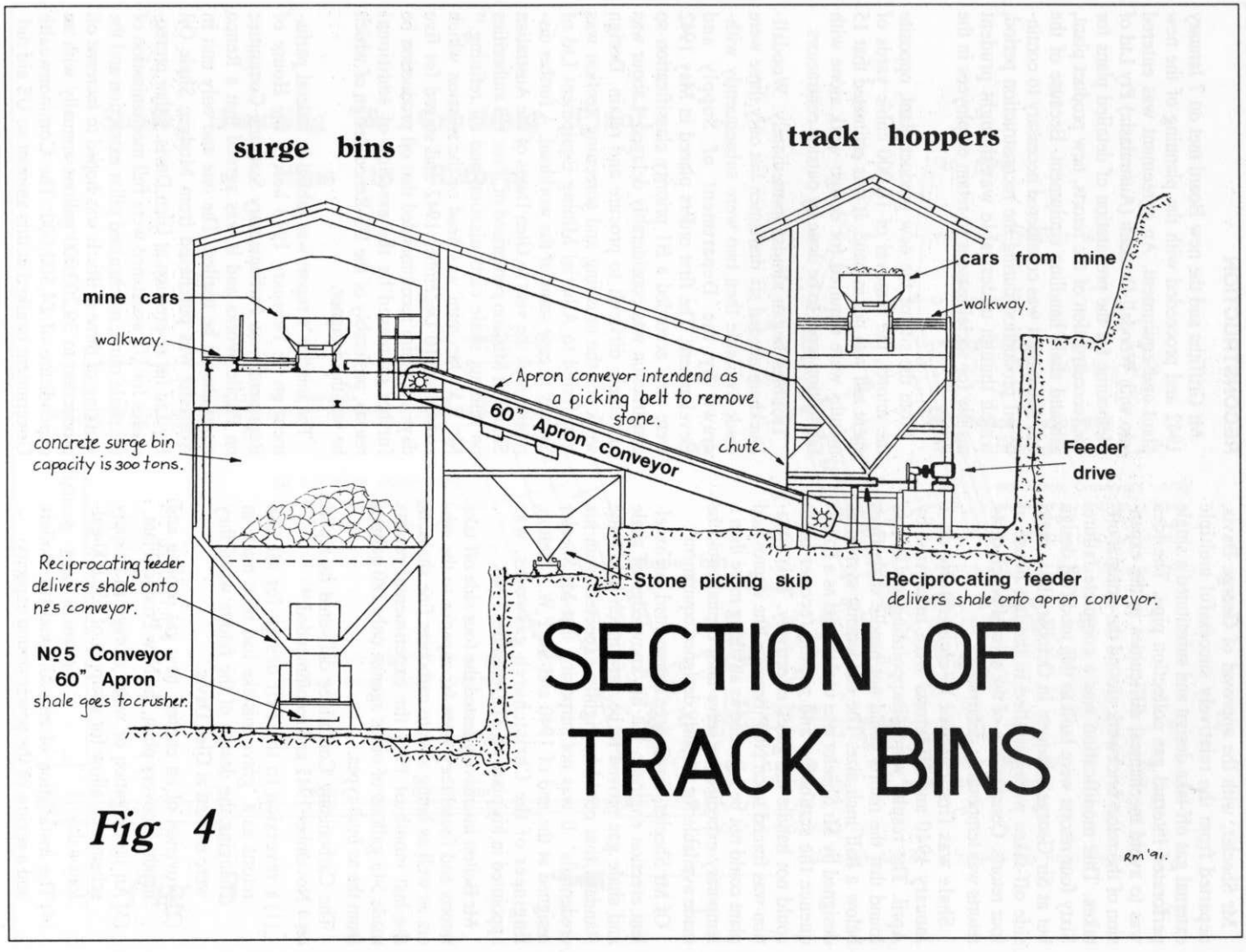
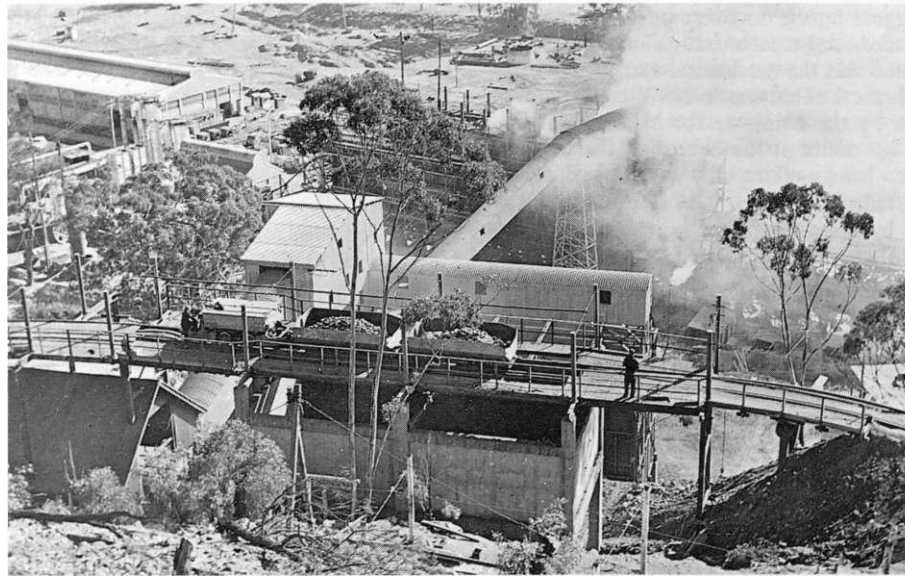


Fig 4



Dumping shale at the surge bin. Note the automatic door closing device just ahead of the Mancha battery loco. An early view circa 1940. Photo: Mr. M. Davis Collection.

not eventuate. The current rebuilding programme was already costing £1,000,000.

A further problem was that the water supply from bores and a weir was unreliable causing sections of the plant to be shut down from time to time. About this time the NSW State Government was planning a water supply scheme to service the Central Western districts from a dam on the Fish River near Oberon, 60 miles to the south. Because of NOP's difficulties the Federal Government gave its support to the scheme which cost £608,597 of which £325,229 was charged against the company.[16]

The Federal Department of Supply appointed an engineer in the person of Mr G. Shanahan at the end of 1943 to assist the company directors as construction was only progressing at a very disheartening pace.

THE SHALE MINE

The company's first attempt to mechanise the shale mine had now halted and shale was being loaded by hand into the mine cars. The new Board, acting on the advice of Messrs Hindmarsh and McKensey (Supt of Hebburn Collieries) submitted an estimate for full mine mechanisation to the Department of Supply and Shipping. Mr Bowdler estimated the cost near to £54,190.

Central to the issue of full mechanisation was the purchase of four 14BU Joy loaders. The agents had successfully demonstrated a small 8BU loader and seven 32 in Joy three ton shuttle cars to move the shale from the loaders to the mine cars. Other pieces of equipment required were three elevating conveyors to load the cars of which 15 new five ton types were wanted. Three Mavor and Coulson electric 'Putters' were needed to spot the cars beneath the shuttle car ramps.

It was proposed to order two loaders and five shuttle cars immediately with the balance at a future date. This equipment was necessary for production of 1400 tons of shale a day. By comparison, the daily (two shifts) production of shale for June 1942 was only 422 tons. Obviously hand mining was untenable.

On 13 August 1943 two loaders and five shuttle cars plus five batteries were ordered through the agents, Noyes Bros of Sydney.[17] A lease-lend arrangement was entered into with the Commonwealth Government as these machines were built in the US by the Joy Manufacturing Co of Franklin, Pennsylvania.

The war was creating difficulties with overseas orders and it was not until July 1944 that NOP was advised the War Production Board in the US had released the loaders and shuttle cars for delivery.

The biggest hurdle to overcome and one that would render total mechanisation impotent if not implemented was the mechanical extraction of pillars. Mechanical extraction in NSW collieries was forbidden by the Minister for Mines, Mr J.M. Baddely, no doubt at the behest of the Miners' Federation - hand working only was allowed.

On Thursday 4 February 1943 the mine was inspected by Mines Inspector Lorriman accompanied by Miners' Federation District Officers to determine safety measures for pillar extraction.[18] Afterwards at a pit top meeting the men accepted the proposal and agreed that it was safe to attempt mechanical pillar extraction at Glen Davis. The miners Lodge was later to renege on this agreement.

It came to the attention of the NOP Board that the Coal Commission had available at its Newcastle coal dump (Port Waratah) two 11BU Joy loaders and four 42D, 4.5 ton shuttle cars. This included two Australian made Malcom Moore shuttle cars and other sundries associated with them.[19] These were purchased and commissioned in April 1944 at the shale mine. Mining costs immediately fell by three shillings a ton. As a result of this move, Glen Davis became the first pit on the western coalfields to be fully mechanised.

Of the US order, the five 32D shuttle cars came on the *SS Kent,* arriving at Glen Davis in August 1946 and the two 14BU Joy loaders did not depart New York until 29 October 1946 aboard the *SS City of Dieppe.*

Selective extraction of the main seam was not practicable with the introduction of fully mechanised mining, because of the minimum operating height required by the loaders. With the full height of the seam extracted, including the 'Whites' assay values as of 1946 declined to 65 gallons of oil per ton. To satisfy both benches of the new retorts it was estimated that 7,659 tons of 60.75 gallon shale per five working days was needed. If, on the other hand, selective mining of the high grade shale, with a value of 98.8 gallons per ton was pursued, only 4,591 tons per five working days was necessary.

On August 20 1946 Mr Hindmarsh and the Mine Manager issued a joint report which stated 'The question as to whether the output could be increased to 700 tons run of mine per shift or 1400 tons run of mine per day can be answered in the affirmative.' This additional tonnage was anticipated for December 1946. An additional 150 employees were required for the increased production but these were not forthcoming as at this time skilled miners were in very short supply.

Mr Bowdler also said 'Boring of the seam preparatory to shooting appears to be the most difficult of all operations in the mine.' The men had imposed a limitation on the number of holes drilled per shift with hand held machines, in effect a darg, although this of course was denied by the Lodge.

Three principal factors governed the increase in output:

(1) The inadequacy of labour, skilled miners being practically impossible to get.
(2) The elimination of the boring darg and
(3) The mechanical extraction of pillars as at that time there were over one million tons of shale available in the pillars.

LOCO MAINTENANCE

Interruptions to the haulage task adversely affected the supply of shale to the bins, so proper maintenance of loco and skips was of the utmost importance. Saturday mornings were devoted to maintenance work on the locos' controllers. Apart from the Jeffrey loco, all the other locos had revolving drum type controllers with spring loaded fingers. The segments on the rotor would burn so they required dressing or replacing. Additionally the springs often needed re-tensioning and other moving parts required greasing. George Wilson, who was an electrical apprentice at the time relates that it could take all Saturday morning to do this job properly.

New controller fingers were difficult to procure so the company made its own. The Jeffrey locomotive had a cam operated contactor of a much superior type and needed very little maintenance. Resistances were mounted at the front of the locos and were only air cooled, requiring a fair bit of maintenance, especially if allowed to overheat. This was common in winter because some of the loco drivers, if standing for a while on the main road, would endeavour to keep warm in their loco cockpits as the incoming air would be bitterly cold. They would wind on the handbrake then apply power, thereby heating up the resistances which acted like a radiator. This practice was not appreciated by the electricians as the resistances would become red hot, distort then possibly short out.

If the traction motor commutator needed honing due to wear, the top was taken off the motor and a special honing stone was affixed. A battery loco was then coupled up and the loco under repair was towed around the yard for about an hour. On the average, a loco would run three to four months before attention was required. If the commutator

was running true then the brushes lasted longer. An undercutting machine for the commutators was also used. If a traction motor had to be changed on a battery loco it was pushed over a pit, the bearing was split then the bottom half dropped out. The front end of the motor was held down by a spring underneath and a bar and spring on top so the assembly wasn't rigid. The motors were subject to shock loading and overspeed problems.

Bearings and insulation materials were of poor quality so maintenance was high and in later years failure became commonplace. There were two workshops at pit top, mechanical and electrical. The electrical workshop had a repair pit, travelling beam and pedestal drill while battery charging was carried out just inside the doorway. The mechanical workshop was equipped with a ten inch turret lathe (adequate to turn skip wheels), pedestal grinder, compressor, oxy-acetylene set, power hacksaw, vertical drill and repair pit.

A battery attendant and lamp cabin attendant were employed on each shift. Their job was to charge and clean the loco batteries, making sure to keep them topped up with water. The loco driver and offsider changed their own batteries each shift. Battery cells were arranged in batches of four, so if one cell 'went down' it could be pulled out. 'Edison' nickel iron type batteries were tried but although they gave a long life of up to ten years, they were very expensive. The 'Exide' lead-acid type had a life of about three years but were only half the cost of the nickel iron type. In 1947 the price of an Exide battery was £450.

Maintenance of the loco's braking system was most important. Wear strips on the axle boxes, made of spring steel, were adjusted usually once a fortnight otherwise the brake rods could get over centre, causing the brakes to either come on unnecessarily or not engage properly. The fitters had to check and sign for the brakes every day in a book which was kept in the manager's office. When the rigging was correctly adjusted only one and a half to two turns of the handwheel were enough to apply the brakes. Ratchet type levers worked the brakes. Brake linings were replaced every three or four months. Timken roller bearings on the axles only needed greasing occasionally.

MINE CARS

The mine cars were often subject to rough handling so repairs were an ongoing job. Broken axles frequently occurred, mainly due to excessive speed, rough track and an absence of springing. If an axle broke inside the mine, the car was jacked up using a 'Wallaby' jack, the brake fully applied, then the car was skidded outside for repairs. Hollow wheels were welded up then re-profiled on the workshop lathe. If doors or axles needed repairs a wire rope was attached to the mine car, run through a snatch block then fastened to a loco out in the yard, which by pulling on the rope turned the car over on its side.

Car doors were the biggest headache for the fitters. Clarrie Jacques, then an apprentice fitter, recalls having to lay into bent doors heated up by an oxy set, if really damaged, with a 25 pound hammer. Each lip on the door held up the next door while the third door had a spring to hold in a sliding bar which caused all the doors to lock in place. If the lips were badly worn, the doors would not lock up or could fall down in transit.

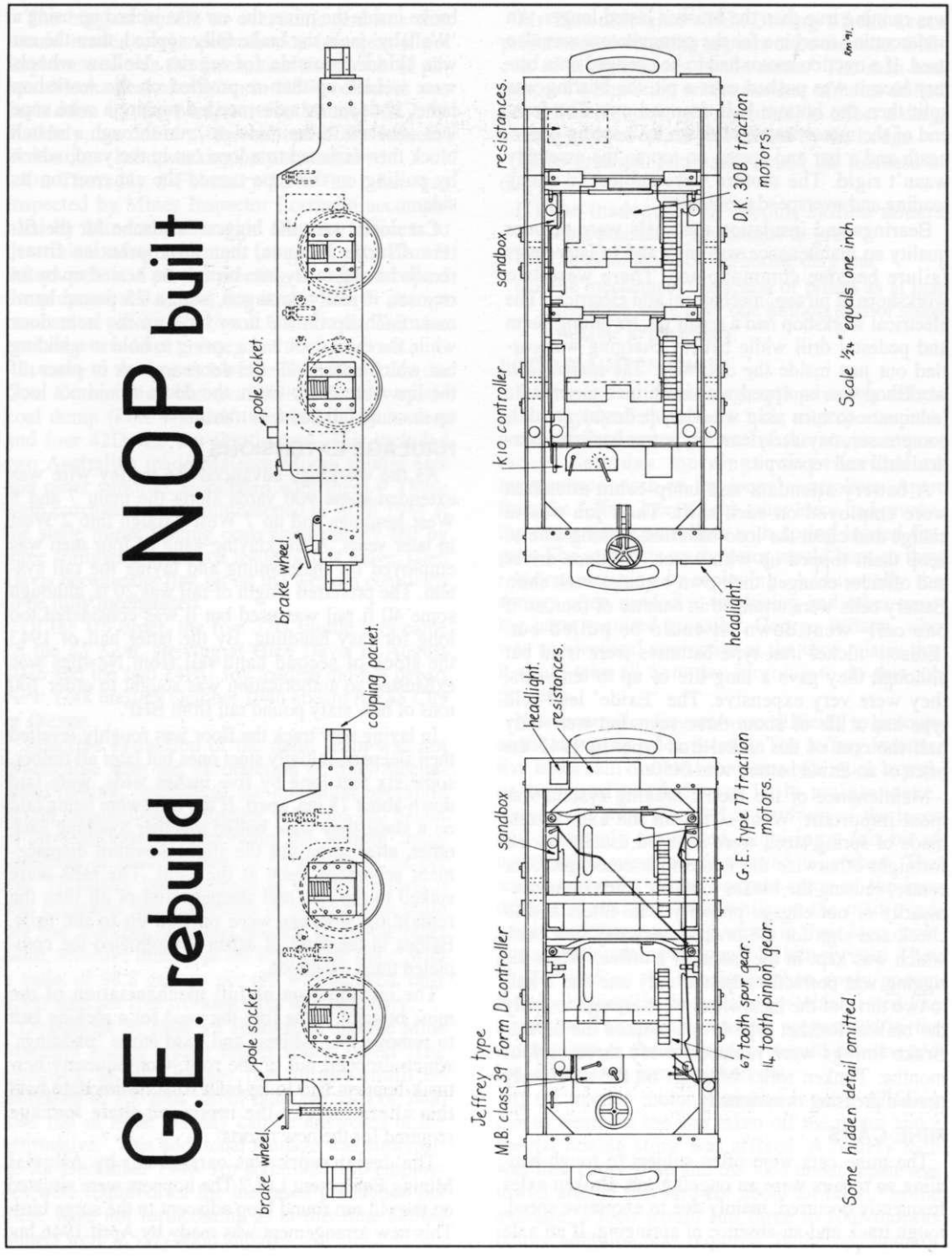
HAULAGE EXTENSIONS

As the workings advanced the trolley wire was extended some 900 yards along the main 7 and 8 West headings and up 7 West through into 2 West in later years. A tracklaying gang of four men was employed for maintaining and laying the rail system. The preferred length of rail was 20 ft, although some 40 ft rail was used but it was considered too long for easy handling. By the latter half of 1943 the stock of second hand rail from Newnes was exhausted so authorisation was sought to order 100 tons of new sixty pound rail from BHP.

In laying new track the floor was roughly levelled then sleepers, initially steel ones but later all timber, some six feet long by five inches wide, were laid down about 18 ins. apart. If the rails were being laid on a slope they were bolted together touching each other, after some use the slight downhill displacement separated them at the joint. The rails were spiked to the two end sleepers first of all then the remaining sleepers were packed up to the rails. Ballast in the form of ashes consolidated the completed track extension.

The introduction of full mechanisation of the mine brought to the fore the need for a picking belt to remove the 'whites' and hard stone 'puddings' which dropped out of the roof. Consequently new track hoppers had to be built to accommodate both this alteration and the increased shale tonnage required for the new retorts.

The design work was carried out by Alluvial Mining Equipment Ltd.[20] The hoppers were situated on the old run round loop adjacent to the surge bins. This new arrangement was ready by April 1946 but



Loading blocks of shale outside the mechanical workshop. The miner's bathroom is in the background. Both Mancha battery loco and mine cars are in as-new condition, circa 1940. Photo: Mr. M. Davis Collection.

modifications were required to increase the strength of the beams carrying the rails. The original weighbridge building was demolished and a new one erected alongside the hoppers. The hopper building was completely enclosed, enabling the locos to be stabled beneath its roof during inclement weather.

After several years of pleading, John Bowdler was finally allowed to acquire a second hand 200 kw motor generator set. It was delivered on 28 March 1945 from S. & E. Downie and placed near the junction with 7 West. Its sole purpose was to supply the trolley wire.

GOVERNMENT CONCERNS

By 1944 the Federal Government expressed its concern at the spiralling expenditure incurred at Glen Davis. The directors replied that 'the production of a quantity of petrol although at a high cost was regarded as a national work and essential to the war effort. Apart from any other considerations this aspect of the matter dominated the policy of the directors.' 'Attention was specifically directed to the shortage of draftsmen for design work, the general manpower shortage and to our failure to obtain the highest priorities in placing our orders.'

Messrs Butler & Griffith attended a full cabinet meeting of the Curtin Government on 26 February 1945 and explained in detail the position with NOP and inherited difficulties.[21] They estimated that the final capital structure would be approximately £3.82 million, which included £150,000 for housing. With completion of the full bench of retorts and new plant by the beginning of 1946 the company would be in a position to produce 9-10 million gallons of petrol per annum at a cost of approximately one shilling as against present production costs of three shillings and three pence a gallon.

Mr Butler expressed the opinion that Sir George Davis had been sold a 'gold brick' because the original cost estimates by the Newnes Investigation Committee proved entirely erroneous by the time Sir George was induced to begin the venture. Keith Butler said 'that Glen Davis could not now be an economic success due to the inadequate plant installed by Sir George Davis, the high capital charges resulting from excess expenditure over that originally anticipated, the very large additional sum provided by the Federal Government since the new Board was created coupled with accumulated trading losses now amounting to two thirds of a million pounds.' As a result of this meeting with Cabinet,

an additional sum of £387,817 was provided for.

Production of crude oil in 1945 amounted to only 3,527,435 gallons. On 19 December 1946 Cabinet approved a further advance of £100,000 bringing the total net provision for the undertaking to £3,557,506. Mr Kenny said to Keith Butler 'from Mr Chifley's remarks it is apparent that we sailed pretty close to the wind last February and if it had not been for your strong representations, Lord knows what would have happened.'[22] The whole enterprise was on very uncertain ground so the Prime Minister, who was most disheartened with the state of affairs, visited the town on 16 December 1946 for a first hand look.

The No 2 bench of 44 modified retorts was commissioned on 30 November 1945 along with the new product plant and all worked satisfactorily. The original No 1 bench was shut down in early December so as to be entirely rebuilt to the side off-take design. The rebuilt section was recharged once again on 11 February 1947. With increased steam demand for the retorts and power generation two new Riley Dodd boilers were installed in the power house. These were complemented by a 1250 kw turbo-alternator. From this point all that prevented Glen Davis from becoming financially self support ing was the amount of shale that could be supplied to the retorts for carbonisation.

LOCOMOTIVE PROBLEMS

The two General Electric locomotives were now showing their age and becoming unreliable. By 1945 motor rewinds were necessary and overheating was a constant problem. This was brought about by a combination of overloading, excessive speed and adverse gradients so that the locomotives made maximum demands in excess of the continuous rating of their traction motors. A special glass insulation tape was tried to overcome the problem and enquiries were made for 240 volt electric fans delivering 300 CFM to force ventilate the traction motors. (The use of forced ventilation allows an increase in the continuous current capacity by 30% to 50%.)

The original controllers in the locos were changed in 1944 to a Jeffrey MB Class 39 and General Electric K12 contactor type respectively. The K12 was obtained from the Randwick Tramway Workshops in Sydney.

On Saturday 30 June 1946 a General Electric loco crashed head on with the Jeffrey loco. The General Electric was severely damaged, with its cast iron frame being broken into four pieces leaving the shunter and driver sitting bemused on two different

The drivers 'favourite, the Goodman, standing at the weighbridge. Note the cable-reel on top of the loco situated behind the resistors and the twin trolley poles. With two poles the loco driver would avoid the need to change pole sockets when travelling in 8 West. Photo: Mr. George Wilson.

halves.[23] Thirlwell & McKenzie of Wollongong fabricated a new steel plate frame to replace the broken one. It arrived at Glen Davis on 5 August 1946 and proved satisfactory in service. In any case a replacement frame was long overdue as the originals had cracks above the axleboxes and at the points where the bolts held the coupling pocket onto the frame. The locos had worked for years in this condition. An opportunity was also taken to overhaul the mechanical parts of this loco, especially the gears. This unit re-entered service in early December 1946. Ever increasing haulage distances, the expected increase in tonnage and the poor reliability of the two General Electrics locos made the acquisition of a further trolley loco imperative.

Four quotes ranging from £6,900 to £5,480 were solicited for a heavy duty main road haulage loco but management considered this loco type to be in excess of immediate requirements. John Carruthers & Co, the Sydney agents for the Goodman Manufacturing Co of Chicago, offered an alternative quote for a Goodman type 136B-04C2 12 ton cable reel trolley locomotive at a price of £5,361. This was complete with trolley pole, steel tyred wheels, roller journal bearings, drum type controller, sanders and electric cable reel driver from the locomotive axle.

After careful consideration Mr Bowdler considered the Goodman to be the most suitable locomotive on offer as it would be capable of hauling eight empty mine cars up the 5% grade of the West side and could pull six loaded cars from the East side as well as ten loaded cars on the main road. The unit would be ideal for secondary haulage in the districts and, if necessary, could be used as a cable reel locomotive on spotting at the face. If heavier loads were envisioned on the main road two of these locomotives, one backing up the other, would be capable of hauling 80 to 100 tons in one trip. The Board approved the purchase of this unit[24] on 10 August 1945. As delivered the Goodman loco was actually a type 134C04C-02, builders number 5473.

The Goodman loco was plagued with production delays and Keith Butler made an alternative suggestion to convert a Mancha storage battery locomotive for use on either battery or trolley wire power. This system was operating successfully at two of BHP's Newcastle collieries; a two way switch selected either power source. It was decided to proceed along these lines as conversion of the Mancha locomotives would probably preclude ordering a second Goodman locomotive.

MANCHA CONVERSIONS

The two Mancha locomotives gave valuable service in spotting mine cars at the face but by 1942 troubles began arising with their controllers and they needed continual maintenance. Mr Bowdler suggested that a Jeffrey starter and contactor be purchased for attachment to the Manchas as the Jeffrey product was most satisfactory. With management's decision to convert both of these locomotives to dual battery/trolley operation an order was placed with John Carruthers for two Type XC6891 T controllers, four trolley poles and four trolley pole brackets.

By mid September 1946 the conversion of one of these units was completed. When the locomotive was to work on 250 volt trolley wire power the Edison 'A6' battery was removed and a welded frame of bull head rail was lifted on with a block and tackle to provide adhesive weight. The two 110 volt traction motors were connected in series and a resistor was added to the circuit to reduce the trolley wire voltage to suit when the pole was put up to the wire. A 'half moon' type knife switch was mounted on the right side of the driver's cockpit.

The conversions were only of limited usefulness. The low adhesive weight and small diameter wheels of the locomotive meant that it was very easy to get into a skid and braking was a problem.

NEW LOCOMOTIVES

A proposal was then put forward to replace the under-powered General Electric motors with obsolete DK 30B traction motors which were then available from the Randwick Tramway workshops in Sydney. These English Electric motors formerly powered Sydney's trams and were rated 48 hp at 610 rpm at 600 volts.

With the success of the new fabricated locomotive frame it was decided to build two new additional trolley locomotives instead of entirely rebuilding the General Electric locos. Hol Frith discussed with P.M. Rickard of Jones & Rickard Pty Ltd a Sydney electrical engineering firm, the conversion of these traction motors to 250 volt operation. Mr Rickard was confident it could be done although speed and horsepower would be reduced, 448 rpm and 38 hp respectively. Cost of the conversion was £86 for each motor.

The Tramway Department approved the sale of four traction motors at sixty pounds each plus four 14 tooth pinions 18/8 each, one 70 tooth spur wheel, four axles, four sets of bearing castings and three K10 controllers.

A. Goninan & Co Ltd of Newcastle successfully tendered for two fabricated steel locomotive frames at £625 and the order was placed on 9 December 1946. Mr Kenny noted 'The completion of the locomotives in question without delay is a matter of extreme urgency in order that adequate haulage may be provided.... No appropriation is available for the specific purpose at present. However the outlay can be met by utilizing allocations for certain authorized jobs now regarded as non essential'.

The assembled frames were despatched from Goninans on 28th March 1947 and assembly began immediately at Glen Davis under the foreman fitter, Mr Cliff Evans. Weight in working order of the locomotives was eight tons. Cast in Carbon Chrome steel, the wheels were supplied by Commonwealth Steel.

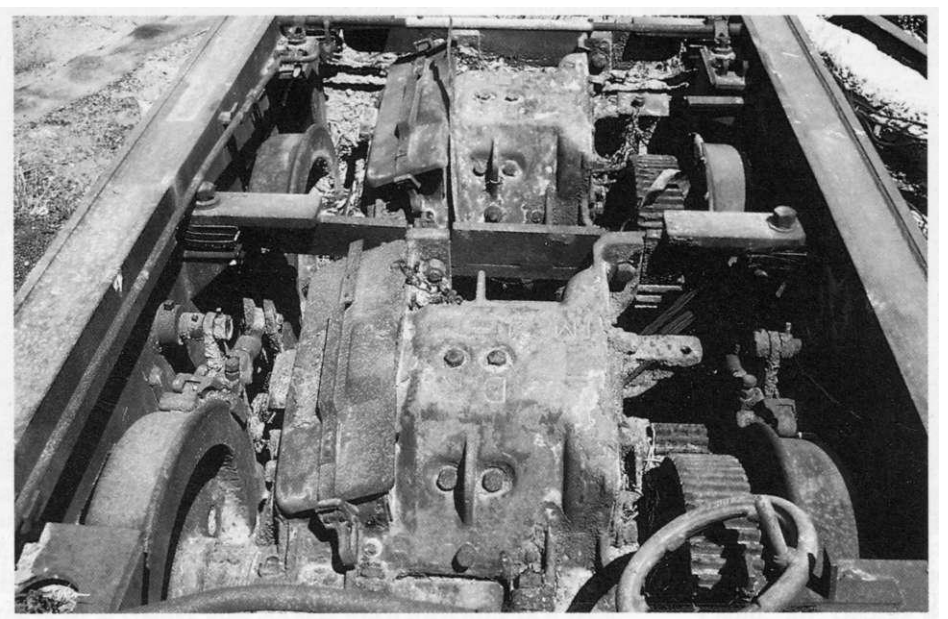
In anticipation of completion of the locomotives in the main workshop a special transport trolley was built to carry the assembled units to the mine. The first locomotive entered service in June 1947 and management remarked 'Every credit is due to the Engineering Department for its good work in connection with this new equipment.'[25] However, by December defects made themselves obvious in the traction motors so they were returned to Jones and Rickard for rectification.

Because of an acute labour shortage, the second locomotive did not enter service until 1948. One locomotive was painted gray and nicknamed 'the Grey Ghost' while the other one was yellow. Both were fitted with bells and headlights but crew comforts were non existent. The driver's seat was a hard wooden affair. Many drivers considered the 'Grey Ghost' to be the superior unit of the two both in pulling power and braking. In 1951 this locomotive was involved in a serious accident that ended its working life.

THE GOODMAN LOCO

At long last the new Goodman locomotive was shipped from New York, arriving in Sydney aboard the 'Pioneer Star' on 9 September 1947. Particulars of the locomotive are weight 27,410 lbs, controller LM 97E; 30 inch diameter steel tyres; 66 inch wheelbase; 120 hp rating. A VA-28 cable reel was mounted on the top. It had a low torque electric motor so it was possible to stop or drive against the reel's motor without damaging it. The unit was painted a light grey lacquer, fitted with two headlights and a foot operated bell. It was very popular with the drivers who nicknamed it the 'Flat Top'. There was plenty of power and it was well sprung.

Close up view of the "tram" loco showing how the traction motors were secured to the frame cross members. The sand boxes had spring loaded plunger valves. Steel cover plates were on top of the loco when in regular service. Photo: R. Mainwaring



A high and low speed range selector was fitted. The driver could select either 'series' or 'parallel' for pulling or speed respectively in either direction.

The wooden trolley pole could be reversed to either end of the locomotive. An electric cable which plugged into a Roco type socket was of adequate length to permit this. When going up into 8 West, the driver removed the trolley pole from its socket and changed it over to the opposite side to suit the wire. The procedure was that when enough speed was gained, the controller shut off, then the pole was swapped over to the right hand side without stopping. On this locomotive the shunter sat on the opposite end to the driver so no assistance could be given in changing over the pole. Twin trolley poles were eventually fitted to overcome this difficulty.

Before the unit could enter service two buffer beams had to be cast by J. & A. Brown's engineering workshops. A temporary coupling was made in the meantime. The unit was commissioned in mid October.

The combination of heavy loads with grades resulted in rapid brake shoe wear on the Goodman loco. Mr Hindmarsh suggested the inclusion of a mild steel insert into the iron brake shoe as was the practice at AIS collieries on the South Coast and David Bros 'Garden Hill Foundry' at Wollongong subsequently received an order for 50 shoes. Although shoe life was increased, the braking force was reduced.

One of the most memorable accidents involved the Goodman with driver Reg Florent and his shunter Henry Davies in October 1948. At the start of the afternoon shift a critical shortage of empty cars had developed, so to make empties available quickly, Reg coupled up to a full set of 17 cars. Many of the men were skeptical that he would even make it to the surface.

From 4 East to 1 East there was a big dip, or 'swallow' in the haulage road where it followed the shale seam. To be certain not to stall on the uphill run out of the 'swallow' a very fast acceleration was required, some estimates being as high as 30 mph. As the set rocketed along Henry Davies, seemingly aware of impending trouble, ducked right down in his seat in the rear compartment. Upon reaching the surface the locomotive and first three cars safely crossed the first set of points, which were worked by a ball lever, but the weight and vibration caused the points to move beneath the following car bringing instant disaster. The locomotive and three cars crashed near the junction of the line into the machine shop where a sand pit was situated. The Goodman spun around and around, tearing up the track and slicing off the steel channel irons that supported the trolley wire.

After the dust had settled and the crew realised they were uninjured it was found that the trolley wire was still alive as the wire had burnt into the brake handwheel and coupler pin. A hurried phone call was made to the power house to switch off the power. Normally the overload relay should have activated to cut off the electricity but the shunters often stuck a piece of wood into the relay so they would not need to walk back to effect a reset if the trolley wire tripped out.

An urgent call was made to the road laying gang to come out early to restore the track. Oxy-acetylene was used to cut away the coupling pin between the locomotive and the cars which were badly smashed about. Temporary posts were hastily erected and the power wire re-strung. By this time it was nearly 1 am. The remaining full cars were then emptied and Reg was told to push them back into the mine. On the way in, a newly relaid rail had a steel splinter protruding from it which caused the leading car to derail and spear into the roof, severing the main 2 kv cable in the process. After temporary repairs the set continued on down towards the 'swallow'. Unknown to the driver, Charlie Gawthorne and his track gang were working on some split rails in the 'swallow'. When the set of three remaining good cars suddenly appeared the gang flattened themselves against the rib but one car derailed and catapulted up to the roof, becoming firmly wedged in the timbers.

Charlie was afraid that the roof might fall in but Reg was more confident about handling the situation. Sand was liberally applied to the rails, power applied and the Goodman successfully pulled and lowered the offending car. The six timber bars which were lifted off their legs in the derailment dropped back into their respective positions. The debris was quickly shovelled clear then the set continued on its way. Needless to say production was severely disrupted that night. All the other mine cars that were booked for repairs with flat wheels etc were temporarily brought back into service until the wrecked ones were attended to.

When Reg arrived at work next day he went to the Lamp Cabin as usual, but was refused a lamp by his father-in-law and told he had to report to the manager. Fourteen days' suspension was Reg's punishment, then he was banished to the driving of shuttle cars. This incident is vividly remembered by most

employees of the shale mine and spawned a poem called 'The Driver's Lament'.

The Driver's Lament

It happened one day, about six months ago.
They gave Evers a shunter, whose nickname was Flo.

He worked his way up, in a month or two
And went on to driving, the worst thing he could do.

He started off slowly, at a nice speed
But he wasn't happy, till he got in the lead.

They put him up seven, to try out his skill.
But if Fred had his way, he'd be sent down the hill.

Jacques gave him a shunter, to go on the flat.
'Ah!' said young Davies, 'I won't mind that'.

Seventeen skips wasn't such a big load.
Things would have been quite OK, had they stopped on the road.

On reaching the surface, there was a great crash
For they jumped off the line, and Boy! What a smash.

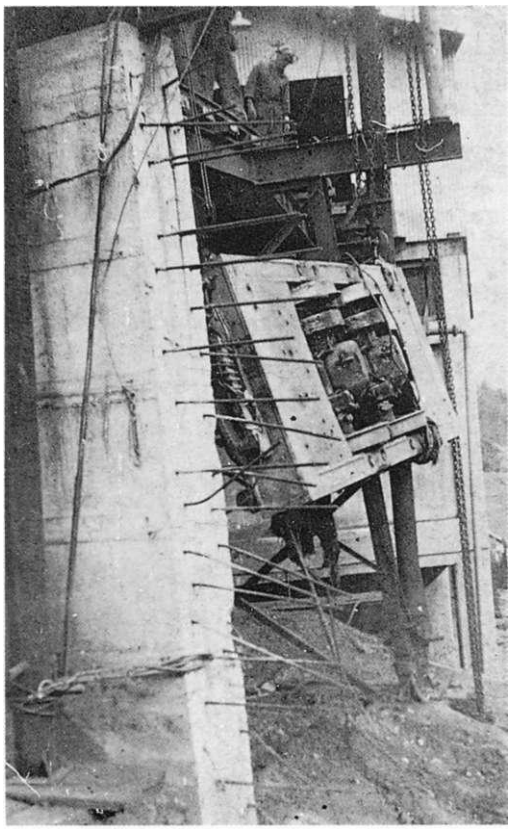
As Florent stood by, awaiting his fate
Up came Fred Johnson, and said 'Get out that gate.'

'S' is for Sibra, who had a collision.
His rates were reduced to the second division.

Why should Fred worry, he'd do the same.
Who are you kidding? He wouldn't be game.

Now our story has ended, I'm pleased to relate.
But hope no more drivers meet the same fate.

Poem by Mr Jeff David and Mr Joe McFawn, courtesy of Mr Reg Florent.



After crashing over the side near the surge bin, a rebuilt G.E. is winched back up to the track. The driver jumped off just in time.
Photo: Mr. Alf Bingham.

INCREASED POWER DEMANDS

The Electrical Engineer, Hol Frith, became concerned that with the introduction of the additional trolley locomotives, the motor generator supply set would be inadequate to meet future demands for DC power and recommended a DC substation of at least 300 kw capacity. He further recommended that to make the General Electrics into useful locomotives the following would need to be done.

(a) A reduction of the hp/weight ratio when new frames were supplied
(b) An increase in the tractive hp available by using fibrous glass insulated armatures and forced ventilation.
(c) Possible decrease in tractive effort by fitting of chilled cast iron wheels.

With increased electric haulage the existing 7 West motor generator set would be unable to meet demands placed upon it and the 120 kw set would only give feeble relief as a standby unit. On many occasions low voltage supply to the mine seriously affected production.

In the post war years it was difficult to get the desired equipment such as a Mercury Arc Rectifier, so after many enquiries overseas an order was placed with the manufacturers, English Electric Co Ltd, on 5 January 1949 but the rectifier did not arrive in Sydney until January 1951. It cost £6420 and comprised 3 Type P.V. 50720 rectifiers rated at 125 kw. It was installed in a cut through adjacent to the older motor generator set.[26]

ROLLING STOCK

In September 1945 quotations were called for 15 five ton mine cars. The successful tenderer was Thirlwell & McKenzie Pty Ltd.

Some alterations to the original designs were made. Capacity was increased to six tons and frame members were enlarged for additional strength. A heavier duty wheel bearing was also fitted as experience with the earlier J. & A. Brown cars prompted these changes.

Mr Bowdler requested that Thirlwell & McKenzie follow standard practice of the South Coast mechanised collieries in making the female coupling rigid and the male coupling on the back of the car spring loaded. In the letter dated 3 July 1946 it was said 'This in effect means that there is no flexibility between the locomotive and first skip on train. Mr Bowdler is now seeking confirmation of this practice from another source and in the meantime Messrs Thirlwell & McKenzie have been advised to withhold shipment'.

The first of the cars was delivered to Glen Davis on 6 August 1946. They weighed 2 tons, 5 cwt 2 quarters.

As the distance to the working face in the mine increased transportation for the men became necessary to maintain productivity. This need was met by the provision of wooden planks mounted inside an ordinary mine car. In February 1946 two four wheel transports able to seat 20 persons, ten each side, entered service. On 27 November 1946 the men went on strike over the practice of their having to sit in the mine car. Management refused their demand that the transport make a second trip assuring the men that new transports were in preparation. The men's concern was well founded for it was not unknown for bottom doors to accidentally drop open with injury caused to the occupants as well as the loss of production capacity with the dedication of the car to the transport of men. As a result of the dispute, Thirlwell & McKenzie (Thirlmac) received an order for two more transports on 4 December 1946 These cost £390 and arrived at the mine on 21 May 1947. After these had entered service it was decided to amend future designs by way of increasing the wheelbase to six feet.

In anticipation of an increase in the number of mine employees from the present 220 two more transports were ordered from Thirlmac. The company recognised 'Past experience has shown that failing the availability of transport cars of approved design, industrial trouble is likely to ensue'. As well, two hours a day working time was lost because of insufficient transport. Thirlmac submitted a quote of £282 a car as of 10 June 1947. This quotation was approximately 45% above that of the previous order but the manufacturers claimed 'that they had made a considerable loss on it, so could in no way reduce the price on the two now sought'. These later cars were of a modified design but derailments sometimes occurred possibly because of their longer wheelbase. If this happened the men simply got off and lifted the transport back onto the rails. Longitudinal wooden plank seats were fitted, sitting ten men on each side. No handbrakes meant that a transport had to be chocked if stationary.

FATAL ACCIDENT

Loco driving was a potentially hazardous occupation given the steep grades with heavy loads and greasy rails. And at no time was this more clearly demonstrated than at 3.15 pm on 22 November 1945 when Mr Ernest Morrissey, aged 38, was pulling away from No 4 Bord up in 8 West and his Mancha loco immediately fell into a skid. The eight ton loco and four full cars careered down the steep grade completely out of control, rounded the turn onto the main road and then collided with an incoming set of mine cars at 7 West junction. Bob Doorey was the trolley loco driver pushing the empties, five in number, when he looked up towards 8 West to see a loco bearing down on his train with sparks flying from beneath its wheels. A terrible collision occurred and the resulting dust was so thick that vision was cut off for a few minutes.

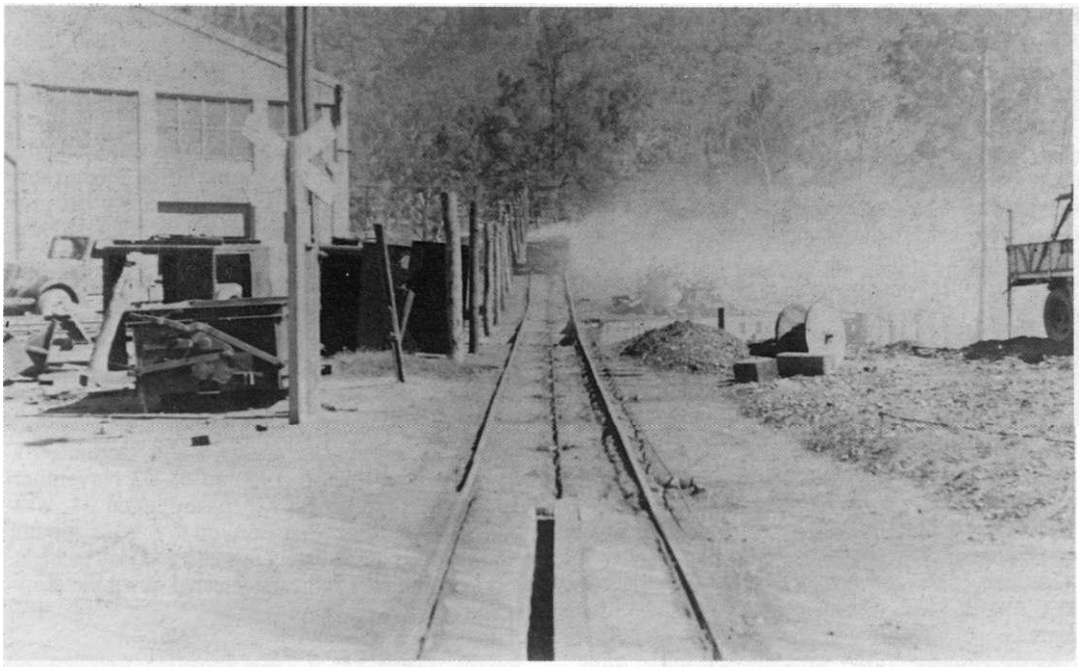
Bob and his shunter, Keith Jones, ran up the heading and found Ernie Morrissey lying on the side of the road with severe head injuries some 80 yards inbye of 7 West junction. Morrissey had jumped off the runaway loco just before the collision but had collided with a wooden prop beside the road. Bob lifted the injured man's head to stop him breathing sand into his nostrils while someone sent for the doctor. The victim was attended to in the first aid room before he was conveyed to Rylstone hospital where he later succumbed to his injuries. Mr Morrissey left a wife and two children.

TO BE CONTINUED

References will be included at the end of the full text in the next issue.

Conversion:

1 mile	= 1.6 km.	1 shilling (s)	= 10 cents
1 chain	= 20.10 m.	1 penny (d)	= .83 cent
1 yard	= 0.914 m.	1 gallon	= 4.55 litres
1 foot	= 304.8 mm.	1 pound (lb.)	= 454 grams
1 inch	= 25.4 mm.	1 t o n	= 1 . 0 2 tonnes
1 pound (£)	- $2.00		

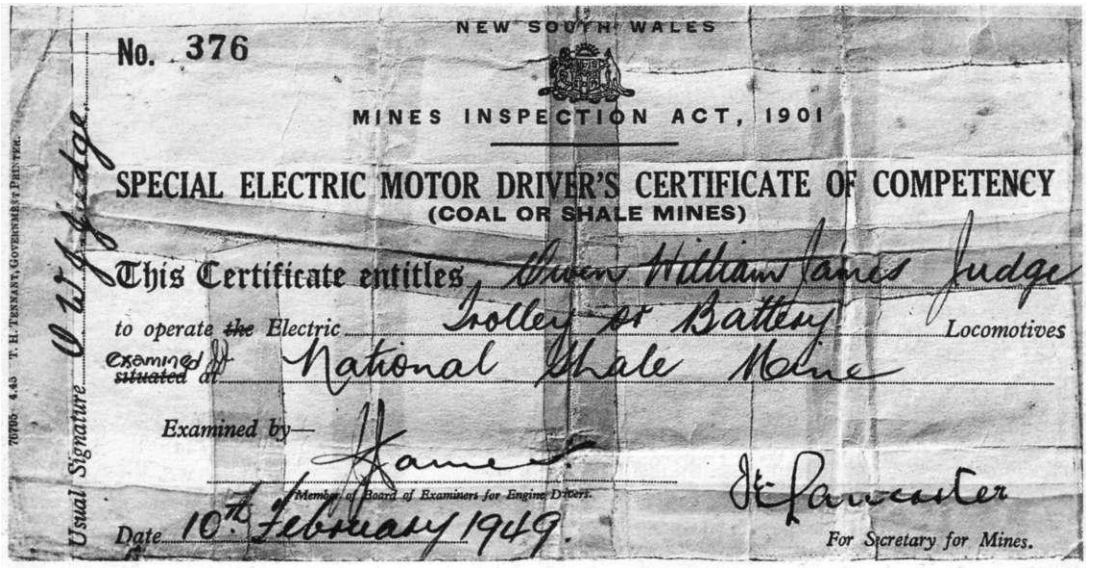


Above: Ash disposal skipway, the "Burma Road". Note the wire ropes running down the centre and to the right of the rails to which the skip was attached.

Photo: George Hicks Collection.

Below: Mr. Owen Judges' loco ticket, dated February 10, 1949

Photo: Author's Collection..



NEW SOUTH WALES

No. 376

MINES INSPECTION ACT, 1901

SPECIAL ELECTRIC MOTOR DRIVER'S CERTIFICATE OF COMPETENCY
(COAL OR SHALE MINES)

This Certificate entitles Owen William James Judge

to operate the Electric Trolley or Battery Locomotives

~~Examined~~ situated at National Shale Mine

Examined by—

Member of Board of Examiners for Engine Drivers.

Date 10th February 1949.

For Secretary for Mines.

Usual Signature O W Judge

70705 4.43 T. H. TENNANT, Government Printer.