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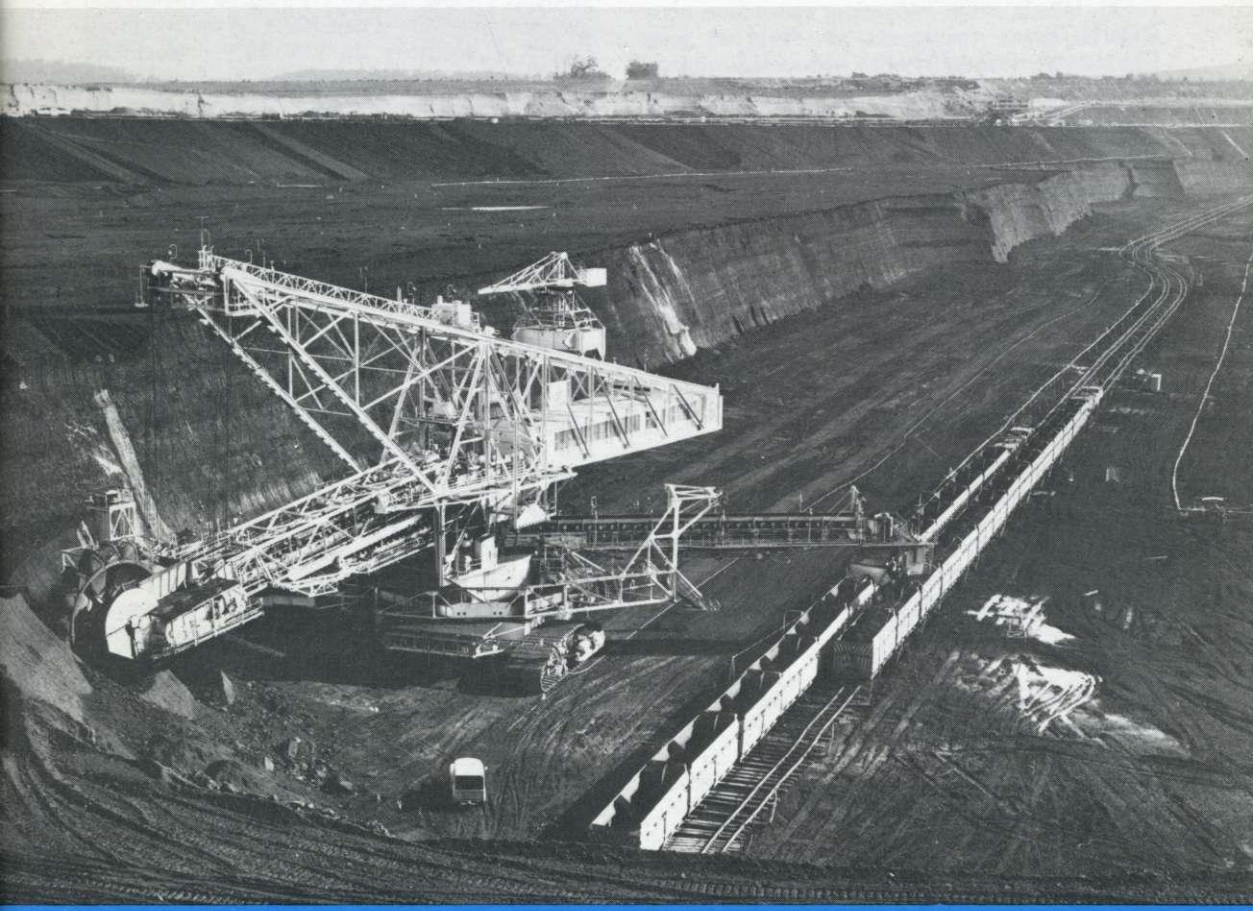

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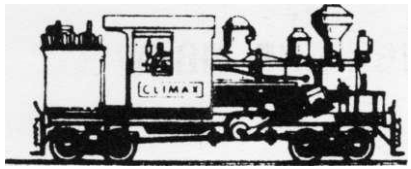

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Cover: The immense scale of the SECV Yallourn open cut operations are apparent in this 1960s view of No. 6 bucket dredger loading coal onto trains.

Editorial

It is readily said that we live in an electronic age, for today's home, factory, commercial building and 'palance' of leisure is dependent on the continued supply of electricity. In Victoria that electricity largely comes from the brown coal resources of the Latrobe Valley.

Since 1921 the exploitation of the brown coal resources to meet the growing demands of Victoria's electricity consumers has been the task of the State Electricity Commission (SEC). Railed transport has played a major role. Horses, ropeways, steam, electric and diesel traction have operated on 20**'/2**in, 24in, 90cm, 3ft 6in and 5ft 3in gauge railways to move overburden and haul coal to the power stations and briquette factories. At the height of railway operations in 1964/65, 42 electric and 3 diesel-mechanical locomotives operated on a railway system which covered 107 track kilometres and carried 277,081 loaded train-kilometres per year.

Light Railways is proud to present the first of two special issues covering John Buckland's detailed history of the SEC mining and railway operations at Yallourn. The second issue (scheduled for ***LR.84)*** will cover railway operations at Morwell, together with details of the locomotives and rolling stock and a description of more recent train operations.

Acknowledgements

Acknowledgements to the many who have assisted with the preparation of the articles will be provided at the conclusion of Part II. It should be noted, however, that photographs, diagrams and maps are from official SEC sources unless otherwise indicated.

BRIQUETTES AND POWER: SECV INDUSTRIAL RAILWAYS AT YALLOURN AND MORWELL

by John L Buckland

PART I: THE YALLOURN STORY

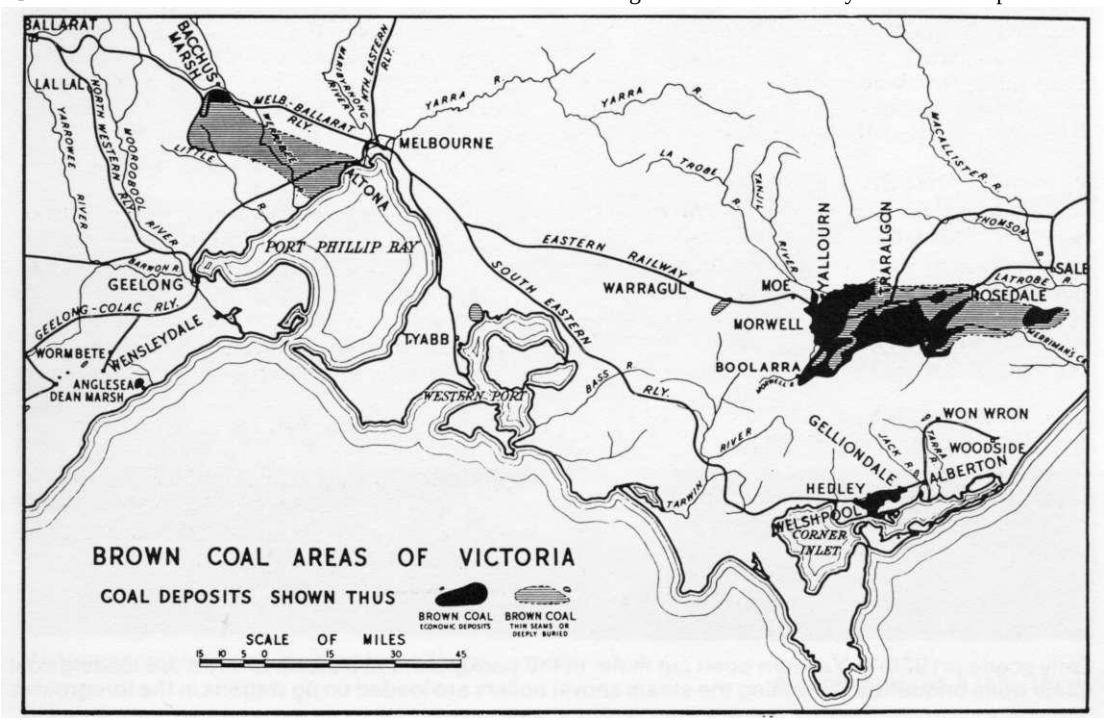
Introduction

Knowledge of the existence of brown coal (lignite) in the then Colony of Victoria dates back to 1857. By 1876 deposits had been located in at least 32 localities, but systematic studies were not undertaken until the early 1900's when Dr H Herman, the State Director of Geological Survey, commenced a survey of brown coal resources.

There were a number of early attempts to exploit brown coal deposits commercially by private enterprise at Boolarra in 1889, near Morwell in 1890, at Moe in 1895, Dean's Marsh in 1901 and Altona in 1911, but these met with only limited success. The possibility of making town gas from brown coal was discussed as early as 1889, and one JC Newberry first suggested piping gas from Morwell to Melbourne over 50 years before the Gas and Fuel Corporation's Lurgi gasification plant was in fact established there.

Investigations were made into the possibility of making briquettes from brown coal and in 1894 a briquetting plant was installed at the Great Morwell Coal Mine, which subsequently became known as North Yallourn. Although contemporary reports suggest that this plant ran badly and was constantly breaking down, good briquettes were made which soon established themselves in the market. However, the plant was subsequently destroyed by a bushfire. Most of the early ventures into mining and marketing brown coal failed because the product, whether raw brown coal or briquettes, was unable to compete with Victorian black coal from the Korumburra coalfield, which at that time, was readily available and competitively priced.

Interest in brown coal revived following the Newcastle (NSW) coal strike in 1916, when arrangements were made by the Mines Department



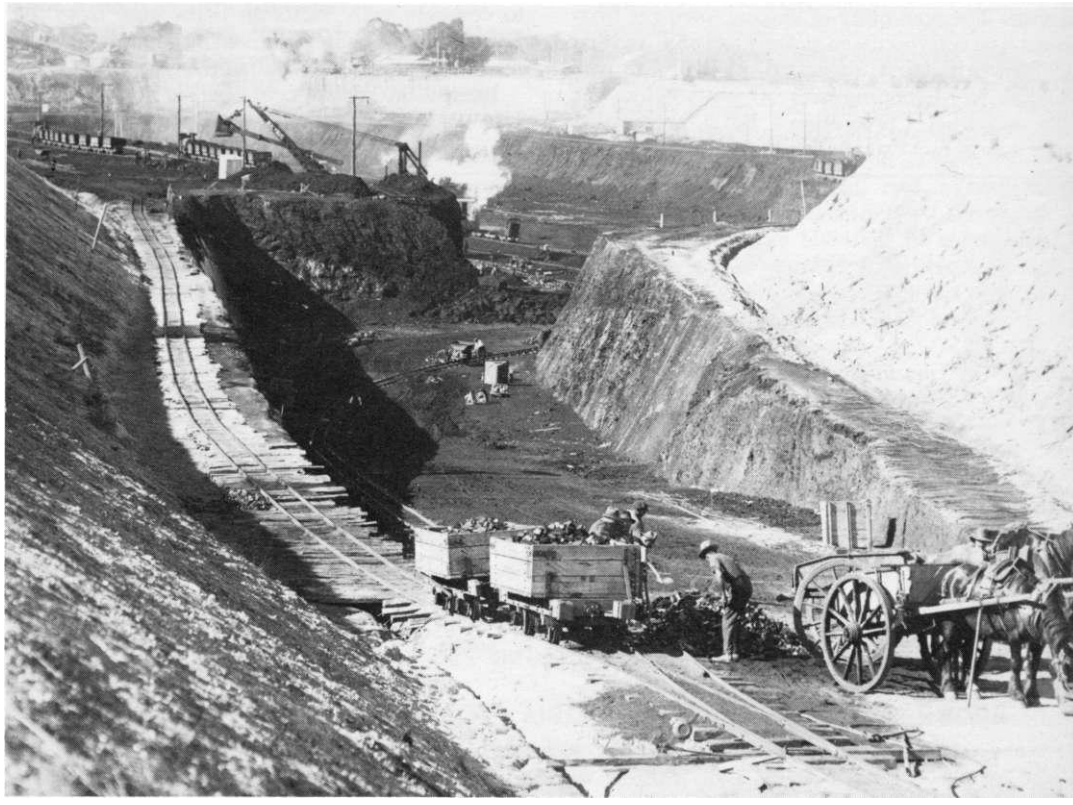
to re-open the old Great Morwell open cut. Operations were suspended almost immediately when the strike ended a week after they had commenced. However, further industrial trouble on the New South Wales coalfields brought about a resumption of operations in 1917, when output was 34,000 tons. This had risen to 162,000 tons by 1920.

Meanwhile in September 1917, a Brown Coal Advisory Committee had presented to the State Government a report recommending development of brown coal deposits near Morwell and the generation on site of electricity for transmission to Melbourne. After due consideration the Government in 1918 introduced an Act of Parliament to appoint State Electricity Commissioners who were charged with implementing the recommendations of the Advisory Committee.

The new Commissioners, under the part-time chairmanship of Professor Sir Thomas Lyle, after some initial difficulties, decided to establish a large open cut mining operation and a power station, situated on the south bank of the Latrobe River, 85 miles east of Melbourne, and a new model town nearby, to be known as Yallourn, to house the workforce. Selection of the site by the Commissioners was due to two factors: the coal deposit was the largest and best suited to open cut mining; and the normal flow of the Latrobe furnished a soft water supply sufficient to meet the requirements of a large power station without need for re-cooling. (This facility has become necessary with the later installations - Yallourn W1 and W2 power stations.)

The coal-bearing land then vested in the Commission extended from the Latrobe River on the north for two miles to the south, and from the Morwell River on the east for two miles to the west. It contained an estimated 600 million tons of coal with an average depth of 45 feet of overburden and 200 feet of coal. This quantity is, however, only a fraction of the total deposit in this portion of the Latrobe Valley of central Gippsland.

In December 1920, the Government enacted the State Electricity Commission (SEC) Act, 1920,



Early scene (c1926) in Yallourn open cut mine. In the background two steam shovels are loading coal trains while briquettes for fuelling the steam shovel boilers are loaded on ng wagons in the foreground.

and in October of that year the former General Sir John Monash was appointed general manager of the undertaking. In January 1921 he became the first full time chairman of the Commission. In February of that year construction work at Yallourn was commenced in earnest with site preparation for the power station and clearing and excavation for the commencement of coal winning.

Characteristics of the Coal

The Latrobe Valley brown coal deposits of Central Gippsland, of which the presently worked Yallourn/Maryvale seam forms but a part, cover an area of more than 800 sq miles. In the area presently vested in the SEC there is an estimated 22,000,000,000 tons of brown coal, almost the whole of which is recoverable by open cut mining. Seam depths vary, but they are remarkably uniform and thick. In the Morwell field, south-east of Yallourn, there is one solid seam more than 500 ft thick - one of the greatest known coal seams in the world.

In the Yallourn seam none of the recoverable coal is more than six miles from the power station. Geologically the coal is 'young'; the beds having been formed in the Miocene Age about 20,000,000 years ago. The coal was formed from many types of vegetation which drifted or was carried into primeval swamps by streams and then settled in beds of resinous mud. The coal bears a striking resemblance to German brown coal from the Rhineland and contains fossilised tree trunks and limbs, ferns, leaves and vegetation which is little changed physically, although their chemical properties have altered materially.

In its raw, undried state, the Yallourn/Morwell coal contains from 66 to 70 per cent moisture and is therefore much softer than comparable German brown coals. It can be won readily by dragline, power shovel or bucket dredge, whilst offering uniformly good resistance to surface pressure; as

Water sprinklers in use on coal faces in Yallourn open cut.

Australian News & Info. Bureau

evidence the coal dredgers weighing up to 1600 tons operate on crawler tracks directly on the coal surface, while previously rail-mounted deep dredgers weighing over 400 tons were similarly supported on temporary trackage prior to substitution of conveyor belts on the coal faces.

The dried coal, as used for briquette manufacture by pressure, has a low ash content of only about 1.86 per cent and a calorific value of 10,855 BTU's per pound. By contrast, the raw coal has a calorific value of but 3792 BTU's per pound and is slow to give up its moisture content; it is, in fact, somewhat akin to a stiff jelly. As the exposed surface dries in contact with the atmosphere it forms a fine powder which is highly combustible and once ignited, it is very difficult to extinguish. For that reason extreme precautions are taken to guard against fire and smoking is restricted throughout the whole open cut area. All the exposed coal surfaces, except the actual working faces, are interlaced with high pressure pipelines and hydrants. In dry weather these exposed coal surfaces are regularly sprinkled for the dual purposes of minimising dust and preventing fire. In 1944, for instance, a fire started in the open cut by sparks from a bushfire in the vicinity burned for three and a half days, damaging dredgers and transport tracks before it was finally extinguished.

Owing to its naturally 'sticky' nature the raw coal does not readily discharge from hoppers and bunkers unless the slopes are very steep. This difficulty is accentuated in wet weather. The low specific gravity of the coal (1.1) makes it a bulky material to transport for a given weight. One effect of this is the necessarily high volumetric capacity of the transportation equipment and the storage bunkers; the loose coal averaging 50 cubic ft to the ton mass.

Steam-Operated 3ft 6in (1067mm) Gauge Railways

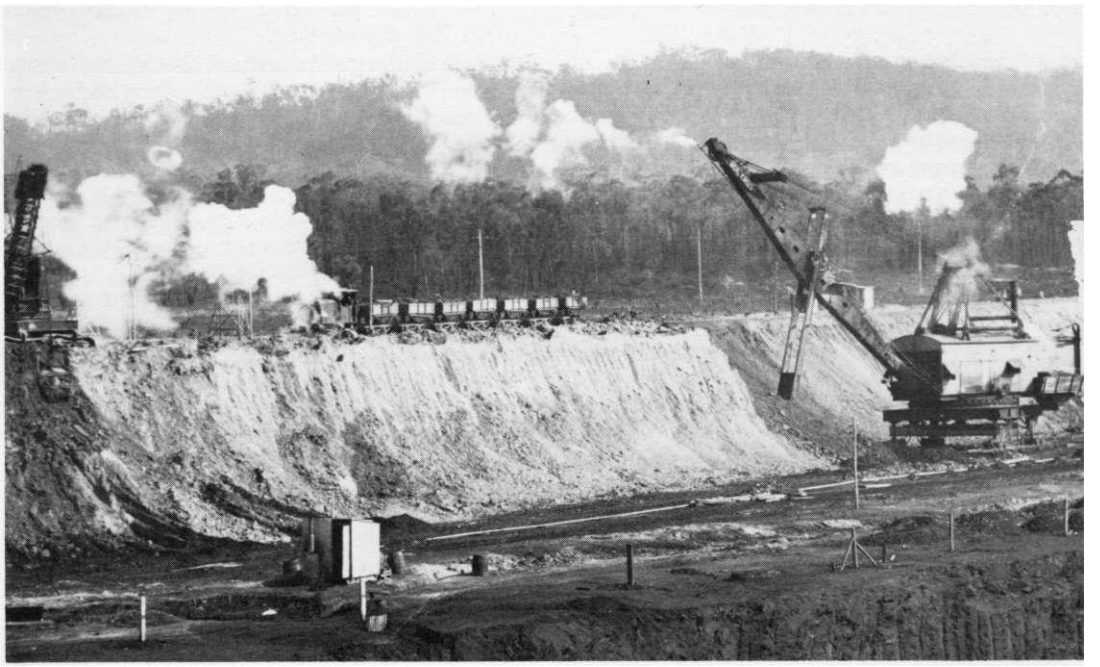
With the bringing into operation during June 1924 of Yallourn 'A' power station and the following February, the first section of the briquette factory, several ropeway systems had been installed and tested. A contractor, AH Russell had laid a 3ft 6 in gauge railway on the site of the open cut excavation to speed up the stripping of overburden late in 1924, on which at least two, and probably three, small 0-4-4T locomotives were employed to haul rakes of side-tipping dump wagons. The locomotives were purchased secondhand from the South Australian Railways in August 1924 and were that system's V-class Nos. 11, 143 and 144, built by Beyer Peacock (1599 of 1876) and James Martin (67 and 69 of 1893), respectively. An early picture shows one of the type heading a string of dump cars, during a period in 1921-22 when No. 10 of this type was hired from SAR for use at Yallourn during the early construction period.

Trains of these wagons were loaded direct by the steam shovel engaged in making the initial excavation for the open cut at the north end. Russell's contract terminated at the end of 1925 and he later sold the three engines to the Goodwood Timber Company's logging line at Noojee, where they ended their days as scrap, being cut up in the bush. In November 1924 the SEC had ordered two small secondhand 0-4-2ST locos through the agency of Hampton & Wheeler for hauling coal from the steam shovel working in the open cut out to a temporary loading plant where it was dumped for transfer to the No. 1 ropeway system. This haulage had initially been performed by horses. The locomotives were of the well-known ***Wallaroo*** type originally supplied and built by Hudswell Clarke & Co., Leeds, England for the Wallaroo & Moonta Mining and Smelting Company in South Australia. They carried their original owner's Nos. 3 and 12, which were retained by the SEC; their builder's Nos. being 394 of 1892 and 803 of 1907, respectively.

In February 1925 a third engine was acquired from the same source and it went into service at Yallourn in April. This was originally Wallaroo No. 5 (Hudswell Clarke 609 of 1902). With all three locos available for coal haulage, horses ceased working in the open cut. The locomotives in their turn were replaced by the No. 3 ropeway at the end of November 1925, after which they were not again used for coal haulage. No. 5 was scrapped at Yallourn prior to December 1929 and parts used to maintain Nos. 3 and 12. On March 6,1926 all three steam locos resumed operation on overburden haulage on the south side of the open cut excavation, hauling 5 cubic yd tipping wagons.

Shortly afterwards, they were joined by three new engines, ordered through the agency of Knox Schlapp & Co., Melbourne from Robert Hudson & Co. Leeds, but built by Hudswell Clarke & Co. (1569-1571 of 1925). They too went into service on the 3ft 6in overburden railway in April 1926. All six locomotives and 40 five cubic yd dump wagons were engaged in overburden haulage to the dump area until November 17, 1926, when steam operation was supplanted by the new 90cm gauge electric railway. However, from the end of 1926 two of the steam locomotives and 25 dump wagons were temporarily transferred to the Old Brown Coal Mine (Old BCM) at North Yallourn where for

Above: Hired SAR 3ft 6ln gauge locomotive V.10 working on construction of a railway embankment to carry the broad gauge line to the future site of Yallourn power station and the 'Old Brown Coal Mine' in late 1921. Below: Robert Hudson 0-4-0ST locomotive on overburden train moving into position for loading by Bucyrus steam shovel (right) with Marion dragline of the left, c1926.



a year they were used for overburden removal. Steam locomotives were not used again at Yallourn until the emergency reopening of the old workings following flooding of the open cut after phenomenal rainfall in November 1934, when the Latrobe River flooded over the levee banks, resulting in complete inundation of the open cut workings to a depth of 200ft. It took five months of pumping and reclamation work to restore the dredges, railway tracks and working faces to operation, during which time the power station maintained operation on coal won from the Old BCM, transported over the 90cm gauge electric railway.

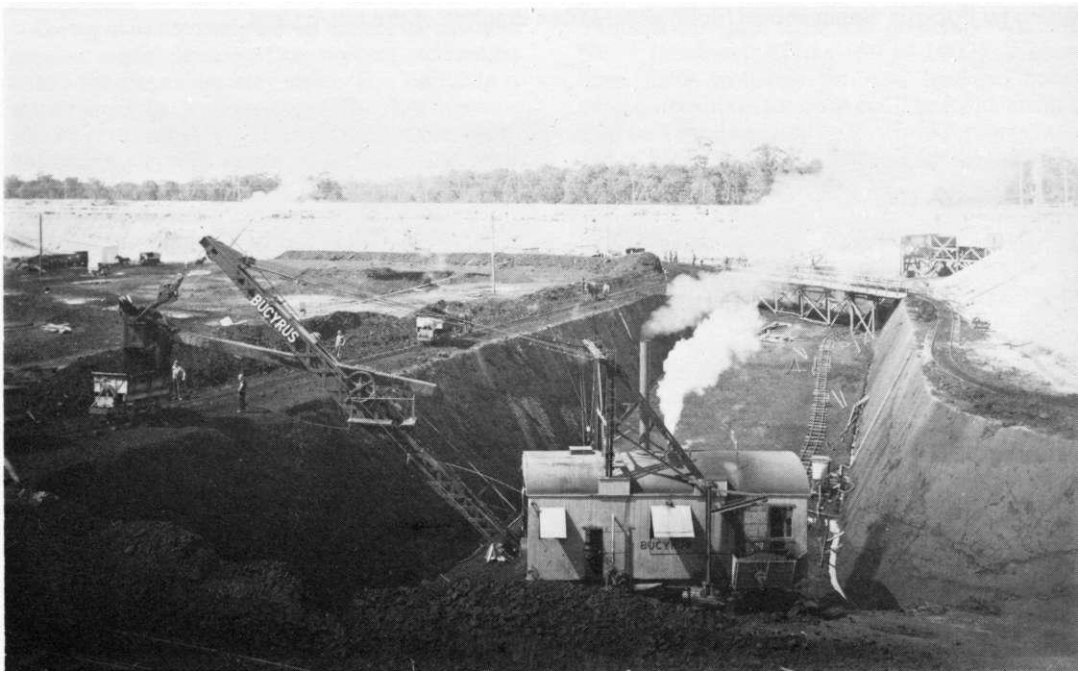
Four of the five remaining steam locomotives were transferred to the Old BCM overburden line by January 12, 1935 and the fifth shortly afterwards, for use on overburden removal until June 1935 when operations were resumed in the open cut, which is now ringed by levee banks to guard against a flood level 30 per cent higher than the 1934 record level.

Open Cut Coal-Winning Development

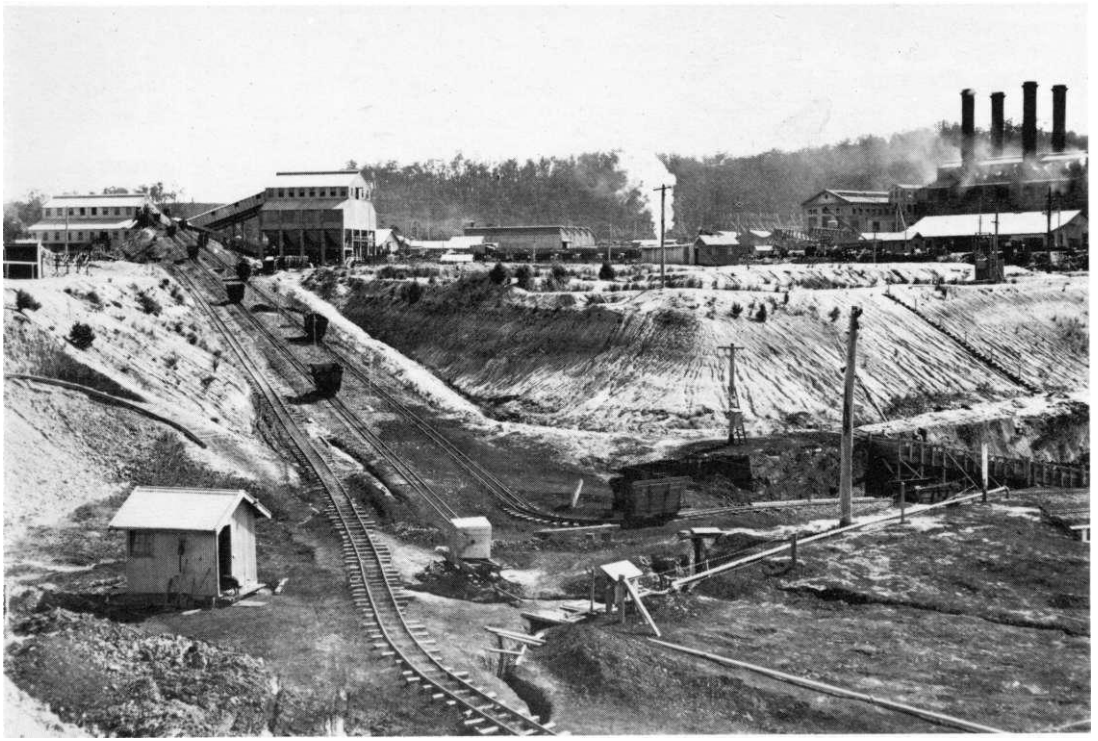
The mining operations at the Great Morwell Company's mine at the Old Brown Coal Mine (later known as North Yallourn) by the Mines Department's tenancy involved quarrying into the side of the coal seam across the river from the Commission's territory. It continued open cut mining on this site initially to provide a supply of fuel for the temporary power station established nearby to provide electricity during the construction phase of its operations.

The original Yallourn 'A' power station of 50 MW was built at the north-western edge of the field, adjacent to the river, which is prone to seasonal flooding, so to protect the site (and particularly the adjacent open cut excavation) overburden excavated from the latter was used initially to build protective levee banks along the south bank. As well a system of surface drains were dug to intercept drainage from adjacent hills to the south and west of the works area.

During this construction period the SEC employed horses and drays, horse-drawn scoops and steam shovels for stripping the overburden down to the surface level of the coal seam. In addition, there is evidence that 24in gauge side-tipping dump wagons drawn by horses were used to transport filling until in 1921 a system of conveyor belts and an overburden boom-stacker was installed. Two Bucyrus-Erie steam shovels - one ***2-1/2*** cubic yd capacity and one 175B of ***3-1/2*** cubic yd capacity were delivered from the United States in November 1921 and assembled on site. The smaller



Horse-drawn side tipping wagons ex-Bucyrus shovel loading coal, 1924.



Ropeway system on 20'/2 in gauge climbing 1 in 7-1/2 grade to transfer bunker adjacent to power station, circa 1925.

shovel commenced overburden stripping at the west end of the north side of the open cut in February 1922 and the 175B shovel joined it in September. Ten acres of coal had been exposed by the following June.

Coal-winning was carried out in the early stages with a 175B shovel bucket loading into horse-drawn rail wagons. A 250R electric shovel equipped with a 10 cubic yd bucket was installed on the coal face in June 1925 and in 1926 a ropeway system of truck haulage was installed for transport of coal out of the open cut. This system with a capacity of 1000 tons per day was supplied by the Mead-Morrison Manufacturing Co., of USA and over 100 bogie gable-bottom coal wagons each of 3 tons capacity, having a tare weight (mass) of 2-1/2 tons were employed on four separate ropeways, all of which had a track gauge of 20'/2 in. The endless haulage cables were 1in dia. and were electrically driven.

As the output from the open cut eventually outgrew the capacity of the No. 1 ropeway operating up an incline from the coal working level to the top of the screen-house and transfer bunker adjacent to the power station, it was supplemented by amalgamation with the No. 3 ropeway on the floor of the open cut. No. 2 ropeway was an elevated line which ran from the screenhouse bunker to the original 'A' and 'B' power station bunkers, and No. 4 was the mile long route from the screenhouse bunker to the Yallourn briquette factory established in 1925, which had a total rise of 122ft and a maximum grade of 1 in 14.

The operations of loading and unloading the wagons, opening and closing the doors and ungripping and regripping the rope were entirely automatic. The wagons were not detached from the rope for loading but received their charge as they passed under an automatic loader. The haulage rope travelled at a speed of 300ft per minute, driven by a 150 hp electric motor located near the briquette factory. The 43 ropeway wagons on the briquette factory line were built by Scott & Co., Footscray, Victoria.

The capacity of the No. 4 ropeway system was a maximum of 1900 tons per shift, which became quite insufficient for briquette production, so a

conveyor belt system was provided from track hoppers on two operating levels in the open cut to replace it by mid-1945, after which the ropeway was eventually dismantled.

The Ruston & Hornsby 10 cubic yd electric shovel, ordered in 1924, commenced coal-winning in the open cut working the following year, releasing the smaller Bucyrus steam shovel for overburden stripping. The Ruston shovel and the larger Bucyrus machine then dumped coal excavated to establish the No. 1 working level into rail-mounted travelling crusher-loaders astride the No. 3 ropeway track operating on the level surface of the open cut. The ropeway wagons were loaded from the hoppers of these machines, which automatically weighed each load. The ropeway wagons formed an endless procession to where they dumped their loads at a transfer hopper in the south-west corner of the open cut at the bottom of the No. 1 inclined ropeway which climbed on a grade of 7-1/2 per cent (1 in 13.4) to the screenhouse bunker, adjacent to the power station.

The screenhouse had a reinforced concrete bunker with a capacity for 3500 tons of coal and facilities for transfer of coal to (a) No. 2 ropeway to the power station boiler house; (b) No. 4 ropeway to the briquette factory; and (c) to the VR on the screenhouse siding, though this facility was seldom used. After completion of the power station terminal bunker in 1927, electric 90cm gauge trains were used to transfer coal destined for the power station from a track hopper ('ditch bunker') near the top of No. 1 ropeway, at which the 20-ton coal wagons were loaded by direct dumping from the ropeway wagons. This was immediately after the No. 2 ropeway had been discarded.

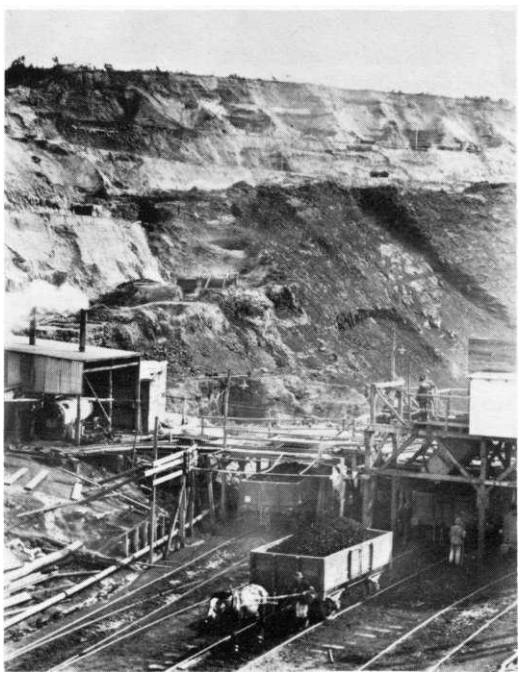
The Bucyrus 3-1/2 cubic yd steam shovel was converted to electric operation for open cut coal-winning which it performed after November 1925 until displaced by the No. 1 level deep bucket chain coal dredge. At the same time Nos. 1 and 3 ropeways were amalgamated to haul coal from the crusher-loader-weighing hoppers, adjacent to the shovels in the open cut, to the screenhouse bunker, or to the transfer track hopper for loading electric trains destined for the power station. Twenty-four more ropeway cars were installed for this purpose.

The 2-1/2 cubic yd Bucyrus steam shovel was converted to diesel operation after commissioning of the first overburden dredge and transferred to the Old BCM with two of the steam locomotives and 25 of the 5 cubic yd dump wagons formerly used on the overburden railway, as already mentioned. The open cut excavation originally commenced only 700ft distant from the centre of the power station boiler house, thus reducing the distance coal supplies needed to be transported, but as the area of the open cut workings expanded in line with increased demand to supply the boilers of the five power stations established successively on the site, the distances increased considerably.

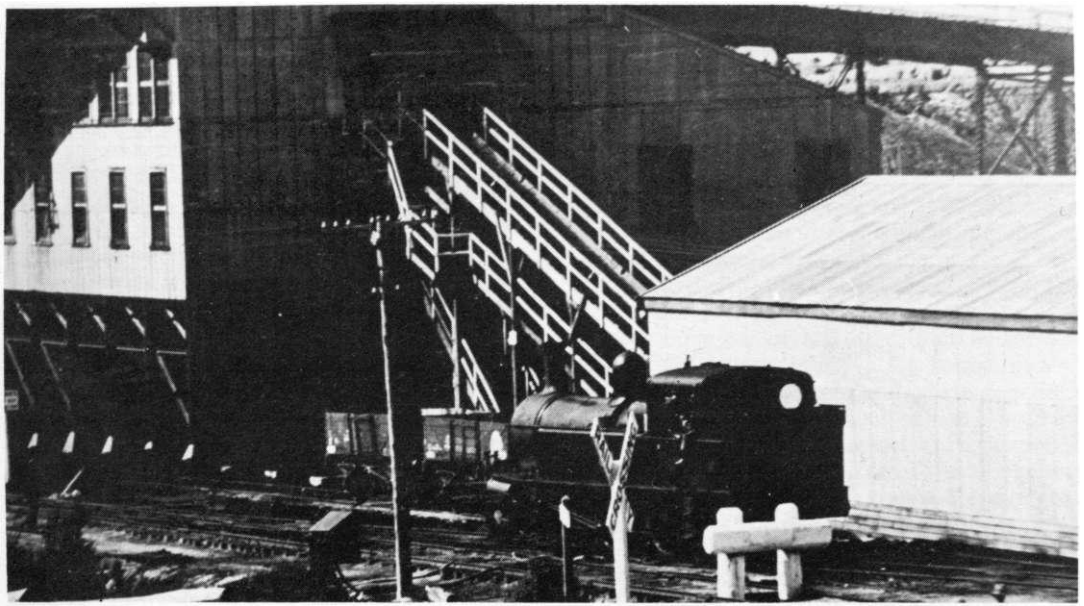
Adoption of a railway system to transport both coal and overburden made it of advantage to approach the excavation on curves. The working faces were kept tangential to those curves, so that as the excavation progressed, both they and the transport tracks swung back fanwise from the alternating pivot points, obviating having to 'break' the tracks and eliminating stoppages for this purpose.

Broad Gauge Railways at Yallourn

A branch off the main Gippsland line of the Victorian Railways was opened from Herne's Oak to the newly-established town of Yallourn on 11 January 1922, partially over the right of way of the long-abandoned Great Morwell Coal Mine siding line, which originally went straight over the area now occupied by the open cut to the mine on the north bank of the Latrobe River. A connection to serve the power station site and construction sidings



Horse power was used to shift loaded wagons from the 'Old Brown Coal Mine' for haulage by steam locomotive to the power station in 1926/27.



Ex-VR Dde-class locomotive No. 255 engaged on coal haulage between North Yallourn and main screenhouse bunker adjacent to power station, c.1927.

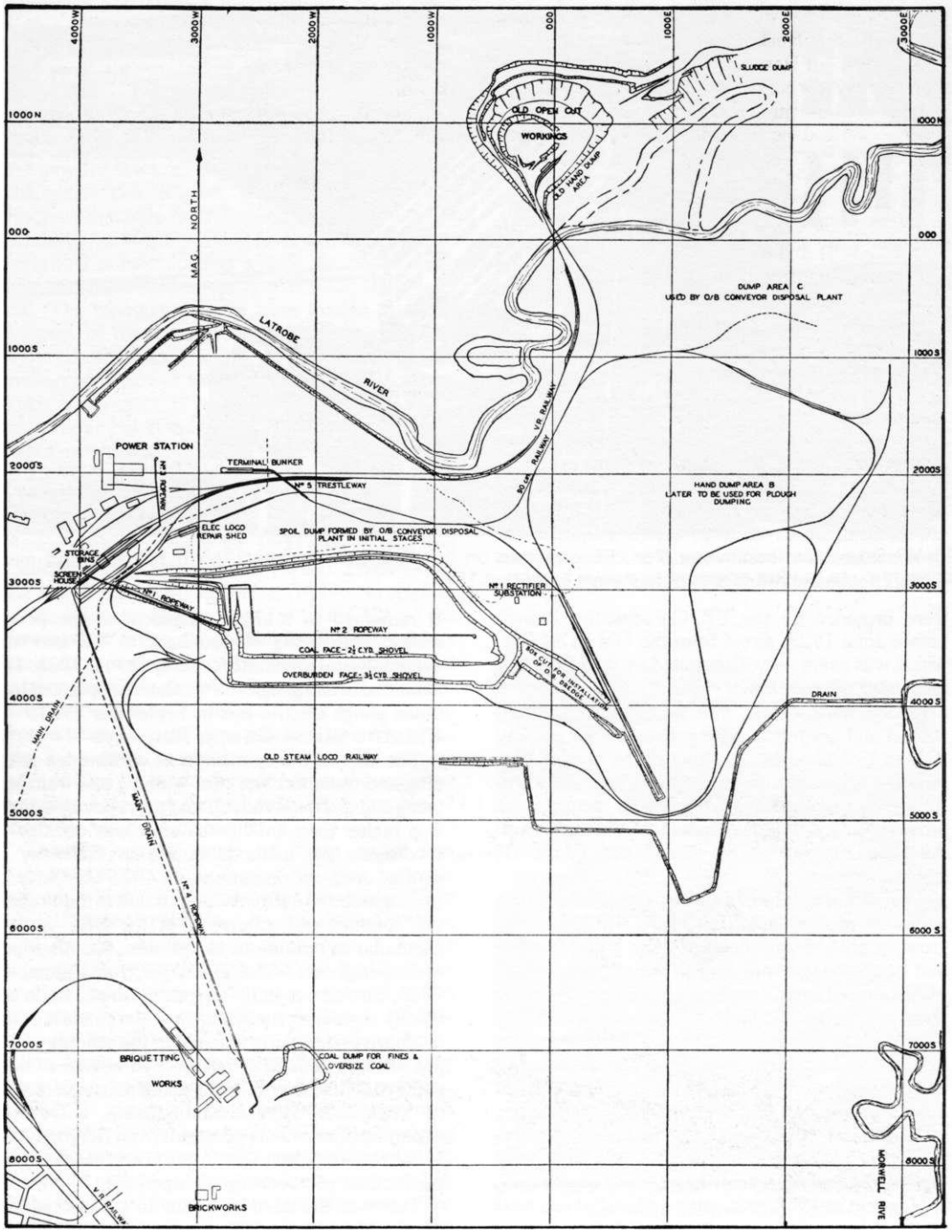
were provided by the VR Construction Branch before June 1923, direct from the Old BCM line, which was eventually dismantled by the VR a year later after the new line through Yallourn had been extended northwards. The SEC built Yallourn station and several nearby residences for railway staff in February 1923, although no regular passenger services were ever provided to the new town. Sidings to serve the nearby briquette factory were provided in 1924 from adjacent to Yallourn yard. All these lines and sidings were worked by the VR as required.

The SEC made a brief foray into broad gauge operation at Yallourn from 1926, when, to meet growing coal requirements for the power station and briquette factories and to supplement output from the open cut, a broad gauge extension from the power station to the Old BCM workings was made. This line was also used to shift an overburden dump from the vicinity of the workshop area adjacent to the power station. The SEC purchased a surplus 4-6-2T engine No. 255 from the VR in September 1926. Control of the Old BCM had been transferred from the Mines Department to the SEC on 1 April 1924 and the former DDE-class engine built at Newport in 1908, was employed on hauling coal to the power station and overburden to a new dumping area further downstream for about 18 months until it became redundant and was set aside. It remained in a shanty adjacent to the power station after being offered back to VR and was eventually cut up on site for scrap in July 1938. The extended broad gauge line was later supplanted by a 90cm gauge electric line in September 1927.

Electric 90cm Gauge Railways

The cost of the operations of overburden stripping and transport and coal-winning and transport using conventional shovels and the ropeway system was higher than anticipated so it was decided to investigate the methods in use in Germany in similar open cut operations. In 1925 the Government appointed a Royal Commission to inquire into the conduct and efficiency of the SEC and in particular its operations at Yallourn. An American mining engineer, Willits H Sawyer, from Columbus, Ohio, carried out an investigation which, while not wholly sustaining the criticism of the conduct of the Yallourn undertaking resulted in the sending of Mr JM Bridge, then SEC engineer in charge of coal supply to Germany in 1925 and a subsequent visit to Victoria of Herr Johan Klitzing, a German expert on brown coal operations from Bergbau AG, It was then decided to institute a complete change in the method of operating the open cut.

This was the decisive factor in the subsequent development of the Yallourn undertaking, for the constantly increasing demands of the power stations and the briquette factory had overtaken the capacity



Map of the Yallourn area as at December 1927 showing steam operated railway lines.

of the overburden stripping and coal-winning and transportation plant originally employed.

As a result of Herr Klitzing's report and recommendations the whole of the operations - overburden stripping, coal-winning and transportation - were mechanised and increased in capacity by adoption of specialised German-designed and made equipment similar to that used in European open cut coal-mining practice. Briefly, the Klitzing recommendations were for substitution of dredgers for power shovels and electric railway transportation for the original ropeway haulage system in the open cut.

Equipment ordered subsequently included a bucket-chain deep coal dredger capable of operating to a depth of 100ft below track level, an overburden dredger for stripping overburden and loading directly into 20 cubic yd dump wagons operating on 90cm gauge railways, 20 ton capacity hopper wagons for coal haulage and electric locomotives, besides other specialised machinery and equipment, including track-shifters for quick relocation of rail tracks on both coal faces and overburden tracks. Yet another item was a special steep haulage system to overcome the difference in levels between the deep coal dredger working level and the top of the power station terminal bunker. A second deep coal dredger was ordered subsequently to work from the level bench left by the No. 1 dredger to approximately the bottom of the coal seam.

The 90cm (35.4in) gauge electric railway was built and is operated by the SEC's Coal Supply Branch. It served the overburden and coal dredges at the various working levels and at its peak was a complex installation quite without parallel in Australia. Electrification is on the overhead contact wire system at 1000-1100 v direct current. The contact wire is staggered to ensure more even wear of locomotive pantograph pans. Rail weight was 801b/yd and latterly 941b AS flat-bottom section laid direct and spiked to hardwood sleepers 8ft x 4-1/2in x 9in wide. Crushed rock ballast is used for permanent lines, where the contact wire is suspended from outriggers from power poles. Other permanent trackage is ballasted with river gravel. Formerly the temporary track laid direct on the working benches was unballasted, as these were subject to repeated lateral shifting by track-shifters as the coal working faces advanced. Now all trackage is permanent, but on the former 'mobile' tracks the trolley wire was suspended from metal inverted L-shaped supports bolted at their bases to the sleepers.

Originally where tracks were spanned by loading

The first German-built overburden dredger at work (probably on first cut) at Yallourn open cut loading 90cm gauge train worked by locomotive No. 21 in 1928.

hoppers, or the chutes of coal dredges, the overhead was offset to one side or the other and the original locomotives were equipped with duplicate sets of central pantographs as well as miniature side pantographs which could be tilted to contact the offset trolley wire where employed. These were dispensed with after March 1956.

Overburden-Stripping and Transport

Since installation of the first overburden dredger in the Yallourn open cut in February 1928, the previous array of draglines and shovels formerly in use became redundant. This dredger, itself subsequently superseded by larger more modern bucket-wheel machines of higher capacity, was rail mounted and self-propelled. It operated on a set of rails bolted to hardwood sleepers 16ft 6in long x 7in x 10in wide, astride the transport rails, similarly bolted with sleeper plates interposed between rail foot and sleeper. This arrangement allowed sufficient flexibility to allow the tracks to be shifted laterally without delay or damage by a track shifter propelled by a locomotive.

The dredger traversed the working face of overburden laterally from end to end, excavating its future sub-surface working plane as it progressed. Operation of this dredger - a bucket chain machine - differed from a power shovel in that the spoil was delivered to the overburden trains standing below in a continuous stream from two chains of buckets, through a hopper in the body of the machine. This dredger could excavate against a face of 30ft above rail level, or by rotating the bucket chain upper portion through 180 deg. and lowering the bucket ladder, it could excavate down to 26 ft below rail level. It had a guaranteed minimum output of 6500 cubic yd of overburden in two eight hour shifts. Its actual output was in fact very much larger unless stones, or unusually sticky clay was encountered. Over two million cubic yd of overburden per annum was excavated for transport to the dump area by this one machine.

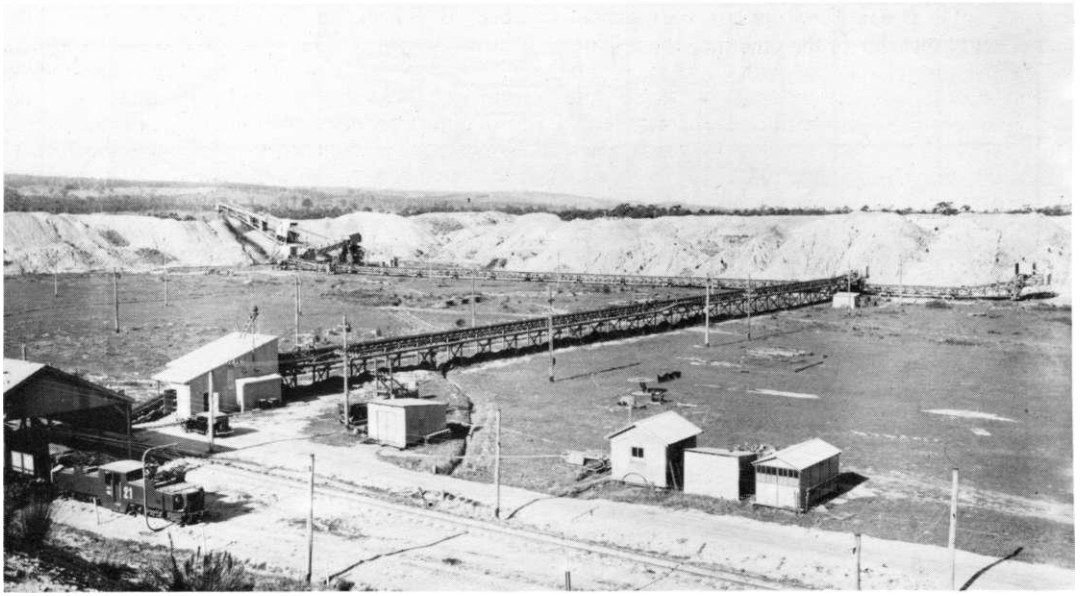
A similar, but larger dredger of the same type was delivered from Germany for the Yallourn open cut early in 1950 and subsequently still larger bucket wheel models have been installed, all of German design and partly manufactured in Australia.

The original 36 overburden wagons supplied for Yallourn were of the side-dumping bogie type, built by Glaser & Pflaum, Kassel, Germany, in 1927. They were of 20 cubic yd capacity with a tare of 16-1/2 tons. As loading by the dredger does not damage the superstructure by heavy impacts, lighter construction can be employed. The archbar type bogies had a double row of SKF self-aligning roller bearing axleboxes, which were greased and inspected every 20,000 miles and sealed against dust and sand. The tipping body of steel construction had one fixed side and both ends attached to the floor; the door of the wagon forming the other side. When tipping, the body tilted about a longitudinal central axis, with the door raised by links attached to the underframe. They were fitted for air dumping, either individually from the ground, or from the locomotive and air-braking. Overhanging cowls at the ends protected the twin train pipe couplings and drawgear/buffer from the dredger loading chute. In the event of failure of the air dumping, hand dumping and righting levers were fitted. In the running position the body was held upright relative to the underframe by steel hooks. When tipping these hooks were first released by a cam operated by the piston of the tipping cylinder.

Dimensions of the original 20 cubic yd overburden wagons were 7ft 10 3/4in wide, 7ft 11 1/4in high and 26ft 0 3/4in long over buffers. Several additional orders for identical wagons were fulfilled by Thompson's Engineering Co., Castlemaine, Victoria between 1941 and 1945 making 90 wagons of this type. Before commencement of dumping overburden back into the worked out sections of the open cut from the northern end, the round trip to the dumping area was 4 1/2 miles, with one train loading, one travelling and the third unloading. Additional overburden trains were later brought into operation to keep stripping in advance of three coal dredgers working continuously.

Originally unloading of overburden at the dumping area was into a trackside hopper from which a series of conveyor belts carried the spoil to an elevated pivoting gantry known as a boom-stacker - a large rail-mounted cantilevered steel structure with a conveyor belt which dumped radially about its pivot. After this system was discarded, dump tracks were laid on and parallel with the edges of the dumps and after trains had been discharged, the heaped material was levelled and spread by an electrically-driven, self-propelled dump plough, fitted with grader blades and mould-boards on either side, which operated on the transport tracks. Since 1940, however, overburden has been dumped back into the open cut by means of a more sophisticated overburden spreader - a rail-mounted machine which scooped up the dumped material from a track-side pit and a pivoted cantilvered arm with a series of conveyor belts which elevated the spoil and distributed it in any desired direction, whilst traversing the length of the dumping face.

Eventually a sufficient area of filling in the



Main overburden dump showing bunker, conveyor belts and boom stacker, 1929.

worked out northern end of the open cut was levelled and compacted to permit erection thereon of locomotive servicing and maintenance facilities for rolling stock repair and sidings for marshalling and storage of trains. Some of these are not wired and therefore movements require the services of one of three diesel-mechanical locomotives built by John Fowler (Leeds) Ltd., England in 1950 (for details see locomotive list). Back-filling the open cut continues with the substitution of a conveyor system in place of railway haulage, which was phased out from 1955 and dispensed with entirely after April 1963.

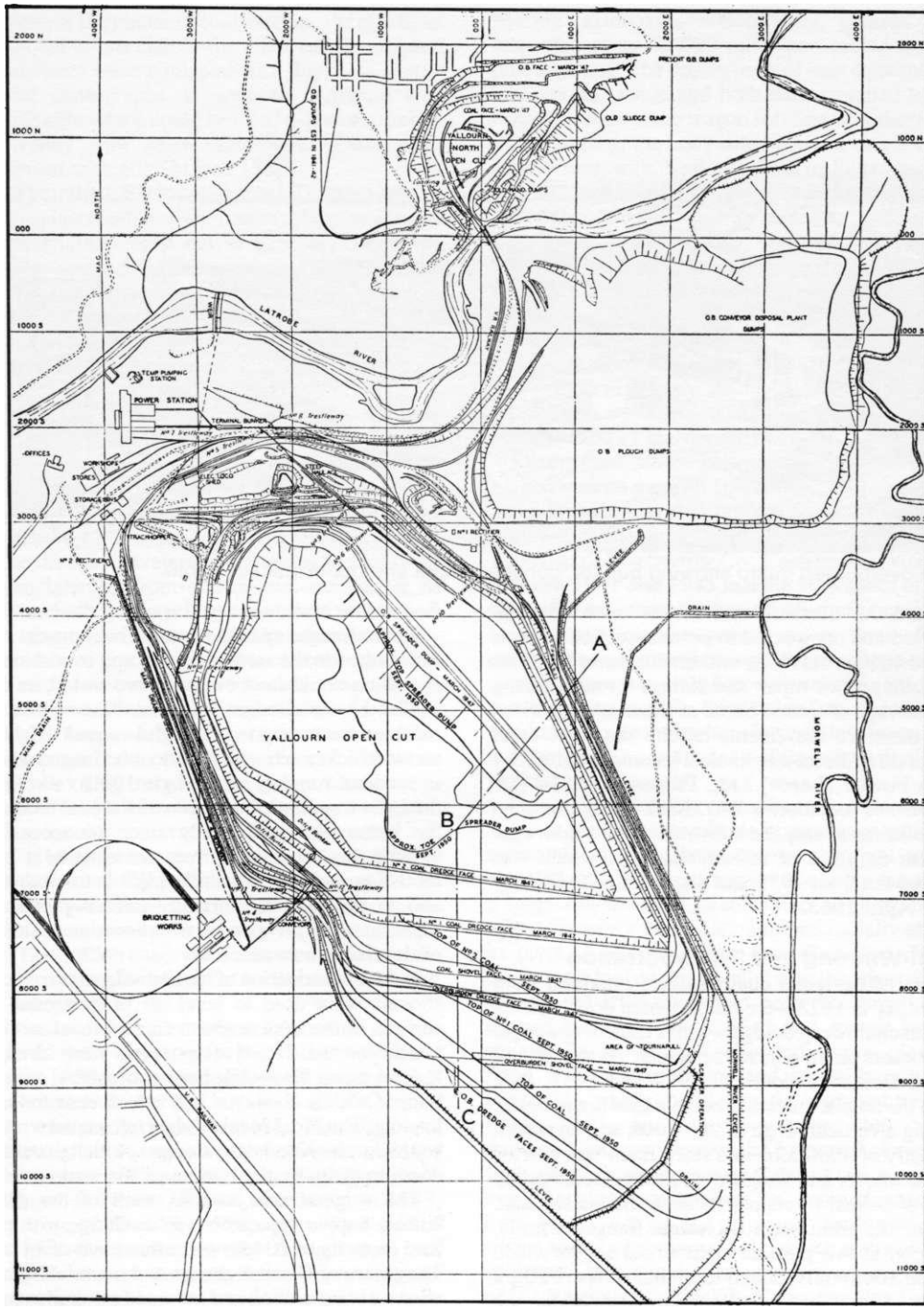
Coal-Winning and Transportation

The two original coal dredgers imported from Germany in 1928 were rail-mounted double portal bucket chain deep dredgers with a train of one cubic yd buckets on an adjustable ladder. At the time of installation at Yallourn in 1929 and 1931, they were the largest machines of their kind in the world, having a vertical range of 90 - 100ft and an output capacity of 4000 tons in a shift. Each was carried on 40 wheels and weighed 411 tons, including 60 tons of ballast to counterbalance the bucket arm. Under the front were 32 single flanged wheels, grouped in two pairs of eight-wheel bogies which ran on 100lb rails, bolted to timber sleepers 20ft x 7in x l0in wide in a similar manner to the overburden dredge tracks. Two bogies were motorised so the machines could traverse the coal face.

Each dredger spanned two railway tracks with rails bolted to the same sleepers, and in continuous operation could load either of two trains, as controlled by the dredger operator. The rear of the machine was supported through an equalising beam on two trucks each with four double flanged wheels in tandem, running on a single 1001b rail. These dredgers traversed slowly across the coal face until the batter was sufficiently steep to necessitate shifting the tracks back from the edge by a locomotive propelled track-shifter. While track shifting was in progress, the dredger normally operated adjacent to the pivot point, where minimum shifting of the tracks was necessary.

Before introduction of No. 3 dredger, two electric shovels were used to level off the irregular top surface of the coal seam to form a level working bench for the No. 1 (top level) deep dredger, loading trains via mobile hopper-crushers, or into a hopper with a conveyor belt attachment for train loading. The No. 1 level dredger left a level working bench for the No. 2 deep dredger, which excavated down to virtually the bottom of the coal seam.

The original coal wagons were of the gable-bottom hopper type with side discharge with payload capacity of 20 tons and a tare mass of 14 tons. They were of German design and manufacture. Of all-steel construction and mounted on similar roller bearing bogies to the overburden wagons, the



Map of Yallourn open cut showing stages of operation between 1947 and 1950.

With both pantographs up locomotive No. 32 lifts a loaded rake of 20-ton hopper wagons up a 1 in 60 grade from the coal face in March, 1946.

JL Buckland photo

original 26 wagons supplied to Yallourn were made by Freid Krupp AG Essen, Germany (Nos. 301 - 316) and Glaser & Pflaum (Nos. 317 - 326) in 1927-28. An additional six identical wagons were made by Foreman & Co. in 1930. Subsequently additional orders for coal wagons were fulfilled by Thompson's Pty. Ltd. - six each in 1933 and 1934; 12 in each year 1939, 1944/45 and again in 1950/51, making a total of 80.

Unlike the overburden wagons, the coal hoppers were not fitted with continuous brakes. Each side, hinged at the top formed a discharge door, activated by individual operation of a dumping lever at one end. Dimensions of these wagons were 25ft 3in over buffers; 8ft 5in maximum width (11ft 6in with doors open) and 8ft 8in high. Like the overburden wagons they had a central buffer through which a forged steel drawbar protruded, secured by a large pin. There were hooks for safety chains above the buffer. A 2ft 8in cowl extension at one end covered the gap between each wagon to prevent spillage of coal during loading under dredges or hoppers.

During, or shortly after the 1939-45 war period, 15 wagons were fitted with top extensions to increase their capacity to 26 tons, reducing the total of 20-ton coal wagons to 65. The altered wagons were identified with a red stripe along each side. Subsequently all of the 33 cubic yd overburden wagons, which had been phased out after disposal of overburden by railway transport ceased at Yallourn open cut from 19 April 1963, were rebuilt at Yallourn Central Workshops as 26-ton coal wagons to augment the capacity of coal transport. Only four wagons were retained for use as maintenance vehicles under dredges; the rest were scrapped.

90cm Electric Railway Operation

The SEC railway system is completely independent and operated by the Coal Production Branch, which has its headquarters at Yallourn. Trains operate seven days a week on three eight-hour shifts per day over the 90cm gauge system which at its maximum extent totalled 67 track miles, of which 46 miles was in and surrounding the Yallourn open cut, 13 in the Morwell open cut area for overburden disposal and four miles constituted the interconnecting railway linking Yallourn with Morwell. As at the end of April 1979 there were 30.3km of track still in operation at Yallourn and 20.1km on the interconnecting railway, but the former total has been reduced progressively as the

Manual operation of hopper wagon doors on a series 300 wagon at one of the ditch bunkers in Yallourn open cut, 1957.

conveyor system at Yallourn was extended.

The intensity of traffic on the SEC system was influenced by the fluctuations in demand for brown coal at the power stations, which remained the principal destination following the cessation of briquette manufacture at Yallourn in 1971. The briquette factories, with their landmark smokestack, were demolished during 1974/75 to make way for extension of the open cut for coal-winning under the former model town of Yallourn, whose residents have been relocated to new urban developments in the area. Traffic statistics were expressed in loaded train-kilometres, which when the system was operating at its peak in 1964/65 amounted to 277,081 train-kilometres per year.

The railway was operated by 42 electric Bo-Bo locomotives and three diesel-mechanical shunters at its peak, each manned by one man and operating on a push-pull basis from:

(a) overburden dredgers to dump areas at Yallourn and Morwell (suspended after April 1963 and February 1968, respectively);
(b) coal dredgers to power station ditch bunkers and until 1971 briquette factory ditch bunkers at Yallourn; and
(c) between Yallourn and Morwell over the interconnecting railway.

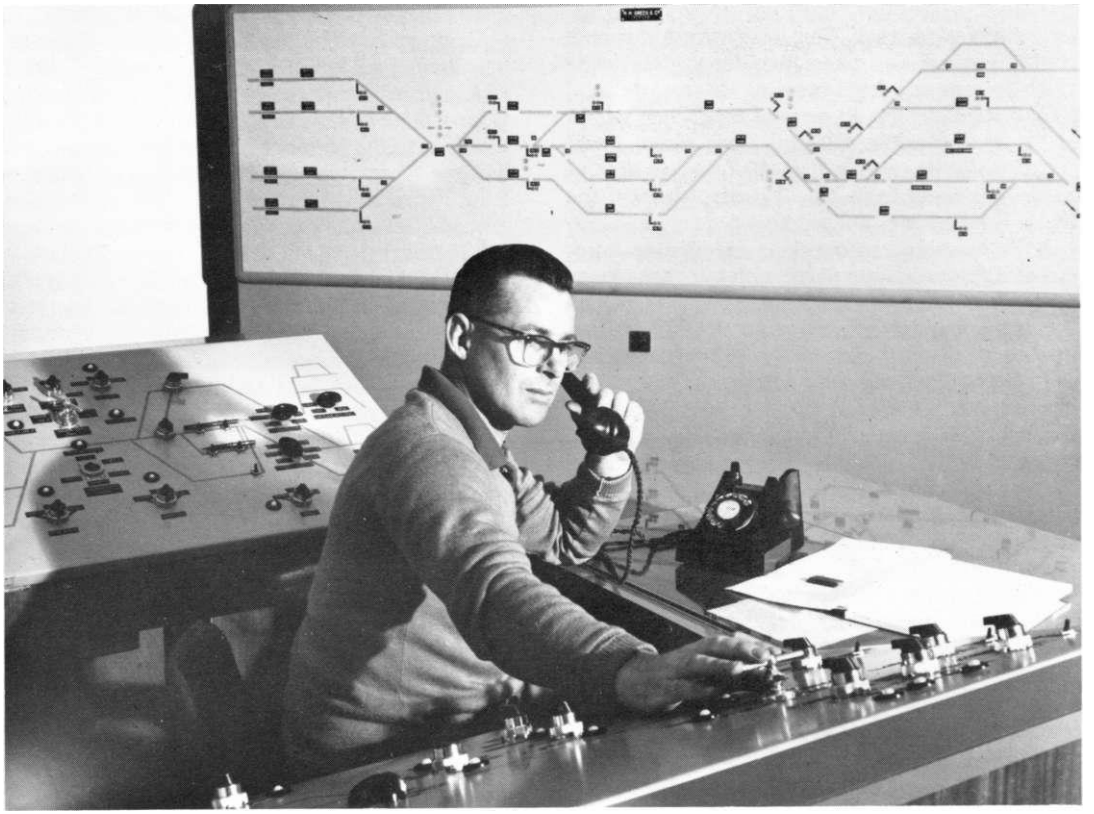
The 24 original 46-ton locomotives were withdrawn progressively after 1964/65 as the transport task was taken up by extension of the conveyor belt system. Initially they were stored in sidings adjacent to No. 1 ditch bunker on the top level, where there was a small loco repair shed. They were sold as scrap to Warragul Metals in or about 1970 and finally cut up on site.

Signalling and Safeworking

On a railway as complex and heavily trafficked as that at Yallourn, in order to prevent conflicting movements and minimise possible accidents, the SEC system early instituted token working for its mostly single line sections between crossing loops.

Prior to discontinuance of rail haulage of overburden at Yallourn, some sections of track were common to both overburden and coal systems, which otherwise were separately operated. At these locations and some other junction points, 'pointsmen' and small electric signal installations were provided for safe operation of trains. Electric switch operation was provided for distant points from the controlling signal cabin. In some instances these were operated by switch interlockings in, or adjacent to the signal cabins, whereas others were actuated by track circuit, or lineside trips operated by trains. For locations were electrical switching

Loco drivers exchanging single line staff tokens at a crossing loop, Yallourn open cut, July 1 962.



South pivot control centre at Yallourn, July 1962. This has now been superseded by a miniaturised and computerised CTC system.

was unsuitable, such as on temporary tracks on the coal surfaces, weighted points levers were arranged to lie for whatever direction required.

All mainline turnouts on permanent lines have colour light indicators, usually mounted on the nearest overhead support pole, consisting of three horizontal lights - a green light on either side of a central amber, which was illuminated continuously. Depending on the switch position, normal or reversed, the appropriate green light was exhibited. At other locations red (stop) light signals are connected with turnouts off the main line, such as at crossing loops, on the interconnecting railway to Morwell, which are invariably arranged for uni-directional working, to prevent conflicting movements. Crossing loops are either named, or numbered for identification.

Single line sections between crossing loops had a distinguishing metal token identified with the particular colour designation, viz. 'Yellow-Black Section'. The working method provided tramway-type permissive block for undirectional running with token working where traffic was bi-directional. A typical junction interlocking formerly existed on the overburden system appropriately identified as '1 in 40 Loop', referring to the maximum gradient for trains descending from the overburden working level to the overburden dumping area in the worked out part of the open cut. The working procedure was for the descending loaded overburden train to be stopped at a signal at the top of the grade controlled by the signalman, who when in possession of the appropriate token, inserted a key attached in the relevant switch in the control box. This action aligned the route and cleared the signal for the descending train, the driver of which was alerted by a nearby hooter.

On arrival at the '1 in 40 Loop' the train driver was handed the token for Yellow Section to the 'Overburden Back-Shunt' and thence to the over-

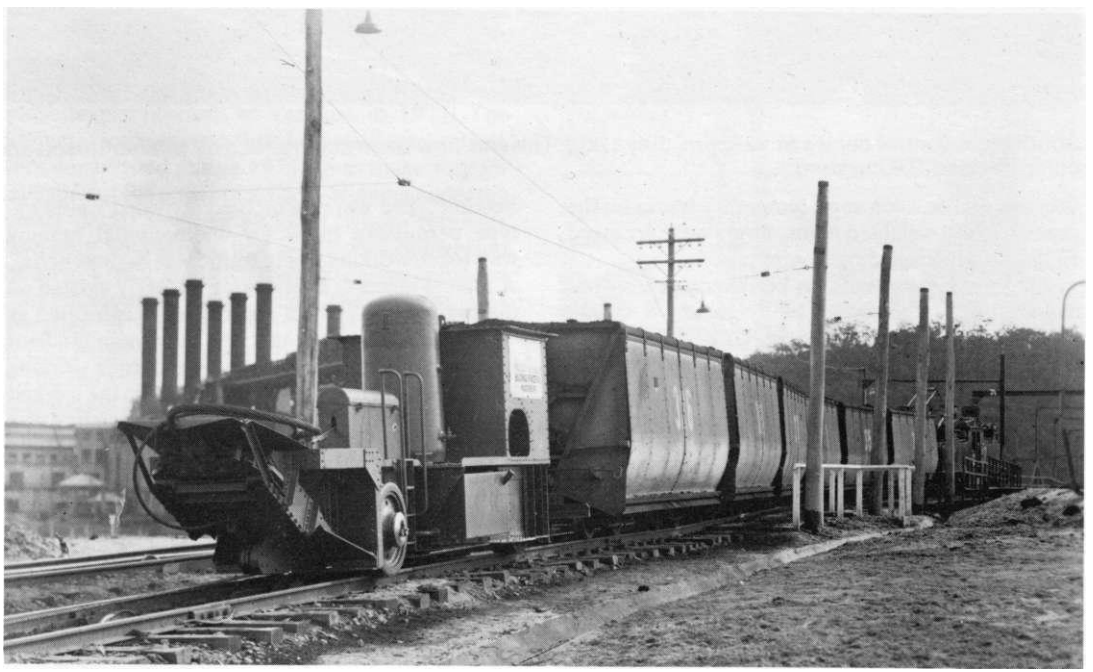
burden dumping track. This interlocking, if such it could be called, also controlled Stop signals on the Coal System at a level crossing on the low level (No. 2 dredger) line to prevent conflicting movements and possible mishap. Coal trains could occasionally be run via '1 in 40 Loop' in case of need to re-route from No. 2 dredger level if the Steep Haulage was not working.

A more recent safe working installation comprised a diagrammatic panel with telephone keys, point indicator and signal light repeaters, which eventually was evolved into a form of CTC working for the entire remaining coal system track, designed and built by SEC engineers and housed in an office located on No. 1 level. As already described single line safe working for one direction required the loco driver to sight the token for the section in advance hanging on a sling hook on a white post adjacent to the track and lettered for the particular section to which it applied. Similarly at the end of each section a post marked 'End of.... Section' was located. Inevitably, despite the safeworking arrangements, mishaps did occur, including some spectacular runaways when unbraked trains got away on the 1 in 40 or 1 in 60 maximum grades.

The Electric Steep Haulage System

Coal produced by the No. 2 (low level) dredger was hauled by locomotive either to No. 7 Ditch Bunker Loop for transfer to the briquette factory conveyor system which replaced No. 4 ropeway in 1945, or to the bottom of a double-acting inclined haulage approximately 1300ft long on a gradient of 1 in 7, designed to raise coal from 130ft below ground level to the top of the power station bunker - a difference in level of 160ft. It operated similarly to a train of skips in an inclined shaft. Going upgrade, a special dummy truck, attached to the steel haulage cable and fitted with a powerful hydraulic buffer, pushed the loaded train up the incline, while concurrently an empty train descended behind a similar dummy on an adjoining set of rails, so that the weight of the ascending train, excluding the coal, was balanced by that of the descending train, ensuring that power was only expended on raising the useful load.

The steep haulage was capable of handling trains of six wagons with an aggregate capacity of 120 tons (less locomotive) in 3½ minutes from bottom to top. The initial capacity of the steep haulage was 11,000 tons in 15 hours, or after re-arrangement of the track layout, about 20,000 tons per day. The



Hydraulic ram at summit on steep haulage transferring a rake of empties from electric loco ex-power station bunker, c.1929.

haulage engine, of the double drum type consisted of two rope drums each 20ft dia. normally operated by one 640kw motor at 6,600 volts with a second standby motor, either or both of which could be operated independently and thus capable of raising or lowering a train unbalanced.

The haulage cables were over 2in dia. with an ultimate breaking strength of 225 tons and a normal working load of 30 tons. Each was 1940ft long and supported in the 'three foot' by greased cable sheaves. A smaller tail rope linked the rear of one dummy through a weighted tension device to the other. The two dummy trucks, of patented construction, consisted of a two-axle carriage running on rails outside the 90cm gauge track on double-width tread, double-flanged wheels, as well as flangeless wheels on the 90cm track. To negotiate points at the bottom of the haulage, raised sections of rail outside the outer dummy rails engaged with the outer tread of the double-flanged wheels, lifting the dummy so that the flanges cleared the rail surfaces of the points.

This was designed to ensure rapid operation to eliminate shunting. The steep haulage was operated by three men: the winding engine driver who had an elaborate light and bell signal system and a shunter at top and bottom to uncouple and couple wagon rakes from locomotives and give signals to the haulage operator, in a station at the summit. The operating procedure was that on arrival at the bottom a loaded train was uncoupled from its locomotive and after placement of the dummy and exchange of signals with the haulage driver, simultaneously the loaded train was raised as the empty was lowered. On completion of the movement the loaded train was propelled to the power station bunker by locomotive and the empty train hauled back to the dredge for loading. Movement up and down the haulage trestle way was made at 50ft per minute, so in every respect it was quick-acting.

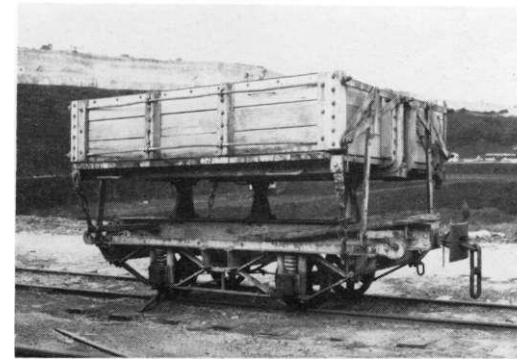
Use of the steep haulage incline eliminated a longer direct locomotive haul, involving reversals of direction, although such an alternative route was available if and when needed. Locomotives were also handled by the steep haulage to effect change-over for servicing. However, after 1956 use of the steep haulage was reduced and finally eliminated by provision of ditch bunkers on both coal working levels to serve a conveyor system to the power station bunkers in 1973.

North Yallourn Overburden Railway

As already mentioned ***Wallaroo*** type 0-4-2ST steam locomotives Nos. 5 and 12 were transferred from the open cut overburden line for temporary use at the Old Brown Coal Mine (North Yallourn) for overburden removal for a year in November 1926, following the Klitzing report recommendation that this operation be resumed pending mechanisation of the open cut mining. Any records of this line have been destroyed, but inspections on site revealed traces of a double track following the contours of the hillside upstream above the Latrobe River about 130ft above the river from opposite the power station, through the old open cut workings and downstream for about one mile to new dump areas. The engine shed was located at this end of the line. The 5 cubic yd side-tipping wagons used were made by Malcolm Moore Pty. Ltd. and numbered from 200 upwards. Some were subsequently altered to operate on 90cm gauge for ballasting until ballast hopper wagons were built for the purpose.

Operation of this line was resumed for five months from January 1935 following re-commissioning of coal-winning at the Old BCM because of flooding of the Yallourn open cut, and as already described, all five steam locomotives were employed there until June 1935, when operations again ceased and the locos stored in the engine shed. With arrival of the Robert Hudson engines in 1926, the SEC adopted what was probably a unique system of numbering these engines by allocation of the last two digits of the builder's serial number as its road number, which was painted on the cab sides in large white numerals. This practice was continued when six more steam locomotives were acquired in 1941-42 for possible emergency use during World War II. Fortunately none of these had similar builder's numbers, or the system might have become confused!

In January 1941, engines No. 3, 69, 70 and 71



200 series 5 cu yd dump wagon used on the 3ft 6in gauge system.

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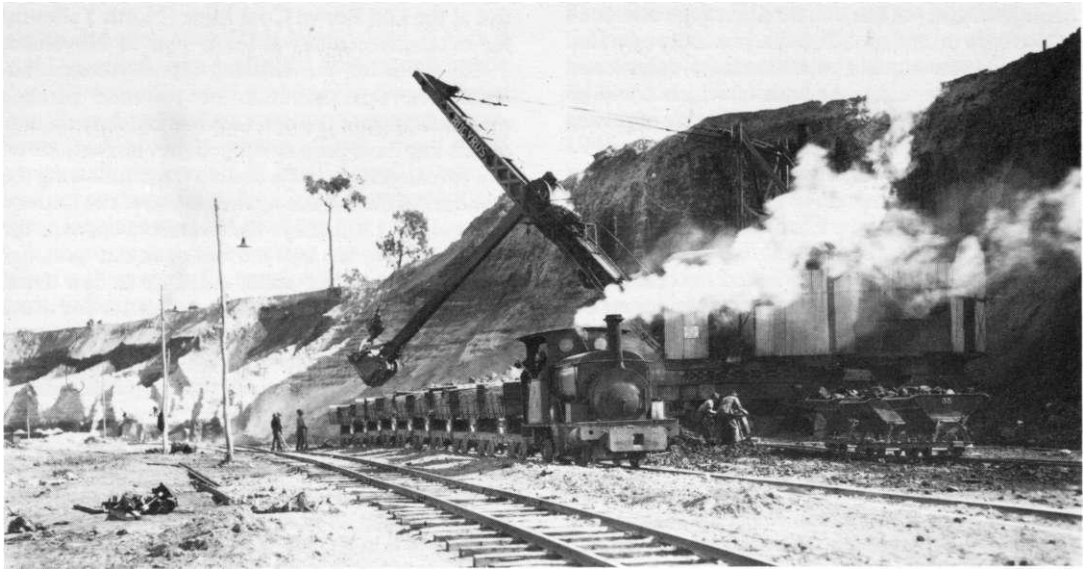


Above: Bucyrus steam shovel loading overburden into contractors dump wagons on 3ft 6in gauge line at Yallourn North open cut after September 1926. The locomotive is *Wallaroo* type No. 5.
Below: Representatives of three types of 3ft 6in gauge steam locomotives used by the SEC lined up outside the former loco shed awaiting a buyer in April 1946. Left to right, they are No. 78 (Perry 0-4-0T), No. 3 (Hudswell Clarke 0-4-2ST) and No. 69 (0-4-0ST supplied by Robert Hudson, but built by Hudswell Clarke & Co.).

JL Buckland photo

were overhauled and made serviceable. No. 12, which needed a new boiler, was condemned and subsequently written off and scrapped. The SEC, at the State Government's urgent request, resumed coal-winning at the Old BCM early in 1941 for industrial use and emergency supplies with coal being hauled out over a reconstructed VR 5ft 3 in gauge line extended from the power station siding, via new sidings on the south bank of the river and extending to a crushing and screening plant located in the old mine workings, by then named North Yallourn open cut. There crushed coal was loaded direct into VR wagons, weighed on a weigh-bridge and hauled by VR locomotives which ran shunting trips to deliver empties and collect loaded wagons. Initial production was 2000 tons per week, rising to some 6000 tons a week at the peak.

To step up the rate of overburden stripping and transport at North Yallourn, the SEC purchased six small Perry 0-4-0T locomotives - two secondhand from Bingle-McDavitt Machinery Co., West Melbourne, which had come originally from use at Ebden, Victoria, on construction of the Hume Reservoir dam walls, and four of identical design from the Melbourne and Metropolitan Board of Works Silvan Dam project, where they had been in storage. Details of these additions to the roster were:

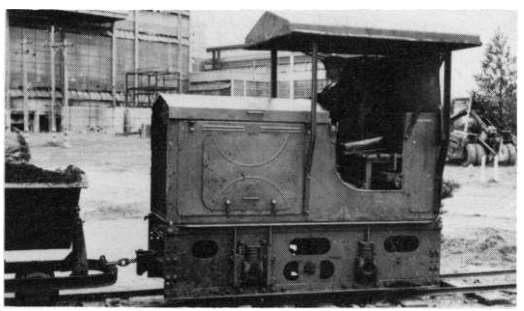
SEC No.	B/No.	Date Built	In Service Date at N. Yallourn			
66	266	7/1926	9/1941	Originally	SR&WSC	No. 7 Hume Dam
67	267	"	10/1941	"	"	No. 8
75	275	1928	3/1942	"	MM BW	No. 4 Silvan Dam
76	276	"	4/1942	"	"	No. 5
77	277	"	4/1942	"	"	No. 6
78	278	"	4/1942	"	"	No. 7

These additional engines were from two batches built by Perry Engineering Co. Ltd., Adelaide, for Victorian public works projects. At North Yallourn the six Perrys, three Hudsons and the remaining Wallaroo No. 3 were equipped with large hopper-type spark arrestors because of the fire danger. They all ceased operations from 11 May 1942, when supplanted by diesel earthmoving machines obtained from the United States under lend-lease. By December 1946, only eight engines remained at North Yallourn, standing forlornly on an isolated section of track near the former engine shed, which had been converted to a maintenance shop for the diesel equipment. Nos. 66 and 67 were sold to Australian Portland Cement Ltd., Fyansford, near Geelong, where they ran on that company's private railway as Nos. 10 and 11, respectively. The others were sold for scrap in October 1951.

Fly Ash Disposal

Before concluding this homily, there remains one small isolated section of line at Yallourn which deserves mention. As can be readily appreciated, the operation of any large power station produces a large amount of ash residue from the boiler furnaces - relatively little in the case of Victorian brown coal - much of which is carried over into the exhaust smokestacks and deposited on the boiler drums which have to be periodically cleaned. The flue gases are now required to be fitted with some form of interception of fly ash to minimise air pollution. Until the early 1950's fly ash from Yallourn was loaded into 2ft gauge side tipping steel contractors' wagons and hauled to a dump site for burial by a small four-wheeled Malcolm Moore petrol locomotive, of the type built by the company for wartime industrial use. No record exists of the identification of the unit at Yallourn, which was soon displaced by other means and dumping of fly ash into the overburden disposal area in the open cut.

Part 2 of this series will appear early in 1984 (Ed.).



SECV 2ft gauge Malcolm Moore petrol locomotive on the fly ash disposal line, February 1949.

JL Buckland