LIGHT RAILWAYS

Number 120 April 1993

Neulyne Mill, Tanjil Bren
Fyansford Cement Railway
Cheetham Chronicles Part V
Sydney City Water Tunnel

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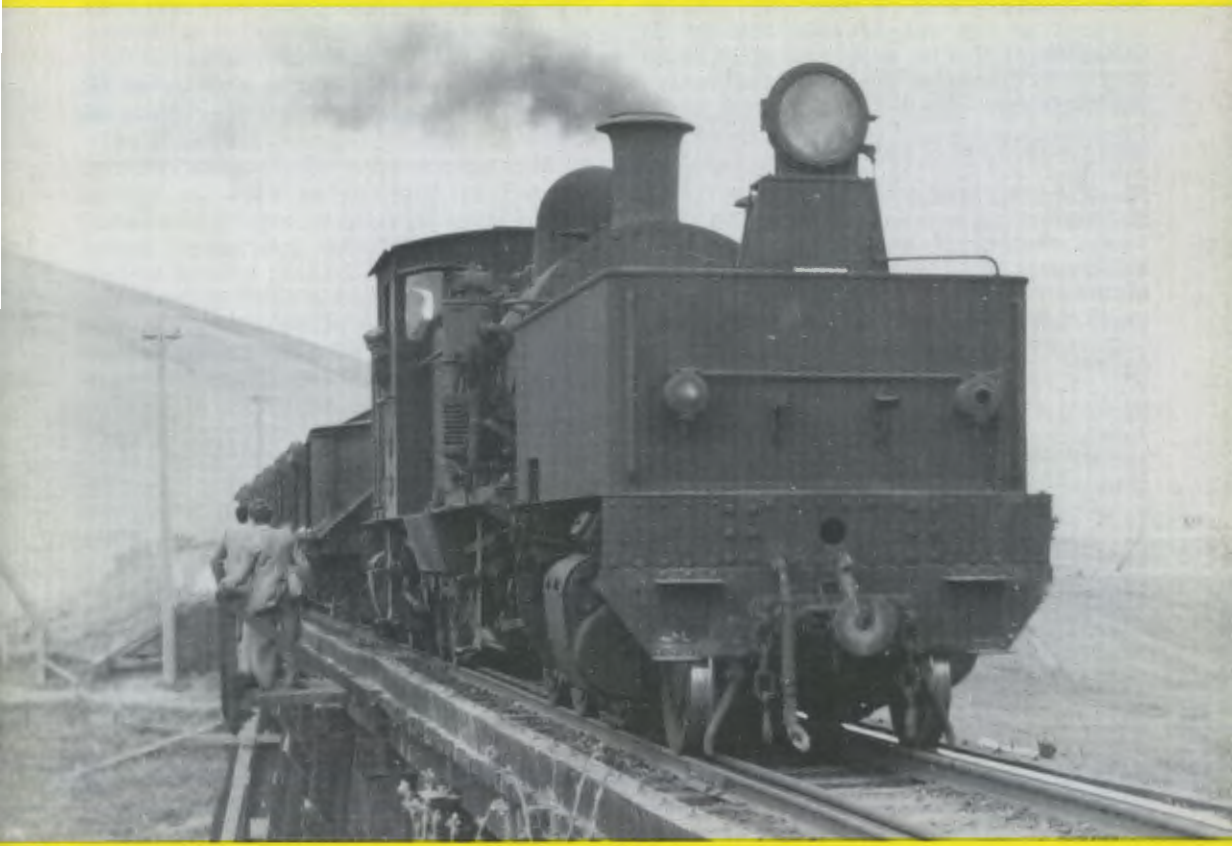

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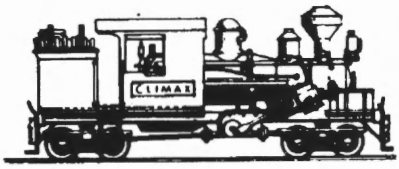

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Cover Photo: Australian Cement Ltd. No 1 Garratt hauling a load of empty hoppers over the Moorabool River at Fyansford. 1951.
Photo: R. Reilly ex Ellis Collection

CONTENTS

EDITORIAL

This issue has, amongst its offerings, two articles written by persons with first hand experience in their trades and represents a change from the usual third person accounts and a different perspective from the usual tramway approach. Horrie Mackie tells us what it was like to build and run the Neulyne mill at Tanjil Bren in the aftermath of the 1939 bushfires. John McNeill recounts his impressions and knowledge of the Fyansford Cement Works railway from the viewpoint of the works manager.

Another instalment of the Cheetham Chronicles appears, this time on the saltworks at Price in South Australia. Not so long ago, Cheetham's works at Moolap and Laverton in Victoria were permanently closed due to their size and cost structures, with Price and Sea Lake being called on to fill the production gap. The article on Price will readily show why this is one of the jewels in the Cheetham crown.

A piece on the water tunnel running from Potts Hill to the Sydney city area looks at the tramway used in its construction.

A lively batch of letters completes the issue.

Norm Houghton

THE NEULYNE MILL AT TANJIL BREN

by Horrie Mackie

My family had been involved in sawmilling since 1899 and we had run mills in the East Otways for many years until after the 1939 bushfires when we received an offer to build and manage a mill at Tanjil Bren. The offer came from P.J. Adams of Melbourne and after my brother Arthur and I had considered it we decided to lease our Otway mill and move to Tanjil Bren to work. Dad chose this opportunity to retire from sawmilling and so ended his forty year career in timber.

My father and Arthur moved to Dandenong where they bought a house. Arthur then camped at Tanjil Bren while putting up the mill. Meanwhile I remained at Barwon Downs until I was able to move into a house I had arranged to be built next to dad and Arthur's. After this I went to Tanjil Bren and was only able to return home once a fortnight.

The 1939 bush fires had killed an enormous amount of standing timber in the area so in order to salvage as much as possible the Forests Commission arranged for additional sawmills to be opened. The mill financed by Adams was known as Neulyne Building Products. The site was the furthest east from Tanjil Bren of all the salvage mills and was eight km out at an elevation of 900 metres on the south west side of mount Baw Baw. The terrain is very steep and the winter climate is harsh.

It was hard work building the mill and in the early stages we only had tents to live in but once we began operating things improved no end. We then had houses and huts, a good canteen for meals (the best in Victoria according to the Forest Officers), a first class mill crew and plenty of snow in the winter for skiing. The school teacher from Tanjil Bren who initiated the ski run used to camp with Arthur at weekends.

Once Arthur had picked the mill site, way above the road, we laid a tramway incline of 3 ft 6 in gauge (1066 mm) 400 metres in length straight up the slope and winched in all the equipment. The incline was powered by a steam winch at the mill and communication between the top and bottom by means of a telephone. We installed a gantry and crab winch on the roadside for hoisting purposes and afterwards used this to transfer the sawn timber from the tram trucks to the road trucks. An 18 kw engine drove the mill and the average tally was around 16 cubic metres a day. The sawdust was taken away by water as we had arranged a flume to run under the saws to collect the dust and deposit it down the slope. The mill crew numbered 25 men.

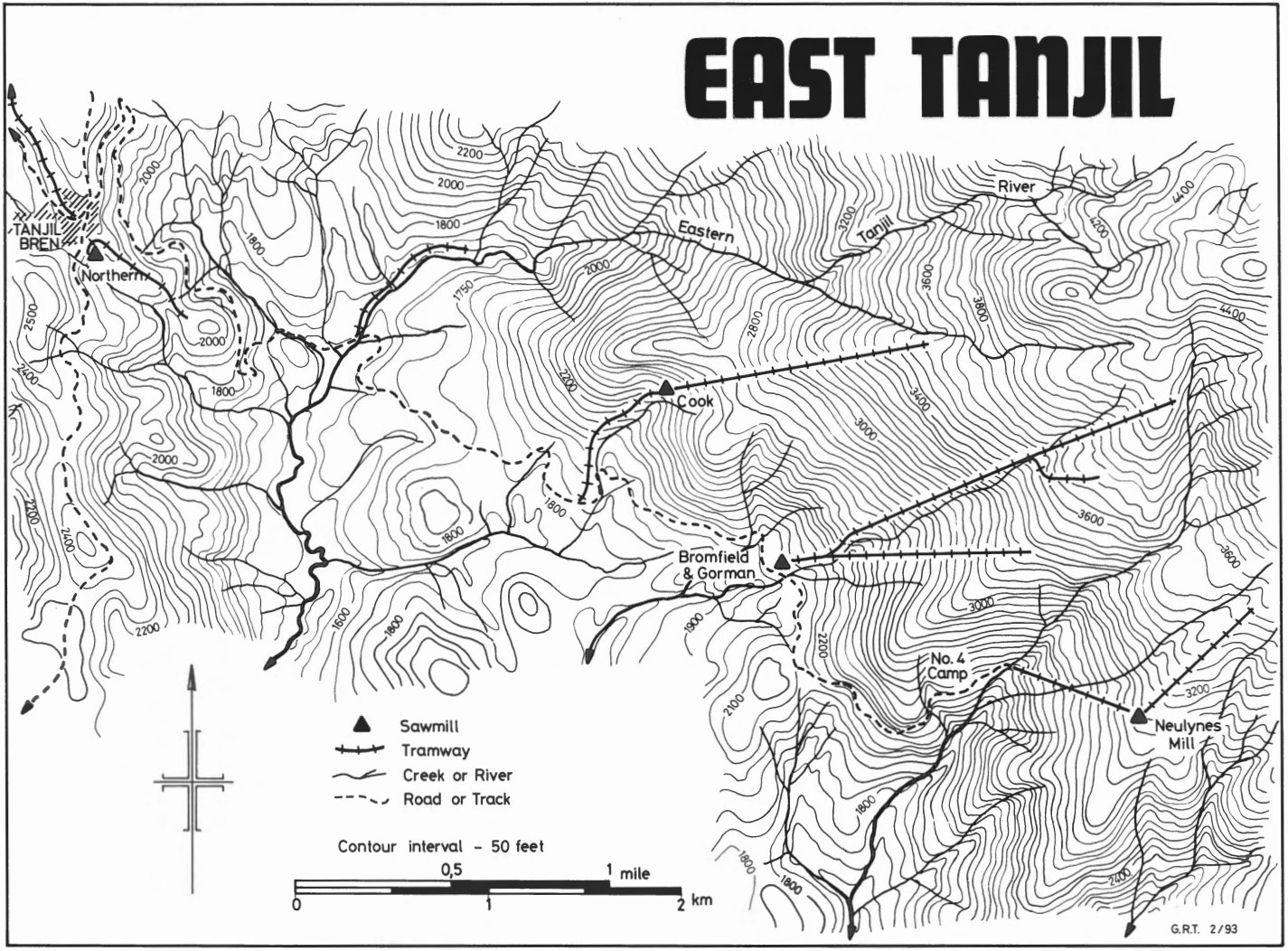
Fallers were engaged to begin dropping the fire killed mountain ash while the mill was being built as it was known that the timber would be better protected from wind and sun cracks if lying on the ground.The bush grew over these logs and later when we began mill found them to be in good condition.

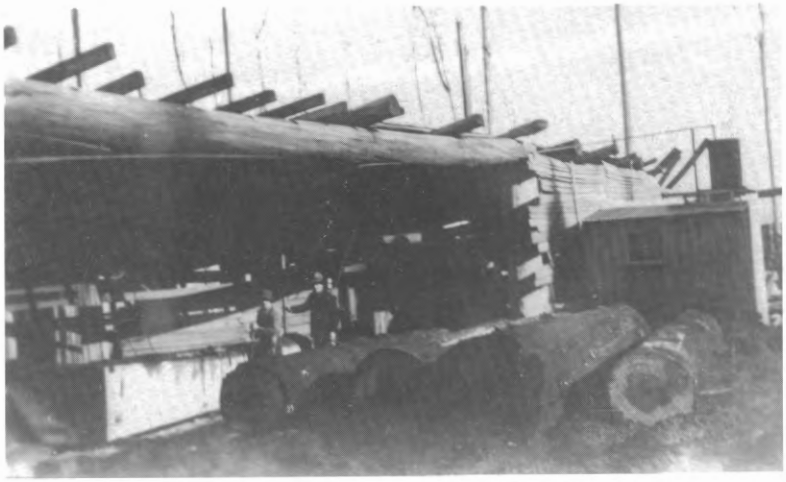
In the early stages the logs were brought into the mill over a three feet six inch gauge (1066 mm) winch powered tramway about 500 metres in length laid north-east straight up the slope. The sawn timber was sent down the other iron rail tramway incline to the road below the mill, from where it was carted to Melbourne, mostly to J.W. Porta & Sons at Northcote. Sometimes the drivers made two trips a day and when this happened Arthur and I would have the second load ready, and no matter at what hour of the night the driver rang from the gantry we would be ready to lower the timber. Once the area around the mill was cleared of saw logs we dispensed with the log tramway and put in a high lead.

The high lead was worked by two Harman steam winches set together on the one boiler. This system of logging was called a high lead because the nose of the log was lifted up when being brought up the gullys. In order to do this a suitable tree was picked out, the top lopped off it and a bull wheel for the winch rope placed near the top so as to keep the rope as high as possible at the winch end. One of the Harmans worked the rope and the other was used to load logs onto the motor trucks, since by this time we had built a road right into the mill. The crawler tractor we had acquired to put in the road was then used for logging.

At the mill we installed a gantry and were able to hoist the pre-stacked cut timbers in the one package straight off the storage piles and onto the motor trucks. We carried on at Neulynes for about six years. The only interruptions to our work came in winter when the snow became too deep so we shut down for up to two weeks at a time. The men returned home or went to Melbourne when this happened.

Around 1946 Neulyne Building Products sold the mill to C.H. Tutton of Oakleigh and not long after this the mill closed. Tuttons preferred to log the site only and cart the logs direct to Melbourne.





Above: View of the Neulyne mill from the log yard.

Middle: Mill workers enjoying a spot of skiing above the mill after a hard day's log hauling.

Below: Skylarking on the high lead spar pole. The high lead winch system did away with the log tramway.

All Photos: Horrie Mackie

Above: The incline winch at the top of the log line.

Below: The base of the access incline at the road level. *Both Photos: Horrie Mackie*

THE FYANSFORD CEMENT LINE

by John McNeill

The author was employed by Australian Cement Ltd from 1938 to 1986, rising to the position of works manager at Fyansford.The following account is based on his research in the company files and on his personal knowledge of operations at Fyansford.

This account is mostly concerned with the rail transport aspect of the plant and quarry.

Introduction

When the Australian Portland Cement Company was established in 1890 raw materials from the quarry were carted four km by horse-drawn wagons. There were no proper roads and serious transport problems were soon manifest. The company went into liquidation during 1902 but was reconstituted in 1905 and production recommenced.

At this stage a tramway was laid from the edge of the quarry south-east for three km across a paddock to meet the nearest road reserve where road cartage took over. This system remained in service until 1911 when an aerial ropeway was installed direct from the quarry to the works.

The aerial ropeway was fed by a narrow gauge system of portable lines worked by horse, with the trucks being loaded by scoops and shovels.

Broad Gauge Siding

Connection of the cement-making plant to the wider world was initially by horse drawn wagons until a branch of the Victorian Railways broad gauge line was built. During 1915-16 the company approached the State Government, requesting a railway line between North Geelong and the works. The company said this would remove the problem of damaged roads in Geelong, link the works directly to a state wide transport system and cope with anticipated increases in output.

Interstate movements of cement, coal and gypsum were also being considered at the time.The government finally passed the North Geelong to Fyansford Railway Construction Act 1916, and the line was declared open on September 9, 1918.

An alternative consultant's proposal for a line from South Geelong station through Chilwell and Newtown, then down the hillside, now carrying the Deviation Road, and to the works site, was considered impractical.

The company had to purchase any private land involved, and transfer title to the Victorian Railways at no cost, for as long as the line remained in use. Its length is nearly five km and the easement width at least 30 metres. The construction cost was only 5404 pounds ($10,808) but the company had to agree to pay 2354 pounds ($4708) a year in freight for 15 years, and the line was also to be available for use by the paper mill at Buckley's Falls.

Railway estimates of freight tonnage were 45,000 tpa (tonnes per annum) cement, 25,000 tpa coal, 750 tpa stores and 300 tpa paper.Paper freight never eventuated as output of the nearby paper mill decreased until its shut down in 1923.

To make proper use of the rail siding, a despatch department was constructed on the land purchased at the junction of Hyland Street and Asylum Road, and that section given to the railways. The company had to agree that all cement capable of delivery by rail to any place further than 16 km from the works would go by rail. This would at least guarantee revenue on the basis that nine pence (eight cents) a tonne was added to normal freight rates for the separate five km haul to North Geelong.

The Railway Act was amended in 1954 to allow widening of bends along the line, and in 1934 and 1975 to extend license agreements. Under these, the company is allowed to store material and goods, and carry out activities on the lease property.

Production levels rose with an improving market at the end of the 1920 coal strike, and the maximum degree of expansion possible on the south side of Hyland Street was put in motion.

To match the kiln fuel requirements and make best use of the new rail siding a complete coal handling and milling system was constructed between 1921 and 1925. A rail mounted steam shovel (RH No. 6) with a 7/8 cyd (about one tonne) bucket, and a grab and dragline, unloaded incoming rail wagons, either into a 1500 tonne storage yard, or to an 18,000 tonne open dump.

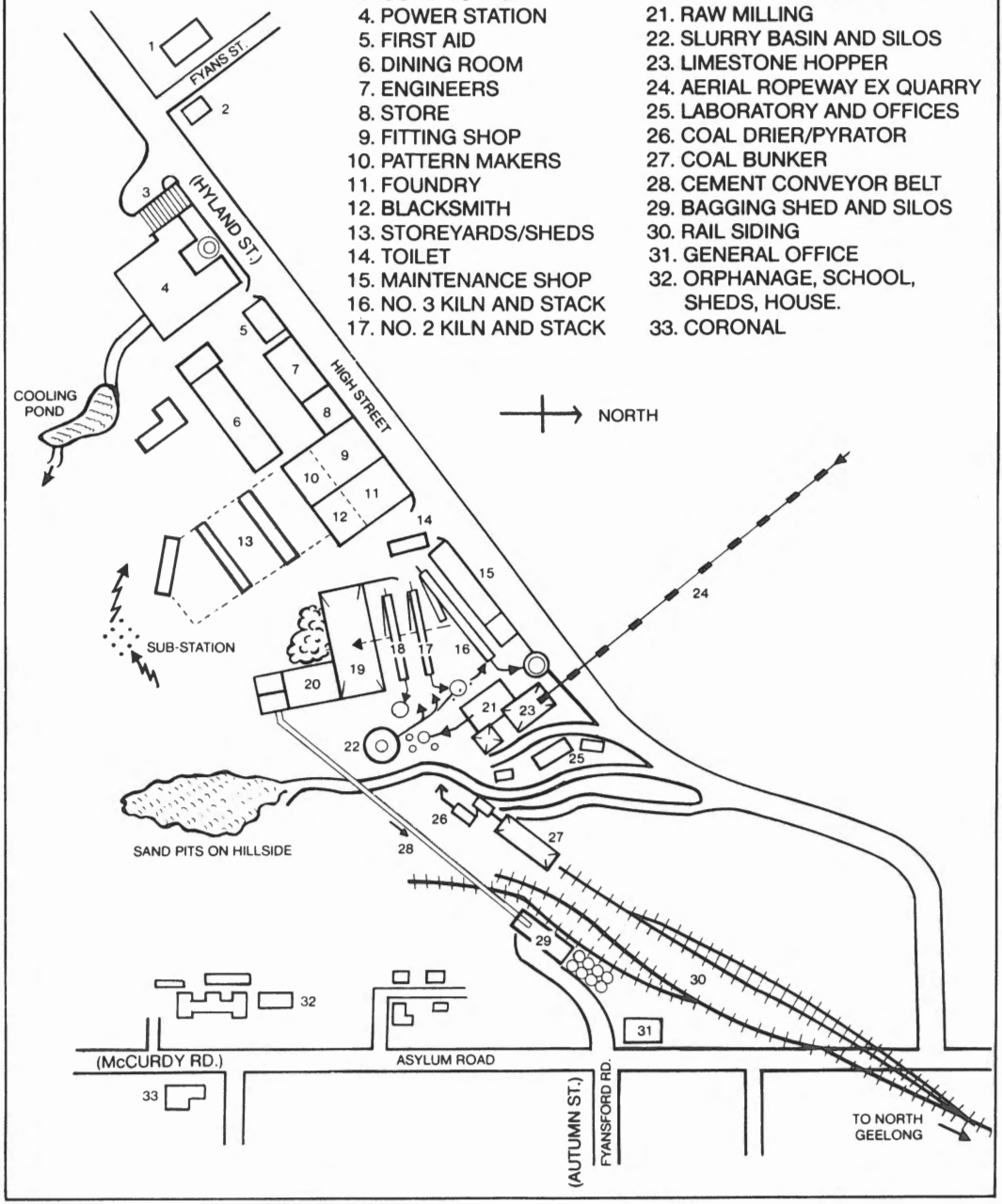
With the first cement silos and bagged and bulk despatch departments being constructed beside the rail siding, a 20 inch (500 mm) belt conveyor system was laid up the hill to the silos.

These first silos were of 1200 tonnes capacity. The first four in 1922 were given numbers 31 to 34, the next four in 1924 are numbered 41 to 44 and together they supply No 1 bagging shed.

The earliest two Bates Baggers of 1919 vintage, were simple two spout models. In 1924 they were replaced by three three-spout machines and these

WORKS LAYOUT 1922

1. ST. LUKES CHURCH
2. POST OFFICE
3. COAL HOPPER
4. POWER STATION
5. FIRST AID
6. DINING ROOM
7. ENGINEERS
8. STORE
9. FITTING SHOP
10. PATTERN MAKERS
11. FOUNDRY
12. BLACKSMITH
13. STOREYARDS/SHEDS
14. TOILET
15. MAINTENANCE SHOP
16. NO. 3 KILN AND STACK
17. NO. 2 KILN AND STACK
18. NO. 1 KILN AND STACK
19. CLINKER STORAGE
20. CEMENT MILL AND SILOS
21. RAW MILLING
22. SLURRY BASIN AND SILOS
23. LIMESTONE HOPPER
24. AERIAL ROPEWAY EX QUARRY
25. LABORATORY AND OFFICES
26. COAL DRIER/PYRATOR
27. COAL BUNKER
28. CEMENT CONVEYOR BELT
29. BAGGING SHED AND SILOS
30. RAIL SIDING
31. GENERAL OFFICE
32. ORPHANAGE, SCHOOL, SHEDS, HOUSE.
33. CORONAL



ACL loco No 9 on the overburden tramway at the top of the quarry.
Photo: R. Reilly ex Ellis Collection

remained in continuous use until the late 1970s. Road cartage of cement up Hyland Street hill was no longer necessary, and in 1922 despatches were 50,000 tonnes over the rail.

The Quarry

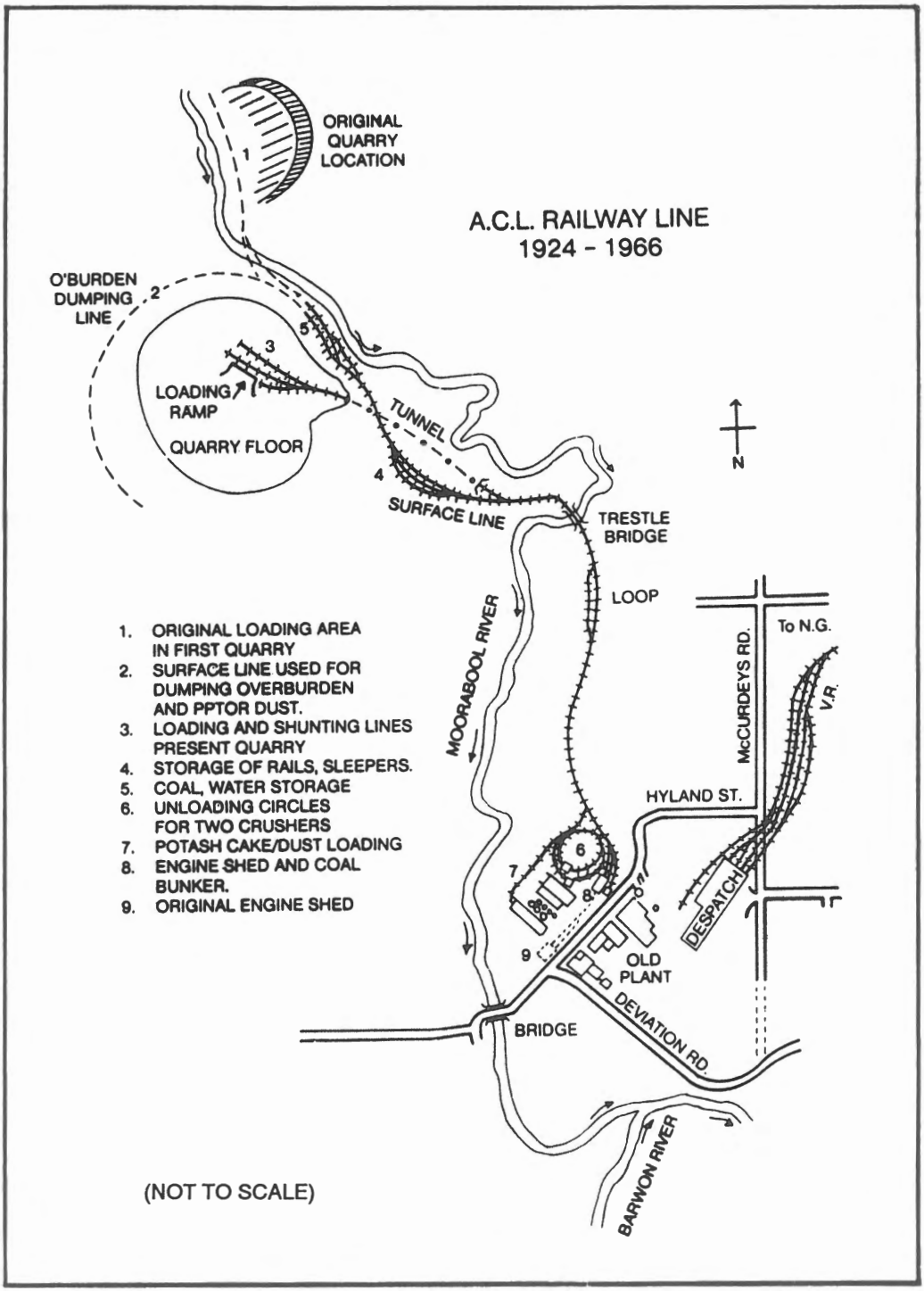
To keep up with increasing demand at the works for limestone, major changes were made at the old quarry. Steam shovels were introduced with larger wagons and crushers at the ropeway loading bin. The programme started in 1921 and continued through to 1926, making the quarry an extremely busy operation in a rapidly enlarging area. The rail system was laid down only in the quarry floor and was not connected to the works as the ropeway did this job.

Throughout its history the company has been involved in the long-term usage of large machines in one of Australia's most efficient stone excavations. A new limestone delivery and storage system was introduced during 1924-25. The existing ropeway system continued delivery to both the new and old plants until 1924 when the company purchased four Hudswell Clark 0-4-2 STs from Wallaroo (S.A.) and in 1926 bought two 0-6-0 STs from the Henderson Naval Base (W.A.). The ropeway had limited capacity and so a three feet six inches (1066 mm) gauge railway was constructed from the floor of the old quarry, across the Moorabool River on a wooden trestle bridge, about half way to the works, and to a shunting loop where new equipment was installed to crush and store the limestone.

The quarry was working deeper into the Batesford hillside and with the limestone deposit tilting down to the south, the overburden ratio was becoming a problem. Stone was excavated from the floor as close to the river as possible, and some of the harder stone across the river approaching the Dog Rocks was also obtained. Rail tracks were moved across the floor to approach the faces where track-mounted steam shovels directly loaded the rail wagons and the first group of locomotives shared the new work load.

The smaller Hudswell Clarkes shunted the 10 cyd (20 tonne) wagons on the quarry floor, while the two Vulcans ran on the new line to the works. To assist blending and quality control at the works, each train load was sampled before leaving the quarry. The sample was analysed for calcium carbonate content, the result telephoned to the crusher attendant, who posted figures on a board visible to the crane driver. That driver deposited the stone in sections of the storage allocated to high, low and medium grades.

The open storage yard had a capacity of 30,000 tonnes of limestone and 500 tonnes of iron oxide, and the covered end could hold 13,000 tonnes of gypsum. The newly installed crusher (No 1) was a Williams Hammermill-Mammoth No 7, with a 220 kw motor, and built to reduce feed down to three-quarters of an inch (20 mm). Rated at 300 tph, it could achieve only 200 tph with a stone which was relatively wet, and an uneven blend of soft and hard material.



ACL No 1 Garratt emerging from the tunnel into the bed of the limestone quarry. 1951. Photo: R. Reilly ex Ellis Collection.

Haulage ropes, 260 metres in length, pulled the wagons to the crusher hopper and a hoist tipped the side-opening wagons. The first crane, operating length-wise above the entire yard, was of 5 cyd (10 tonne) capacity, and worked from 1926 to 1938 before being joined by No 2 of 8 cyd (16 tonne) capacity.

The existing Batesford quarry's production was limited, with a rapidly increasing overburden ratio, and a decrease in the width of property available for quarrying. Borehole testing of the flatter country downstream, basically the McCann family-owned estate of Dryden, indicated a massive deposit of limestone ranging from a high grade of 90 per cent CaCO3 (calcium carbonate) below the overburden to a much lower grade as depth increased. The overburden was mainly clay and easily removed, except in the western area where basalt layers covered the stone.

The course of the Moorabool River crossed the deposit area and was the boundary between Dryden and other properties. To the north, the Dog Rocks granite outcrop gradually cut off the limestone. It was in this area that overburden was to be dumped when quarrying started.

The plan for this operation had several stages.

Open-cut quarrying was used to remove overburden from an area large enough to allow sinking down a working floor for some 37 metres. This opened up a working face with 30 metres of limestone, averaging a usable mix quality and six metres of overburden. With the floor about 21 metres below sea level, a drainage pump system collected water for pumping up into the river.

The limestone from this 'glory hole' type of quarry was loaded on rail wagons used in the first quarry.

A tunnel 1.3 km in length was driven from a convenient point nearer the works down to the accepted floor level in the quarry, and a rail track laid in that tunnel. The gradient was 1 in 37 against the load.

Loading rail hoppers in the limestone quarry. Loco No 5 or 6 (number indistinct) in attendance. 1951. Photo: R. Reilly ex Ellis Collection.

Finally, the limestone was transported to the works, via the tunnel. The total length of main line was 5.6 km.

The underground drainage system installed across the floor of the new quarry was copied from the one which was successful in the original workings. There, the excavation of the usable limestone blend required a working floor level 4.6 metres below the nearby river level, and to collect and remove seepage from that perforated river bed and nearby land, tunnels were driven underground at right angles to the working face, leading back to a sump for pumping into the river.

That quarry was completely flooded only once in its 40 years, and out of action for four weeks.

At the old quarry, the Moorabool was diverted back to the unused workings during the late 1920s to take its course further away from the sensitive section of the new quarry face.

Second Quarry Opened

The work was completed in 1931, and the first quarry was vacated. Four of the five steam locomotive shovels, one rail and three track mounted, were now fully occupied in the new quarry. The original crushers were sold, the loading station demolished and the ropeway system dismantled over a few years. Buildings were transferred if usable, or demolished, and the quarry faces left untouched. Some stone was quarried there when floods covered the new quarry years later.

The original surface rail line was kept in use for cartage of stores, particularly coal for steam shovels on overburden, and transport of workers. An extended section of this line was taken in a circle round the top of the limestone body to take overburden from shovels, and tip it on the dumps. On the quarry floor a team of track-layers regularly shifted the rail lines close enough to the working faces to accept direct loading of limestone from steam shovels.

In the 1950s, the line was lowered into a cutting in the floor and a fleet of AEC Matador rear tipping 18-cubic yard (14 cubic metres) capacity trucks

Above: Passing ACL Nos 1 & 2 Garratts at the crossing loop between quarry and works. 1951.

Below: ACL No 10 by Perry, ex Hume Weir, at the Fyansford loco shed. Original print undated but probably 1951. Photo: R. Reilly ex Ellis Collection.

took the stone from the shovels and tipped it in rail trucks.

To cope with smoke accumulation problems in the tunnel there were originally four ventilation shafts reaching up to ground level, and the locomotives travelled according to a pattern aimed at minimising nuisance to the crew. In hauling loaded wagons from the quarry on an upward slope, the engine was in reverse, with the cabin-end leading. On the downward return, the engine led in normal position, being able to coast, and emit little smoke from its stack.

In 1948, to assist clearing smoke from the large Australian Standard Garratt, a reversible exhaust fan was installed in the vent shaft halfway along the tunnel. The fan blasted air in as the engine approached, and sucked it out after the engine had passed.

The six small locomotives, four Hudswell Clarkes shunting wagons, and two Vulcans taking wagons to the works, continued their duties in this new quarry. The original wagons had wooden bodies of about 16 tonne capacity on a four wheel chassis, and were later replaced by steel wagons of 18 tonne capacity. All were side tipping for delivery into the crusher hopper at the works.

Increasing demand for limestone to match works expansion led to purchase of two Beyer Peacock Garratt locomotives (2-6-0.0-6-2 wheel arrangements) models, weighing 71 tonnes in 1936 and 1938 for mainline haulage, with two of the smaller locos engaged in shunting and four on overburden duties. In 1945, handling capacity was further increased with purchase of an unused, surplus Australian Standard Garratt (4-8-2.2-8-4, weighing 120 tonnes) from the Victorian Railways. One of the Beyer Peacock Garratts then took over shunting at the crusher circles.

In 1946, two small, old Perry side tank engines of the 0-4-0 style were added to the fleet for shunting at the quarry, and in 1957, the last locomotive was bought, a General Motors diesel electric weighing 67 tonnes, and fitted with dynamic braking with a greater tractive effort. With haulage up the tunnel as the main limiting factor on capacity, a comparison of the different engines' performance is indicated below.

1931	Vulcan loco	Three wagons up tunnel each trip, then a total of six to the works once per hour equalling 100 tph (tonnes per hour).
1936	Beyer Peacock	Six wagons up tunnel and direct to the works, with round trip of 30 minutes, equalling 200 tph.
1946	Australian Standard Garratt	Nine wagons with round trip of 30 minutes, equalling 300 tph.
1947	Australian Standard Garratt	Using two Garratts and auto matic signalling system, equalling 480 tph.
1957	Diesel Electric	15 Wagons with round trip of 26 minutes, equalling 550 tph or 4700 tonnes per day.

Rail Closure

At the Batesford quarry, there had been a logical development, with changes of equipment and methods during the years from work in the old quarry through to present days.

The first introduction of Bucyrus steam shovels came in 1921, and the direct loading of rail wagons by shovels at the quarry face, during the first years of the new quarry.

In 1952, AEC Matador motor trucks were introduced, and carted the stone from shovels to wagons which had been shunted into the loading ramp, centrally located on the floor.

Marion three-cubic-metre capacity diesel shovels first appeared in 1958 and stayed in service until 1988 when replaced by modern, faster and more manoeuvrable front end loaders and shovels. In recent years there has been a phased-in transfer of overburden removal operations to contractors. This policy, together with closure of the railway, use of larger equipment and greatly increased productivity of all personnel at the quarry, has markedly reduced the manning level.

The next major step was the erection of the limestone conveyor system from quarry to works in 1966, involving the installation of the larger No 3 crusher at the quarry, seven sections of belt conveyor in a concrete support and protective structure across country for 3.67 kilometres, a rail mounted stacker with a slewing boom, and two rotary plough reclaimers to feed limestone to either the storage yard for the old mills, or to the feed bin for the new raw mill (R22) being installed. The existing crushers at the works, Nos 1 and 2 were taken out of service.

The ACL railway ceased operating in April 1966 and the company disposed of all the rolling stock.

THE CHEETHAM CHRONICLES: PART V - PRICE

by Norm Houghton

Introduction

The sea-waters on the western shore of St. Vincent Gulf have an abnormal density due to geographic and climatic considerations. The Gulf Salt Co. Ltd was aware of these characteristics when, in 1919, it established a solar evaporation operation at the head of Wills Creek near Price. The company took out a lease to 518 hectares of low lying tidal flats and established a battery of crystallisers and storage ponds. The first harvest was made in March 1920.

The Gulf Salt Co. soon fell into financial difficulties, and was taken over by Ocean Salt Ltd in 1921. The Ocean Company's main refining operation was then at Port Augusta, and Price was retained for the production of raw salt only. However, problems with sand drift seriously compromised the Port Augusta works, and in 1929 the decision was made to transfer the refinery to Price and down-grade Port Augusta.

The necessary plant and equipment was removed from Port Augusta and re-sited in a newly-built refinery, engine-house, stores etc. at Price. This was the start of what was to become South Australia's largest salt-producing site and Australia's largest manufacturer of refined grades of salt.

After the initial refinery construction phase of 1929 the plant was enlarged and rebuilt from time to time to meet demand and to capitalise on the site's unique attributes where conditions permit the continuous garnering of salt with a summer and winter harvest. Cheetham's other sites were, or are, limited to one summer seasonal harvest per year.

In the period 1938 to 1942 the plant was entirely rebuilt with a new power-house, factory building and equipment, and potential output raised to 43,000 tonnes per annum. A new mill plant was installed during 1950. The continued rising demand for salt throughout the 1950s led to further enlargement of potential capacity and by 1956 it was 50,000 tonnes per annum of manufactured salt. Actual output was less than potential and depended on market demand, the labour situation and satisfactory performance of equipment.

Tramways

A system of tramways was to develop at Price to serve the various functions of the site, and while the entire tramway network was not large, it offered some interesting features.

The tramways at Price underwent several major and numerous minor alterations during the period 1919 to 1972, but it basically comprised three elements, namely a line to the wharf, a line along the crystallisers serving the salt stacks and mill, and lines along the divisional walls in the crystallisers to move harvesting equipment. Temporary and moveable lines in panels were put down along and between the main systems when the occasions warranted. The track gauges were either 3 ft 6 ins (1066 mm) or 2 ft (610 mm) and the rails steel or wood, depending on the application. Motive power was loco tractors, horses or human muscle power.

Wharf Tramway

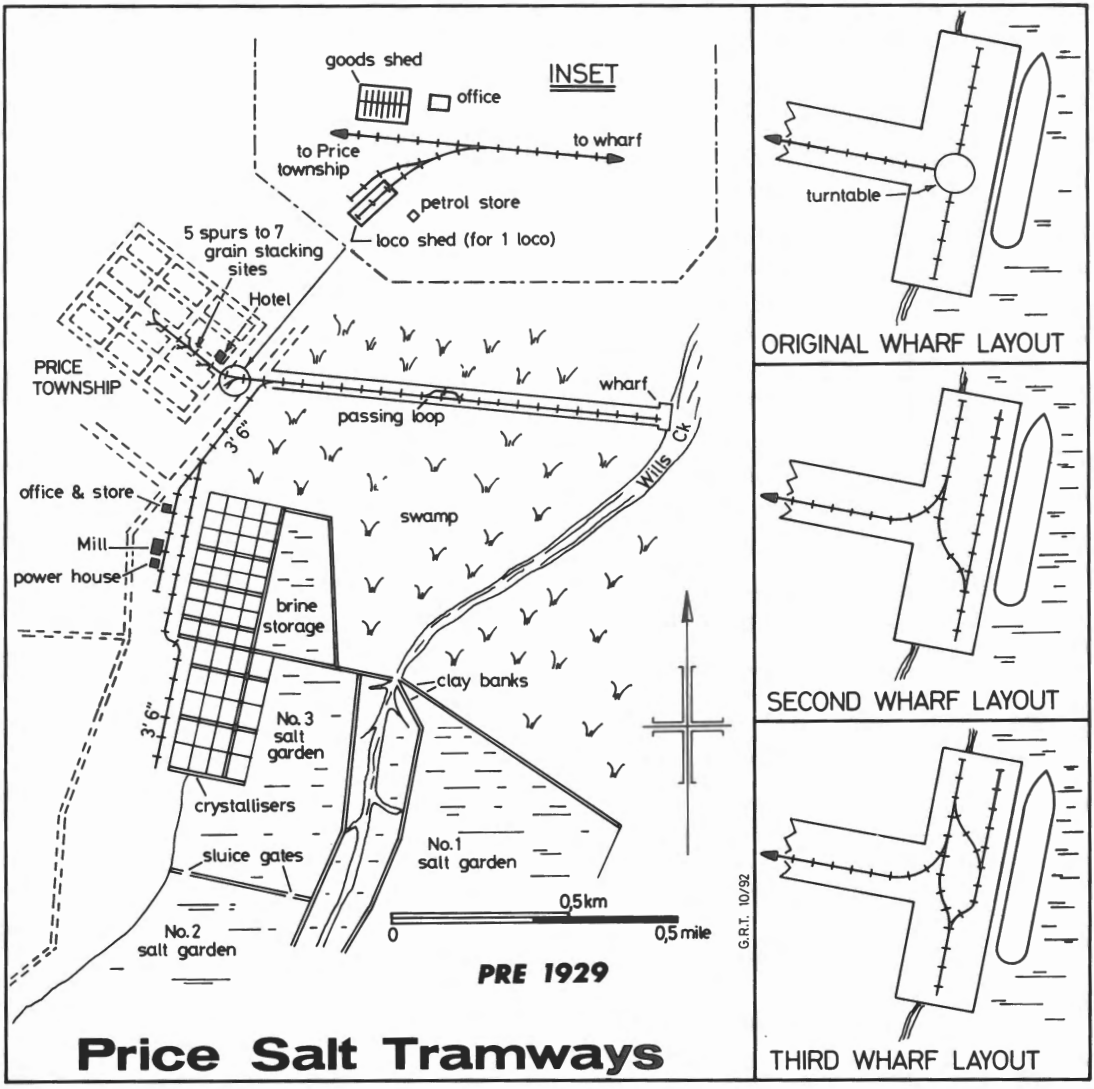
For many years the salt output at Price was despatched by coastal ketches via Wills Creek for Adelaide and trans-shipment to Sydney.

The Yorke Peninsula was not served by the state rail system, and all local outwards bagged grain and bagged salt and inwards bags and general merchandise etc. was lifted by coastal ketches, 70 to 170 tons in burden. The peninsula was ringed by small jetties and their associated tramway systems and Price had such a network.

The Price outlet was built in 1911 and consisted of a jetty on Wills Creek, 1.4 kms east of the township reserve, joined to the mainland by a low causeway across the tidal flats. The causeway was wide enough for road vehicles and the tram, the latter being on the south side. At the edge of the town, opposite the present hotel and at the end of Gardner Street, was the goods shed. The tram then continued up the middle of the street for 1½ blocks to serve seven grain-stacking sites. Five spur lines ran into the stacks.

When the salt works opened in 1919 a spur was put in off the main causeway running south for 500 metres to the salt pans.

The jetty tram was of 3 ft 6 in gauge (1066 mm) steel rail, and originally worked by horses. Rolling stock was a number of the standard South Australian Harbors Board 4 wheel flat-tops with a 5 tonne load limit. The grade down Gardner Street was with the load, and single unattended trucks were gravitated almost to half way along the causeway. At this point there was a passing loop, and



Part of the 3 ft 6 in gauge line at the salt works store and loading dock. 1925.
Photo: Cheetham Archives.

here the horses changed over, with one horse working the jetty end and the other the town end.

When loco traction was introduced (date unknown to writer but probably in the 1920s) the passing loop was removed and a loco shed and fuel shed installed near the goods shed. There were several locos at Price over the life of the tram, mostly Fordsons and one Ruston Hornsby. The Ruston Hornsby, builders number B/N 244869, 1947, was bought new for Price. The Malcolm Moore Fordson units known to be at Price were one 1940 built ex Kleins Point to Price and one 1926 built ex S.A.R. Port Broughton and Franklin to Price. In 1963 the Fordson at Price had the builders number ?40 recorded against it.

During the 1950s and 1960s there were two locos on permanent station to handle the salt traffic, and for a short period there was a third, and its role was the shunter on the jetty. No turntable or passing loops were provided, so the locos ran to the jetty with the load trailing, and returned with the load ahead. The usual load was five trucks. The locos were geared to run either way and were crewed by the driver and a shunting assistant. Slip or fly shunting was used to place wagons in the dead end sidings. Once unloaded, the trucks were barred down into the single spur at the south end of the jetty, from where the tractor would retrieve them and push them back up to the township or salt works.

In the grain season during the 1920s and 1930s, some 400 tonnes a day would go over the jetty, and salt would add another 150 tonnes. In the 1950s and 1960s salt was the major item as bulk handling of grain had been introduced at Ardrossan and bagged grain done away with. All of the bagged loading at Price was manually handled off the tramway wagons and slid down the chutes to the ketches. In addition, the laden wagons at the jetty had to be shunted by muscle-power and pinch bars. A former loco driver, Les 'Blue' Hill, told the writer the job was very physically demanding, especially the muscle powered shunting and picking up the full bags of salt or grain that fell off the trucks on the way.

The Gulf Salt Company laid the causeway branch line with its own labour and materials to the Harbors Board specification, using 15kg/m rails.At the saltworks' boundary the tramline forked two ways, with one route running 800 metres along the western end of the crystallisers (where the salt stacks

were) and the other running 400 metres to the salt store and office.

At that time the salt orders were made up at the stacks. Two-man gangs worked the stack-face at the crusher, filling, weighing, bag-sewing and barrowing a quota of 60 bags per hour.In a working day each man would lump 70 to 100 tonnes of salt. The bagged salt was loaded onto the Harbors Board trucks, 160 bags to the truck for a net weight of 5 tonnes, and carted direct to the wharf when the ketches arrived.

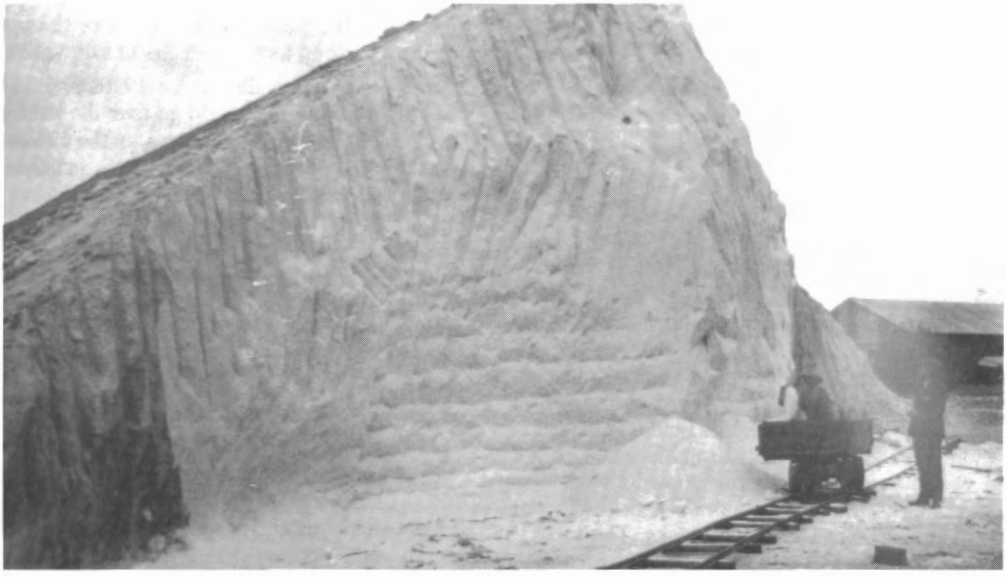
This system continued in use until 1929, when the new refinery was erected. This development required an alteration to the tramway system, as the Harbors Board trucks were unsuitable for conveying bulk salt from the stack to the mill by reason of their height and size (3040 x 1980 x 848 mm). The Harbors Board line was cut back to near the Salt Co. boundary and ended a short distance past the bagged-salt store, where a spur line ran into a loading dock. Initially only one line ran into the store, but in the early 1940s an additional one was laid down and this remained until 1952, when fork-lift operations caused a reversion to the single line. Adjacent to the store there was a long extension for storing empty trucks. Shunting of the trucks into and out of the store spur was performed by a company horse.

The refinery operated all year round, and as the refining plant and bins had very little reserve-holding capacity it was necessary to bag the output as soon as it was produced.

The salt was placed into 50 kg and 85 kg bags and formed into stacks three metres high in the store. All of this work was manual exertion, with the only aids being two-wheeled barrows. The despatch orders were then made up from the stacks, again by manual labour, onto the Harbors Board trucks.

There were three rakes of five trucks permanently allocated to the carriage of salt, so that one could be at the wharf being unloaded, one in transit, and the other at the salt store being loaded. The company owned one of the rakes of five and painted its trucks in a deep red colour.

By the Second World War, the wharf line was in poor condition, and it was criticised by the Harbors Board. The Board, in a letter to the company in November 1943, charged that the rails were too light, sleeper-spacing excessive, joints not sufficiently fish-plated, straight rails were laid in the curves, and some rails canted outwards instead of inwards. These conditions were causing derailments and damage to the Board's rolling stock, so the Board alleged, and requested the company to re-lay the line in not less than 20 kg/m plant.



Barring down from the continuous salt stack into the tramway dobbin. 1930.
Photo: Cheetham Archives.

The company defended its plant, and replied that there had been only four derailments in the previous twelve months, but, as a soother, promised to recondition the line with 15 kg/m rails that it had on hand. This was done during the first six months of 1944.

In 1951 the company acquired a fork lift for work in the salt store, and began using pallet loading as a means of dealing with chronic labour shortages. The pallets were oversize for the existing wharf tram trucks but could be accommodated on the tray of a motor truck. The pallets made the outwards despatch of salt more efficient, and economics favoured using motor trucks to the wharf.

By this time the wharf line along the Harbors Board section of the causeway was in need of considerable repair. Since 1941 salt traffic over the wharf comprised 84% of the total loading, and because salt was a low-rated item for wharfage charges the Board was reluctant to spend large sums on improvements.

In July 1951 the company put a proposal to the Harbors Board that the causeway road be upgraded to bear regular motor traffic from the salt works, and that the shipping channel be deepened to allow larger vessels in. The refinery was then processing 35,000 tonnes per year, and was Australia's largest supplier of refined grades of salt, so the company thought its wishes should be given sympathetic Consideration. The company's calculations showed that the absolute maximum loading that could be shipped over the Price wharf in any one year was 43,000 tonnes and that in the long term better shipping facilities ought to be provided.

The Harbors Board declined to act on the company's suggestion and decided to repair the tramline and provide new rail trucks to handle pallet loads of salt.

Early in 1952 the company workshop began fabricating the frames for five new pallet trucks to the Harbors Board design. Serviceable components from the five superseded wharf trucks were re-used (drawer and brake gear, some axles and axle boxes) but new wheels were fitted. The Harbors Board also provided five new trucks for pallet loading to allow for two rakes. All trucks were completed by May 1952. These trucks could accommodate 3 pallets of 2 tonnes gross weight each.

The use of pallet trucks was a compromise solution, and full advantage of this method could only be taken at the factory end as there was no provision for pallet stowage in the ketches for various operational and ketch design reasons. At the jetty the salt bags were manually handled to the chutes that ran into the holds.

Horse and tramway dobbin on temporary line as last of stack is cleaned up. 1930.
Photo: Cheetham Archives.

One of the TACL locos hauling a rake of salt to the works. 1957.
Photo: Adelaide Advertiser ex Cheetham Archives.

Large direct export orders were not sent over the Price wharf, but were road-trucked to Ardrossan, 16 kms to the south, where there was both a Harbors' Board jetty and the B.H.P. company jetty.

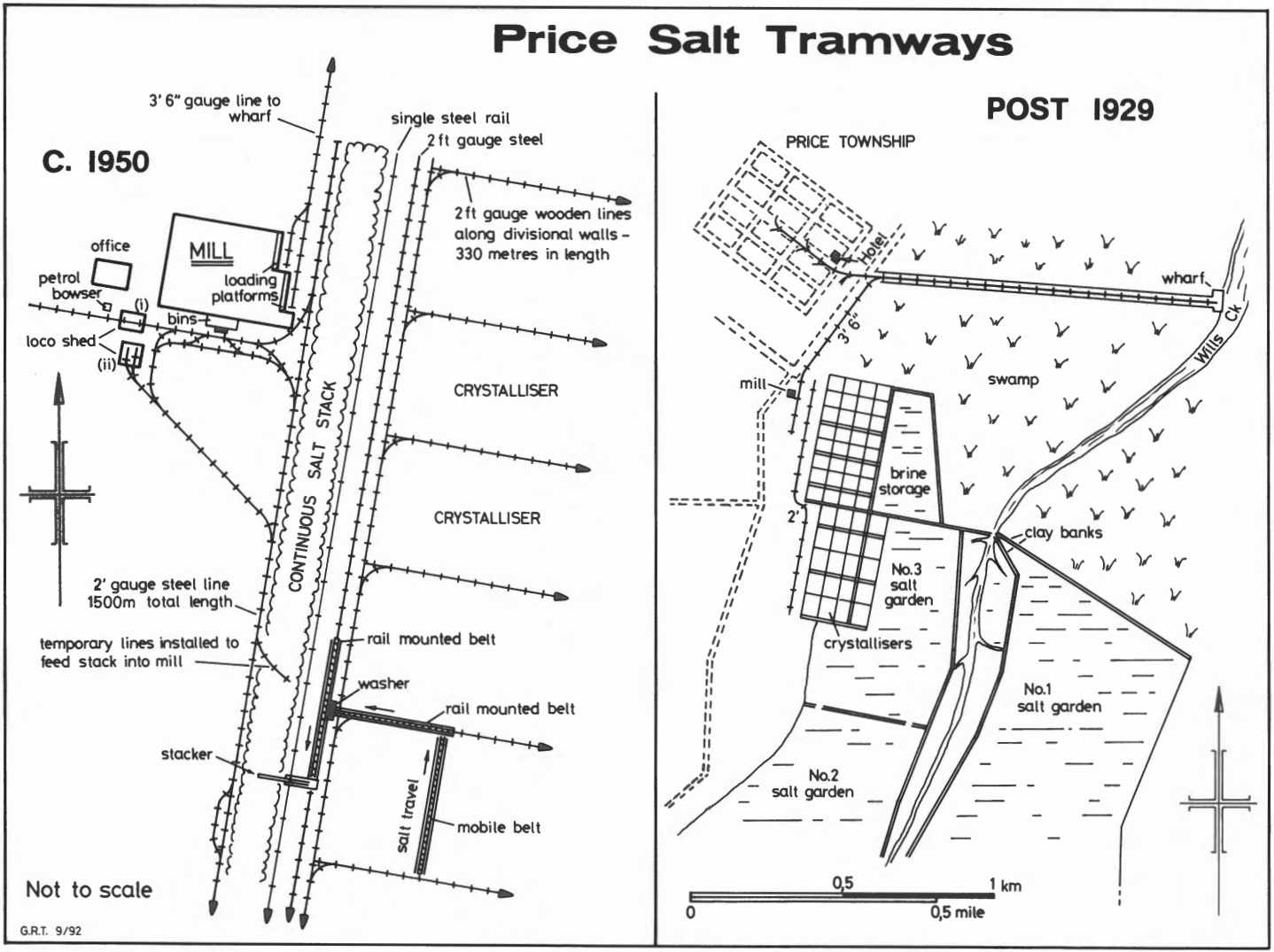
When the company used either of the Ardrossan jetties it sent a gang of men to transfer the salt from the road truck onto the jetty tram trucks and to work in the ship's hold stowing the salt. On one occasion the company hired the B.H.P. loco tractor to work the public jetty rather than rely on the Harbors Board horse. Intrastate orders were road-trucked north to the railway stations at Melton and Wakefield. The use of motor trucks was a late development at Price, there being no road into the site until 1936, and the company did not acquire its own trucks until the 1960s. Contract carters were employed for the Ardrossan transit trade which, in time, became a major outlet when a cooperative scheme with the grain handing authority and B.H.P. in 1965 resulted in a large bulk storage site and belt loader being provided for salt.

In 1960 the company once again gave serious consideration to road-trucking salt direct to Adelaide, and this time the objection came not from the Harbors Board but from Fricker & Co., the ketch operators. In an effort to retain the salt business, Fricker & Co. offered a rate that persuaded the company to continue employing ketch freight, but it was a dying compromise. Within six years ketch cartage was finally abandoned by the company, and the wharf tramway was put out of service in 1967. Some years earlier the section of the tramway running along Gardner Street had been closed through lack of worthwhile traffic.

Stack to Mill Line

The original line to the crystallisers was built to the gauge of 3 ft 6 ins (1066 mm) and ran along the western side of the salt stacks, with a bend halfway down. This line handled bagged, unrefined salt.

When refining machinery was introduced in 1929, most of the 3 ft 6 in gauge line was removed and a new 2 ft (610 mm) line laid to the refinery from the crystallisers. A portion of the wider gauge track was left intact for a little distance south of the refinery and photographic evidence indicates that the 2 ft gauge line was laid as a third rail over this section. In later years, as the number of crystallisers was increased, the stack to mill tramline was extended



to serve them, and eventually reached a length of 1.5 kms. The raw salt was delivered to the factory bins over a loop line from which a siding was laid to the bins themselves. At the tipper the salt trucks were hauled through by a winch and manually pushed out the other side. At first the line was horse worked and only one or two 1 tonne trucks were hauled at a time. In 1938 a loco was introduced and it hauled rakes of six to eight 1.4 tonne trucks. By the late 1940s the operating method on stack-to-mill was for three rakes of 22 trucks to be used, one being filled, one being unloaded and one in transit. The one loco and the three rakes worked continuously on day shift to secure enough salt in the factory bins (6 by 40 tonnes capacity) for the refinery to run all night. The tramway was required to handle up to 100 tonnes of salt per day in the 1940s and 120 tonnes in the early 1950s.

The requirement for steel rails for extensions and renewals at Price seemed never-ending, judging by the file references. The company left the tramway system at Port Augusta intact until the 1940s (just in case the works could be re-opened) so was unable to re-use these rails. Instead, the Cheetham group was scoured for rails, and supplies were obtained from Lake Hart, Edithburgh and Lochiel during the 1930s. These rails were mostly of 15 kg/m weight.

In the early 1940s the Port Augusta rails were released, and several large consignments were despatched to Price. After this the company began buying new and second hand rails (mostly 15 kg/m) from Melbourne suppliers, and this subsequently became the main source. Some 20 and 25 kg/m stock was acquired from the recently closed Kangaroo Island salt field in 1955.

By 1940 the stack to mill line was near the end of its useful life. The track was then 20 years old and had never been laid as a permanent line on proper ballast, so was lucky to have lasted so long.The Engineer's fortnightly reports at this time are repetitious catalogues of track failures and patch up repairs. The entire line required re-ballasting, levelling and re-laying.

Despite war-time difficulties in securing labour and supplies of rails, the engineer managed to survey, peg out, form and lay an entirely new line from the stack to mill alongside the existing line, beginning in November 1942. Much of the ballast for the line was building rubble from the old power house, which was flattened when a storm blew over its chimney. The project was completed in November 1943.

Various alterations and additions to the factory in 1941 and 1942 required the tramlines in the vicinity to be re-arranged and the loco shed to be shifted.

During the 1950s there were few modifications to the existing routes. In July 1952 two sidings were installed on the stack-to-mill line, probably to cater for the extra traffic generated by the new Nos 8 & 9 crystallisers.

In 1957 the tram line was superseded by a conveyor belt. The rails were left intact as a means of access to the bottom crystallisers because no road then ran that far down and the tram filled this role until 1972 when it was closed and pulled up.

Rolling Stock

The original trucks or dobbins were wooden top, steel underframe slab-sided tippers of 1 tonne capacity. The usual working method at the salt stacks was for a portable set of points to be installed on the stack-to-mill line and a length of temporary track and steel plates laid to the stack face. There gangs of two men each barred down the salt from the face and shovelled it into one of the four available trucks, which was then pushed to the mainline for the horse to haul to the factory bins. As the stack was fed into the bins the temporary lines were moved accordingly.

By the late 1930s the original trucks had either been scrapped or rebuilt into heavier carriers to haul 1.4 tonnes.

A number of salt hoppers, mine hoppers and flat top trucks were transferred from Port Augusta in the period 1939 - 1941.

The original wooden body trucks needed a lot of maintenance and were subject to damage on their undersides by the lever- tipping method at the factory bins. In 1941 the tipping method was altered to a whip and eye bolt arrangement to overcome the problem. During 1942 the workshop developed a new truck design using the underframes from some ex-Geelong hoppers, and built a number of these.

Some 24 all-metal 'V' skips were acquired in 1945 from Koo-wee-rup in Victoria, these being low-type 'Sewell' one cubic yard (0.76 c/m) trucks. In 1955 30 side tippers were sent over from Kangaroo Island.

At the peak of the tramway system Price possessed more than 80 trucks or salt dobbins, plus around 20 service waggons (flat tops and mine hoppers).

Harvest Tramways

A system of tramways along the east-west crystalliser dividing walls called streets was used to

Shovelling salt onto the belt in the crystallisers prior to mechanisation in 1948. Photo: Cheetham Archives.

move harvesting equipment and a mobile washer. These lines, built of wood to 2 ft (610 mm) gauge, were approximately 330 metres in length and joined to the steel rail stacker line at the western end. The Price works was originally provided with six crystallisers, and this sufficed until the Second World War, when increased orders required an expansion. During the period from 1942 to 1955, an additional five crystallisers were put in. Tramways along the divisional walls were installed in crystallisers 7 to 9, but the tramways for numbers 10 and 11 were portable arrangements, as harvesting methods were changing by then.

Harvest methods at Price have gone through three phases, from the very labour intensive to complete mechanisation. During the period 1919 to 1948, the salt was manually shovelled onto a series of portable belt-conveyors running north-south that took it to the crystallising wall, where a rail mounted conveyor running east-west finally delivered the salt to a mobile washer and stacker that formed the main stacks running north-south.

The portable pan belt conveyors were moved from crystalliser to crystalliser as the harvest progressed, and it was a difficult task to winch and manhandle the pieces of equipment over the divisional walls. The rail mounted conveyor belt equipment on the divisional walls was more easily shifted around.

All work in the crystallisers was labour intensive, and each harvest dozens of shovelmen were needed. There were, for instance, 16 men shovelling salt onto the first belt. Conditions on the pans were harsh and hot, and few amenities were provided for the casual staff apart from shade tents for meal breaks. The regular work gangs who maintained the crystallisers initially had tents to use as shelters, and these were pitched on the pan floors. Later the company provided a portable hut, and finally a solid-sided hut on runners was introduced. At the peak of these pre-mechanisation days there were 120 men employed at Price.

Mechanical lifting of salt off the crystalliser floor was first tried in 1948, when Cheetham Geelong sent over a harvesting machine. The experiment was not all that successful, as the machine's wheels were far too narrow for the pan floor conditions, and the equipment tended to dig in. Next year, Price made its own unauthorised machine using pieces

from the cannibalised Geelong harvester and, following approval from Geelong, improved on this design in 1950, using a T20 tractor as a basis. Later on Geelong sent over an improved machine that proved suitable. The days of shovelmen were finished.

The mechanical harvesters delivered the salt into the conveyor and washer systems, so the wooden tramways remained in use to cater for these movements. This situation persisted until 1972, when harvest methods were changed.

The company was anxious to reduce ever-rising costs in building and maintaining the harvesting plant and lessen the cost of lifting and stacking. For example, the main east-west conveyor belt system was 330 metres in length and was an expensive item to maintain with all its framing, idlers, motors and belting. It was decided to try an entirely different procedure. Roads were built to the crystallisers so that the mechanical harvester on the pan could deliver the salt direct to the truck bin, as had been the practice at Lochiel for many years. A central stacking site was established, and salt from all the crystallisers was delivered to it by the motor trucks.

The tramways were no longer required, and were dismantled in that year.

Locomotives

Locomotive traction was used at Price on the stack to mill line from 1938 to 1972. The company files show that Price owned four locomotives but a fifth has been recorded by LRRSA member Arnold Lockyer. The first loco was introduced in mid-1938 following a site inspection by Jack Cunningham who expressed disgust at the state of the stack to mill tramline. Cunningham laid the blame on horse traction and instructed the Price manager to get hold of the then unused Fordson loco at the Port Augusta works and give it a trial. The loco was brought down to Price and proved to be suitable. A file reference in February 1939 describes the loco as having plenty of power for the task it was assigned. The grades on the tramway were almost dead level, so there was never any difficulty with this or subsequent locos in hauling the required loads, nor any need for ball-race bearings on the trucks.

The mill fitter from 1930 to 1972 was Ted Cole, who did most of the repair work and fabrication to buildings, plant and equipment as well as the tramway. Workshop facilities were basic in the extreme, with very little provided. The fitter worked from a small shed described by Jack Cunningham in 1938 as a 'pocket handkerchief affair' in which was a lathe, emery wheel and a forge (for shaping and fire welding). Repairs to tramway trucks were carried out on the site of the accident/incident in the open air. Similarly for fabrication jobs, the work was done outside the shed.The fitter was asked to turn out all sorts of work from casting tram wheels, making frames, making points and turnouts, to repairing motors and building equipment. Repairs and maintenance to the locos was also mostly an outdoor job, although the locos had a stabling shed.

Ted Cole told the writer that there were only two serious problems with the locos, namely those caused by salt damp and extreme heat. Salt damp would get into the magneto while the loco was parked overnight, and cause no end of ignition problems in the morning. Initially a removeable magneto was devised in 1943, but later Ted came up with the idea of hanging an electric light globe over the magneto during the night so that the heat kept the damp at bay. On very hot days (40 degrees Celsius plus) the kerosene fuel would vapourise, and the motor stop. The solution was to wrap a wet bag around the fuel lines or, failing this, send the crews home with instructions to return to work at 7 pm when the temperature had cooled down.

By August 1945, the loco was requiring a steady round of repairs to keep it in service, and Jack Cunningham suggested that it was probably time to buy a new unit. The Price manager, John Little, did not entirely agree, and countered with the proposal to buy another second hand Fordson loco so that spare parts could be carried to fit either one. In any case, a quotation for a new unit had been obtained from Power Plant Ltd in Adelaide for a price of $1,950, delivered in 20 weeks.

The Purcell loco at Port Augusta was briefly considered for transfer to Price, but the technical staff who examined the loco ruled out this option.

It then came to the company's notice that a second hand Fordson loco, trucks and rails, was on offer at Koo-wee-rup in Victoria ex-Plowright Albion Quarrying Co. Little travelled to Victoria to inspect the plant and then informed Jack Cunningham that the loco was suitable, although in a run down condition. W. Plowright accepted $600 for the loco in November 1945.

The loco was despatched to Price early in 1946, where it was reconditioned. The motor, final drive and running gear was overhauled, and new wheel bearings and a braking system fitted. The loco

Day loco out of service in loco shed. Note partially dismantled TACL loco on left. 30 Jan 1963. Photo: A.D. Lockyer.

entered service at Price in June 1946, after repairs totalling $528 had been carried out.

The haulage task at Price was sufficient for one loco, but two were kept on site from 1946 in case of mechanical breakdown. A former driver told the author that if one loco failed on the job he would park the disabled one and go to the loco shed to get the other one out.

The next two locos arrived at Price in 1955 from the recently closed Kangaroo Island salt field and were Day and Cheetham made units.

The Day loco, built in 1938, was regauged from 2 ft 6 in (762 mm) to 2 ft (610 mm) by the Price workshop. The valves were reground and new brake gear fitted at the same time. The loco entered service at Price in November, 1955.

The Cheetham loco, built 1951, entered service before the Day as it did not have to be regauged. The Cheetham loco was not used on salt haulage, and served as a general runabout and taxi.

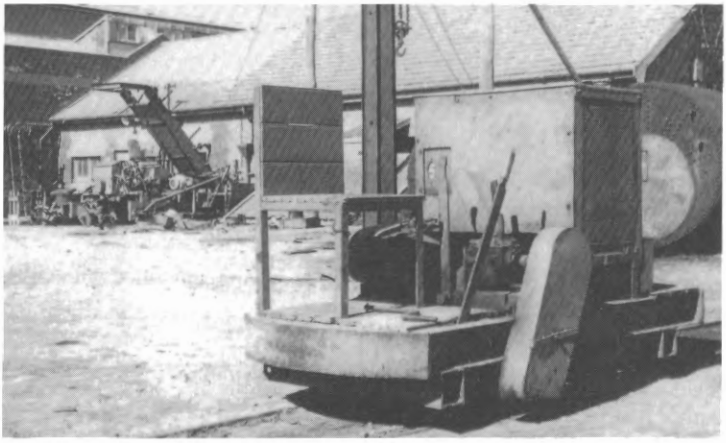
The Price workshop had earlier made a small loco to act as a runabout and taxi and used a Chevrolet Capitol motor for power.

The bottom end of the crystallisers was a long distance from the mill, and to transport the work gangs down there three or four flat-top trucks were fitted with seats. The seats were removable, so that if the trucks were required for other purposes the seats could be unbolted and taken off.

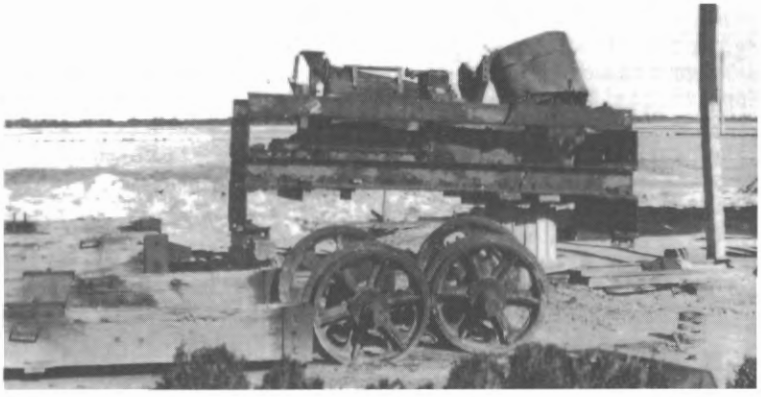
When rail transport on stack-to-mill was replaced by conveyors in 1957 the locos were no longer needed in their primary role. The tramway was retained as a means of access because no road then ran down to the bottom of the crystallisers, so there was a use for one loco. A report at this time mentioned that the locos were worn out, but the Cheetham loco apparently did not fit in this category, and it remained in service right through to 1972. The Chevrolet taxi loco and one Fordson had been scrapped at some time between 1963 and 1969 while the other Fordson was sent to the company's works at Bowen.

Acknowledgements and sources

The generous asssitance to the author of past and present Cheetham staff in preparing this article is gratefully acknowledged, in particular Dr Max White, Ted Cole, Henry Krzyzanski, Keith Norris, Bob Harrison and Les Hill,. Additional assistance was provided by Arnold Lockyer. The Cheetham file sources are noted in detail in LR 115, pp 15 & 16.



Top: Cheetham built, ex Kangaroo Island, loco used as personnel taxi. 30 Jan 1963.
Middle: Price built loco (using Capitol motor) at Price. 30 Jan 1963.
Bottom: Remains of what appears to be a TACL loco bearing No. 2 near loco shed at Price. 30 Jan 1963.
All Photos: A.D. Lockyer



THE CITY TUNNEL CONSTRUCTION RAILWAY

by Jim Longworth

INTRODUCTION

In the aftermath of the Second World War intensive development of housing, and an increasing rate of water consumption per capita placed severe demands on the capacity of Sydney's bulk water supply system to meet demand. The Pressure Tunnel (constructed between 1923 and 1926) was running at full capacity, so an additional water supply tunnel was needed to connect Sydney's bulk water supply system at Potts Hill Reservoir, to the southern distribution system near the city centre.

This scheme was known as The City Tunnel and was designed to amplify the Pressure Tunnel, so that water from the Warragamba scheme could be made available to the City of Sydney. As well as amplifying the Pressure Tunnel, the City Tunnel allowed the Pressure Tunnel to be dewatered for maintenance purposes. The two tunnels are operated independently.

The City Tunnel is 10.4 miles long and was excavated as 10 ft 6 in high and 9 ft 6 in wide at its widest point, tapering to 8 ft wide at floor level. Depth of the tunnel varied from 50 ft to 214 ft below the ground surface. Grade on the pipeline laid within the tunnel varies between a maximum of 1:100 and a minimum of 1:2000. Breaking through occurred between Erskineville and Waterloo on 29.3.1956.

Severe staff shortages after the Second World War were overcome by the massive employment of migrant labour on the project. These tunnel workers were housed in a tent city established in the grounds of Potts Hill Reservoir.

CONSTRUCTION

Construction of the Tunnel proceeded through the stages of design; survey; acquire portal sites and easements; establish surface infrastructure; excavate shafts; install poppet heads, winders and cages; excavate tunnel bore (drill, blast, load, remove spoil); concrete fill overbreak areas; place and weld steel pipe liners; fill voids outside the pipe liners with concrete; install valve structures and connections; fill shaft voids; pressure test; demolish surface infrastructure and commission.

Thirteen shafts were sunk on approximately one mile intervals, to give a maximum length of drive from any one shaft of approximately 3,400 ft. Excavation involved removing approximately 202,585 cubic yards of material.

POPPET HEADS

Double-deck, wood-framed poppet heads were provided at all shafts to allow discharge from cages at both ground level and at the level of the top of the spoil bins. Shafts of 14 x 14 ft plus access ladders and service compartment allowed for two cage operation. Double drum winches were arranged for compensated winding when hauling spoil, and with drums coupled for hoisting and lowering heavy loads. As a loaded skip was hauled up, an empty one was descending. A large U bolt of 2 ton capacity allowed for swinging long rails, pipes, bulky plant such as 'jumbos', locomotives, batteries etc. under the cage for lowering down the shaft.

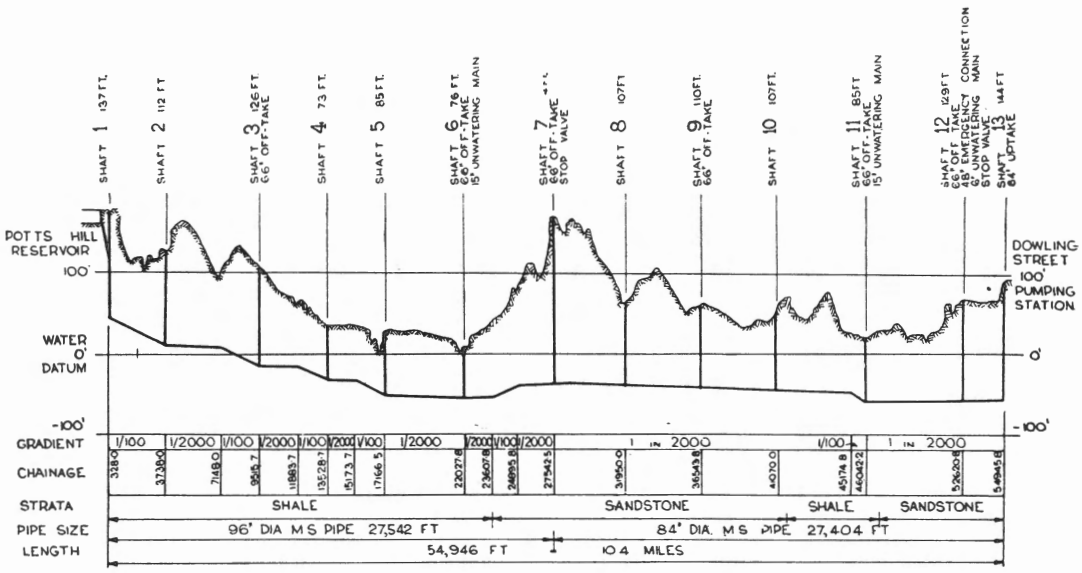
EXCAVATION

Initial proposals were to use the Arrol-Whitaker tunnelling machine which had been purchased previously for the Pressure Tunnel (but had proved incapable of cutting the hard Hawkesbury sandstone) to excavate a 12 ft diameter tunnel through shale sections only. However this was not proceeded with. (Appendix 'A').

Tunnelling moved simultaneously both upstream and downstream from each shaft at a normal rate of 6 ft per face per shift with each gang split into a drilling and mucking team. Excavation at 6 ft per face per shift gave about 60 to 80 ft progress per face per week, for double shift work. Without drilling rigs and mucking machines, hand methods would have produced about 35 ft progress per face per week. Approximately 90 cubic feet solid, bulking to 130 cubic feet spoil, came out of each 1 ft advance.

Each firing of the face produced about 50 cubic yards of spoil which had to be removed. Mechanical loaders operating by compressed air, loaded the spoil into 1 cubic yard side tipping trucks. Loaders operated on rails pushed forward into the loose spoil from the last firing. The loader bucket dug in to the loose spoil at the face, passed the muck overhead and threw it into the waiting skips.

Twelve or fourteen faces were worked simultaneously by up to ten men per face. Clearing the face involved changing trucks, moving slide rails and barring down, taking about three hours per face in



all. Battery locomotives hauled the skips to shafts for elevation to the surface one at a time and subsequent disposal of spoil.

RAILWAY OPERATION

Until arrival of the locomotives in about August 1946 all skips were manually worked from loader to shaft, a task which became increasingly difficult as the faces progressed further from the shafts. Due to time delays in arrival of the locomotives, investigations were carried out into the possible use of ropeway and winches for skip haulage but this proposal was not proceeded with. On delivery of the locomotives, tunnel trains were made up of single rakes of ten trucks. Fifty trucks per shift per side of the shaft were required to remove the spoil.

One locomotive was provided for each shaft to haul from both faces. Also, each shaft was provided with one loader to work both faces, though efforts and resources were concentrated in the upstream end of the job initially.

A train of ten full trucks weighed approximately eighteen tons. Empties had to be shunted to the loaders to minimise idle machine time. In addition to hauling trucks, drill steels, drilling machines, haulage for the miners and changing drilling 'jumbos' from face to face, the locomotives had to haul materials for progressively concreting the overbreak in the walls, floor and roof. Rail, points, sleepers, tunnel lining, air ducting, and all incidentals were also carried.

Later pipe liners weighing from four and a half to six tons were transported on special carriers. Concrete transporter trucks weighing eight tons and concrete pumps weighing about five tons, all were to be transported from shafts to the tunnel faces.

TRACK

Trains ran on 45 lb rail laid at 2 ft gauge but there may have been some 30 lb pound rail used also. The maximum up grade was 1 in 100 which the locos handled easily with a full load.

A single line was placed centrally in each drift. On each side of the shafts a turnout (about 163 ft from the shaft) connected the two parallel but separate cage tracks on 4 ft 7 in centres and allowed for passing and shunting of the skips and moveable plant. Turntables at each shaft provided for turning large or heavy machines. Passing sidings and/or loops were provided at intervals along the tunnels, and one was always kept within 30 feet of the face during loading (called 'boodling' or 'mucking'). The temporary (portable) loops consisted of two sets of Y points and dual sets of rails between, physically placed on top of the existing single central track. Check rail ramps inserted between the existing rails, lifted railway wheels up and over the lower set of tunnel rails.

Originally W. Thorley & Sons Pty Ltd were going to use second hand rails supplied from Water Board stocks to construct the turnouts for the line but later the contractor expressed an opinion that

One of the battery electric locos at the plat with the safety gates raised. 18 Dec 1947. Photo: Sydney Water Board.

working with second hand rail was difficult and agreed to supply some themselves.[1]

Turnouts at the shafts were in 1 in 6 frog Y points. To carry the large tunnel liners, these Y points were converted in early 1949 to three way points by inserting a new single rail between the existing two parallel tracks. Trials were run on the surface with timber rails (seemingly 4 x 8 in). Both bladed style and stub type points were tested, with the preferred scheme being for stub switches. Liner carriers running on the central line, ran one side wheels on the newly inserted rail and the other side wheels on the outside of the rail of the then existing track. 60 lb rail was used (planed down to 12 in at ends to suit the existing 45 lb rail) to make 9 ft 6 in long loose rails fitted into a loose bolted fish plate for hinge.

Approval was given for an order to be placed on Dickson Primer & Co Ltd to supply 70 tons of 45 lb rails and 5 tons of fishplates. To assure supply of the required materials, several orders were approved in 1947 and 1948 for BHP Pty Ltd to supply over 800 tons of rails and 30 tons of fishplates.[2]

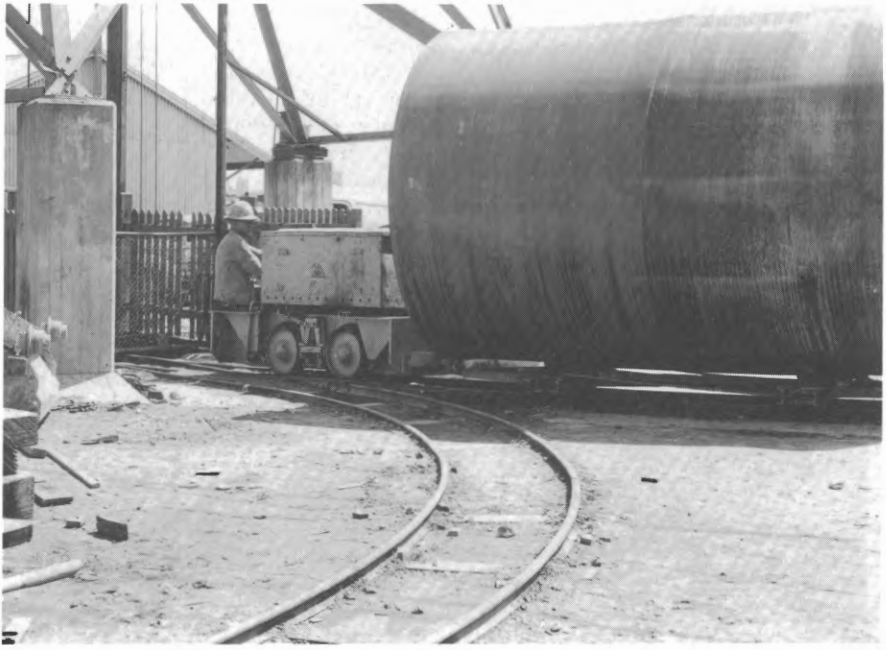
More rails were ordered during 1950, this time 200 metric tons of imported second hand French 44½ lb rails and fishplates from Associated Consulting Engineers.[3] Fishplates were used to bolt together the 4 x 3 in RSJs supporting the timbering. Four thousand were ordered from W. Thornley & Sons Pty Ltd.[4]

Dogspikes were obtained from local sources but with recurrent delays in supply, five tons of English manufactured dogspikes were also ordered from James Maher.[5]

LOCOMOTIVES

During 1946 tenders were called for supply and delivery of eight Battery Electric Locomotives. The lowest tender was from Gardner Waern & Co Pty Ltd for B.E.V. model W 227 locomotives, made in England by Wingrove and Rogers Ltd of Liverpool. Locomotives were fitted with Australian made Exide Kathanode KCL batteries. As these batteries could only be relied on to offer 12.1 miles run per battery charge, batteries might have to be changed during a shift. Therefore one additional battery charging equipment and two additional batteries were purchased.[6] A further six similar locomotives were ordered at £1,442 each.[7]

All reports indicate that the simple and sturdy locomotives performed efficiently and required little maintenance. The locomotives were designed with a power to weight ratio that allowed the



A tunnel liner being hauled to a shaft by one of the battery electric locos.
Photo: J. Longworth Collection.

Battery charging arrangements for the locos. Shaft 7. Photo: Sydney Water Board.

wheels to spin before the motor reached stalling speed.[8]

Gardner Waern & Co Pty Ltd Kardex sales records give the City Tunnel locomotives [9] as:

B/N3683 to 3684 despatched 18/8/1947
B/N3685 to 3687 despatched 25/8/1947
B/N3688 to 3690 despatched 8/9/1947
B/N4492 to 4497 despatched 31/1/1951

BATTERY CHARGING AND MAINTENANCE

Discharge time for the locomotive's batteries varied with haulage distance and demand on the locomotive. Weekly charging was sufficient when the faces were close to their shaft,but when the drives reached about half a mile from the shaft in both directions charging became necessary after eight hours work.

A battery charging room (17 x 7 ft) was excavated at the side of the tunnel near the base of each shaft. Each room was equipped with a rectifier and charging equipment .

Underground recharging eliminated the need to bring the batteries to the surface for recharging, as had been the practice on the earlier Pressure Tunnel.

Exide Batteries of Australia Pty Ltd supplied the spare batteries, which consisted of two groups of fifteen cells contained in hardwood crates.

Weighing thirty eight cwt the batteries had a capacity of 440 ampere hours at a five hour rating.

Charging of the batteries was automatically controlled and with high charge usually occupying about 2-3 hours and the slow charge about 4½ hours, a full charge was completed in about 6-9 hours.

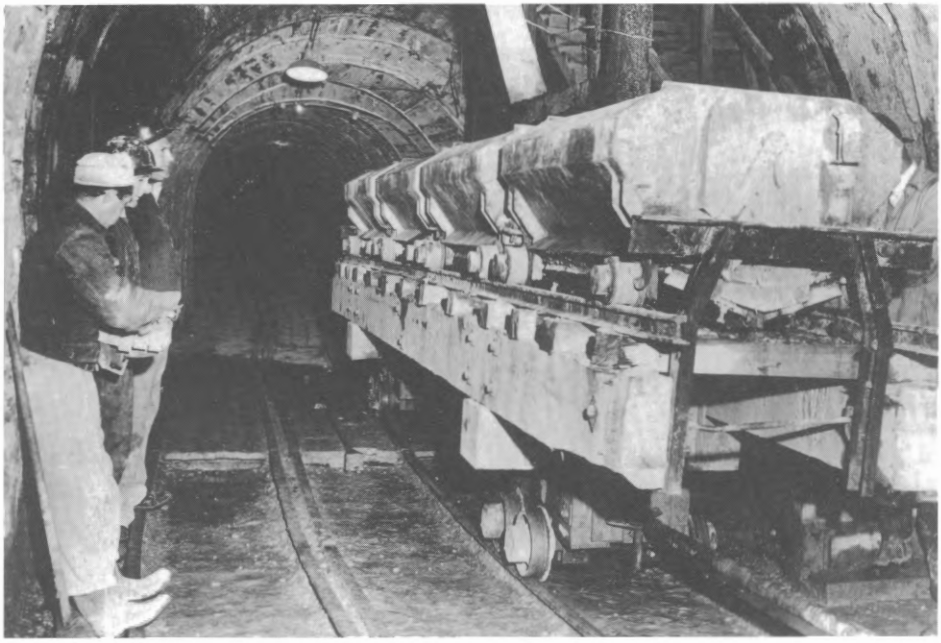
DRILLING 'JUMBOS'

Drilling frames, called 'jumbos' were used to hold the drilling machines rigidly mounted, keeping the drilling steel steady and in the correct position so minimising maintenance. An average rate of drilling was 45 holes per blast in sandstone and 28 to 32 holes in shale.

Gelignite was 60% A.N. used at 45 lb per round in sandstone and 35 lb per round in shale. Jumbos operated on wheeled carriages on the 2 ft gauge tramway.[10]

TUNNEL LOADERS

Blasted spoil was loaded into skips by mechanical tunnel loaders. Tenders were called in November



Transporter truck in position for receiving concrete dropped down the pipe. Note the additional single rail on left for centre track running. *Photo: J. Longworth*

Left:
Experimental mock-up in wood for a proposed three rail track at the plat for tunnel liner hauling. This version was not adopted.
Photo: J. Longworth Collection.

Below:
A battery electric loco at the face of the tunnel. 18 Dec 1947.
Photo: Sydney Water Board.

1945 for supply and delivery of Tunnel Mucking Machines and of six Eimco Model 21 Rocker Shovels were ordered ex USA from Ingersoll-Rand.[11] The locally produced Joy Model 20 Loader was a scraper loader and it was thought awkward to turn around in the tunnel. Initial plans were that twelve would have to be purchased for an equivalent output.

Due to a Commonwealth Government request to minimise use of dollar exchange and a price rise the order on Ingersoll-Rand was cancelled and a fresh one placed with the Sullivan Machinery Co Ltd for the supply of six Sullivan type HL-20 Pneumatic Tunnel Loaders.[12]

It was found that more loaders were required to meet the need of additional miners, spare machines, breakdowns and to allow the then seven machines to be overhauled. A tender was then accepted from Tutt Bryant Pty Ltd for the supply of three Eimco Model 21 Rocker Shovels.[13]

Five more Joy HL 20 loaders were subsequently ordered.[14] The Model HL 20 were fitted with side ploughs and a 7½ - 10 cubic foot bucket.

The Eimco loaders proved the more satisfactory in performance than the Joy loaders, with their greater reliability and economy of operation . Thus when more loaders were being purchased in 1962, the Eimco 21 loaders were the preferred model.[15]

A comparison of loading costs is shown in Appendix 'A'.

MINING TRUCKS

By 1946 the Water Board had a large collection of 30 cubic foot mining skips, of which 130 were in satisfactory order. Tenders were called for an additional 170 for work on both the City Tunnel and Warragamba Dam and finally accepted for 120 units. Tenders were based on a design derived by the Board from a Hudson catalogue. Bernard Smith Pty Ltd were the lowest tenderer at £50/16/0 each with a delivery time of 16½ weeks.[16]

Many skips were without wheels due to the practice of cannibalising wheel sets for use on mining 'jumbos' etc and so in January 1948 quotations were called for 134 sets of wheels and axles to replace the missing sets. The preferred quote was from Commonwealth Steel Co Ltd. These sets differed from the specification in that they had a 5⁵⁄₁₆ in instead of a 5⅝ in inner boss diameter. The difference was not considered as going to produce a significant alteration in the skip's operational performance.[17]

SPOIL DISPOSAL

On arrival at the surface of the shaft the skips were mechanically removed from their cage and tipped. Automatic skip discharge eliminated the need for manual hauling of skips from the hoist cage to the spoil bin, as had been the case on the earlier Pressure Tunnel work.

A piston operating in a pneumatic cylinder operated a running rope which was attached to the skip by a short tail rope. Air admitted to the cylinder pulled the running rope, which in turn pulled the skip out of the winding cage along a tilted track over the forty cubic yard spoil bin. Each poppet head was built with two bins, giving a total spoil bin capacity of eight cubic yards per shaft.On moving over the bin, the skip struck a curved steel rail which forced the hopper sideways into the tipping position, until it tipped and discharged its spoil into the bin underneath.

On emptying of the skip the piston was reversed by means of the valve, and the truck was drawn back into the hoist cage. En route the hopper was restored to the vertical position by means of contact with a fixed cam at the side of the track.[18]

TUNNEL LINER CARRIERS

To provide for the waterway, pipes were placed inside the tunnel excavation. These pipes were of 96 in (internal diameter) between shafts 1 to 7 a distance of 27,542 ft and 84 in (internal diameter) between shafts 7 and 13, a distance of 27,404 ft. All pipes were 12 ft long and were protected on the inside by a 2 in thick lining of concrete.

In order to get the pipes underground, some of the small double shaft cages were replaced with full size cages large enough to carry the pipes. A mobile crane lifted the pipes off the road transport and onto a specially designed liner carrier transport truck. Each truck was equipped with four screw jacks to form a cradle to carry the pipe in which it was shunted to the shaft, descended and was pushed into position at the face (see section on 'Track' for alterations to the track layout at shafts required for running the liner carriers on).

At the face, precast concrete cradles and wedges were placed under the pipe. Four tack welds to the end of the last laid pipe, held the pipe in place after alignment by the carrier's screw jacks, whereupon the carrier was reversed out and back to the shaft for reloading. The rails under the pipe were then removed and the pipe welded finally in place.[19]

CONCRETE SKIPS

Overbreak in the tunnel walls, roof and floor was filled with concrete as tunnelling proceeded. The void between the steel outside of the pipe and tunnel lining was then filled with[20] concrete applied through concrete guns. Concrete was mixed on the surface at shaft heads and dropped down tubes to the tunnel below where it was loaded into specially constructed concrete skips.

Thirty 20 cubic foot capacity, quick dumping, bottom discharge skips were ordered for placing concrete around the pipes. Nielson & Co supplied the steel skips[21] which were 5 ft 4½ in long (over buffers), 2 ft 1½ in high (above rail level) and 3 ft 0 $\frac{9}{16}$ in wide.

CONCRETE SKIP TRANSPORTERS

Four bottom discharge skips were carried at a time on a single decked transporter truck, pushed by locomotive from the base of the shafts to the liners already laid along the tunnel. At the liner face the four skips were winched onto the lower deck of a double deck stationary transporter with a moveable hoist section at the forward end. At the rear end of the stationary double deck transporter, a hinged ramp connected the single deck transporter to either the top or bottom deck of the stationary transporter as required.

Full skips were pulled onto the lower deck of the stationary transporter. The leading skip was then lifted by the hoist to the level of the upper deck and pulled forward over the hopper of the concrete pump. An air controlled lever released the bottom of the skip and the concrete fed into the pumphopper. This operation allowed concrete to be placed by the concrete pump at up to 60 cubic yards per shift.

Empty trucks were fed back along the top level to the double deck stationary transporter, past the hoist to the single deck transporter truck and the procedure repeated for each skip. Usually the top deck of the stationary transporter carried four empty skips which are transferred to the moving transporter immediately the full skips were taken off, so not delaying returning the transporter for another load of full skip s.[22]

In long leads three mobile transporters were used concurrently. The rear trucks were parked in side bays till the leading truck returned.

Operation of the single deck transporter feeding the double decker, appears to be a development of an earlier design. The earlier design had a transporter feeding a 52 ft long loop in two sections side by side. The two sections to the loop were to be supported on bogie wagons, in turn feeding a skip elevator that raised the full skips over the concrete pump hopper.

LIMITS OF THE TUNNEL RAILWAY

When the supply of cement and sand was required within sections of the tunnel already lined, railway technology failed to be the adopted solution. Accurate setting of sleepers to avoid 'wavy' track and possible damage to the pipe's 2 in thick concrete lining from sleeper ends precluded the continued use of rail transport. Three 'Ransomes' rubber tyred 2 ton electric fixed platform trucks were therefore ordered for this job.[23]

NON RAIL USE OF RAILWAY EQUIPMENT

Much rail was used for the hoops to support timber lining of the tunnel and as concrete reinforcement in sections of the tunnel where crossing geological fault zones.

To provide tunnel support at passing loops an order was placed with E.A. Marr & Sons Pty Ltd for approximately 50 tons of 90-100 lb second-hand rail at £14/7/6 per ton,[24] but by the time the order was placed the rails had been sold to another party. Fifty tons of 80 - 100 lb rail was then ordered from the Road Transport and Tramway Department and about 40 tons of 70 lb rail was lifted from the Sydney and Suburban Blue Metal Quarries near Prospect.[25]

CONCLUSION

The 2 ft gauge railway played an essential part in construction of the City Tunnel. Arranging for supplies of plant and machinery for this project was no simple or one-off matter. Quotations were continually sought and often subject to negotiation both before and after a price had been offered. Several times the lowest price was overlooked for better quality products. Much railway material was used for non-railway purposes.

Both the locomotives and their batteries gave exemplary service during construction of the City Tunnel and formed a vital plant item enabling tunnelling to proceed regularly. Reliable operation of railway was the key to attaining optimum construction progress.[26]

Filling the tunnel overbreak with concrete. *Photo: J. Longworth*

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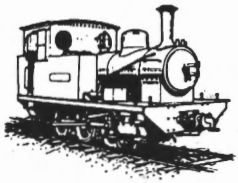
APPENDIX A: ESTIMATED LOADING COSTS INCLUDING OVERHEADS (in shillings)

Method	Per Lin. ft	Per c yard
With Arrol Whitaker Tunnelling Machine adapted to 12' diameter in shale only	116.1	27.6
Blast & load by Conway Loader alternately at 2 faces		
in shale	144.2	44.3
in sandstone	163.7	50.3
Blast & load by Scraper Loader alternately at 2 faces		
in shale	123.1	39.7
in sandstone	141.7	45.7
with 1 Scraper per face		
in shale	128.5	41.4
in sandstone	147.1	47.4
Blast & load by hand		
in shale	154.9	49.0
in sandstone	173.5	55.0



BOOK REVIEW

Bob McKillop, **Directory of Australian Tourist Railways and Museums 1993,** in Rail Scene Australia, Australian Railway Historical Society, N.S.W. Division, Sydney, 64 p, soft cover, RRP $7.95.

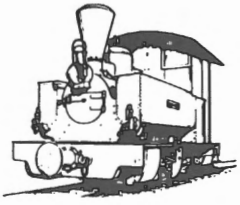
This publication is a joint effort of the ARHS and LRRSA and lists the tourist railways and museums, including electric tramways, which will be open for visitors during 1993-94.

The entries provide a brief background to each museum or railway operation, followed by directions on how to get there by public and private transport, a summary of the feature exhibits and information on opening hours/operating timetables and contacts. All Australian states and territories are represented and there is a comprehensive index provided.

The publication is in the A4 format and is adequately illustrated with photographs and logos. This is the third edition of the directory and it improves each time round.

Highly recommended to LRRSA members. Buy one and leave it permanently garaged in the glovebox of your car.

D.S.



LETTERS

Dear Sir,

Identification

In answer to the request of Jim Smith for information regarding the location of the subject matter contained within the photograph on page 23 of LR 118, I offer the following:-

The photograph depicts Munro's Mill on the Eastern Tyers River near Erica. Going by the scene and taking particular note of the mill huts on the left of the photograph, my guess is that the photograph would have been taken around 1922 or 1923. Munro's mill was moved to this location in 1920 and occupied the site until 1929. I would refer readers to page 2 of Trestle Bridges and Tramways (LR 79) for a photograph taken at much the same location in 1925. The tramway in question operated until 1927 when the Forests Commission of Victoria Tyers Valley Tramway was completed through to Ten Acre Block. After this time all timber went over the new line to Collins Siding.

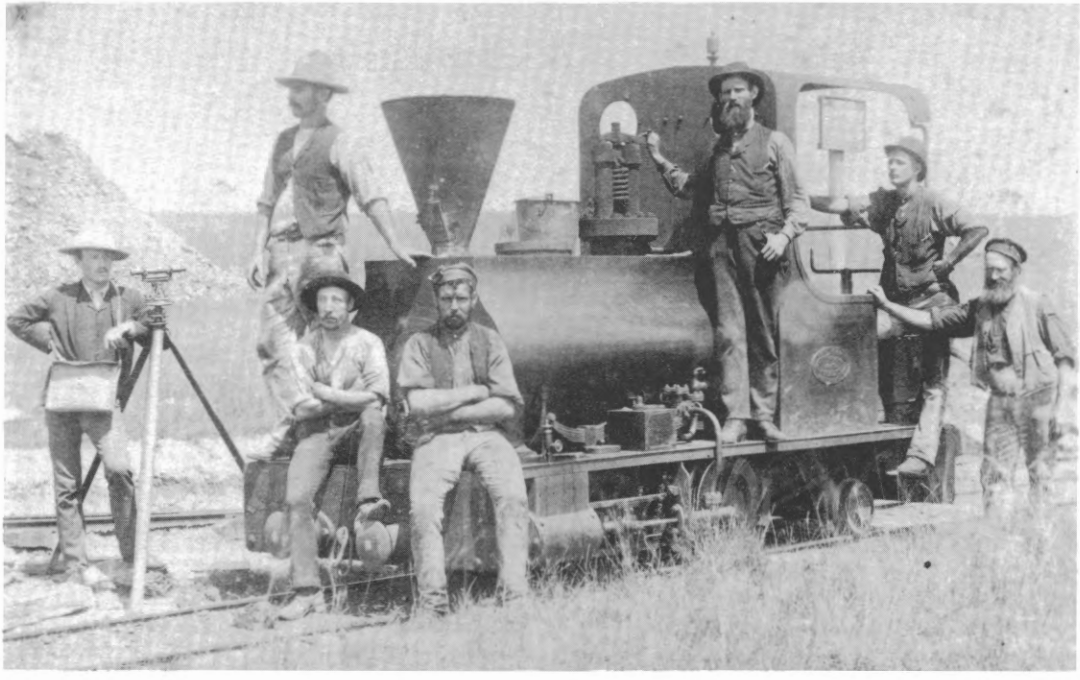
M.J. McCarthy,
The Basin, Vic.

Dear Sir,

Denton Park Loco

The enclosed photograph came into my possession some years ago as a gift from the estate of the late Mr Les Pitcairn, a prominent Maitland identity who had more than a passing interest in local railway matters. Mr Pitcairn began his working life as an apprentice with the East Greta Coal Mining Company (forerunner of the South Maitland Railways) and worked on the assembly of the Company's (2nd) No 10 locomotive (BP 5220/1911), which was shipped out from England in knocked down condition. During these endeavours he became stuck in the firebox of No 10 while tightening boiler stays, and was only extricated with some difficulty, an episode that earned him a place in local folklore. He later established himself as a funeral director as well as the proprietor of a joinery factory in Maitland, and often related stories of happenings on the Mayer's Point Tramway, which was the source of his timber supplies.

Unfortunately, I can add little to the description



recorded on the reverse of the photograph: 'A print taken from a photo of the locomotive that hauled coal from Denton Park colliery to Farley railway sidings during World War 1.

Denton Park colliery was situated to the east of Rutherford, and the railway crossed the New England Highway near where the road dips onto the plateau immediately north of Rutherford Hill. The remains of the formation thereabouts were still more or less parallel to, but well south of, the NSWGR Rutherford Branch, and terminated at an exchange siding at Farley, although there was probably no physical connection to the Main Northern Line.

I believe that Denton Park colliery had a very short existence around the World War 1 period. Considering that this locomotive probably had another life before or after the above period, I have kept a vigil in Light Railways for photographs of a similar machine, to no avail. I hope someone will be able to fit this photograph into a larger jigsaw.

R. Driver,
Killara , NSW.

Dear Sir,

Kookaburra Tramway

I have recently returned from holidays in Kempsey, NSW. One day my grandson took me for a drive out to a place called Kookaburra which is 80 km west of Kempsey in the bush. Many years ago it was a thriving timber mill industry and community. I'm told there was once a school there and you can make out by the formations here and there where dwellings once stood. There are only a couple of parts of machinery left which I have enclosed photos of. I also came across a set of bogey wheels, fairly rusted and the axle bent a little. I'd say they were from a 2 foot gauge track.

At the end of the second world war I worked at George Morgan's mill on the Western Tyers river out from Erica. I recall the Climax loco at the junction and it is interesting to see it restored here in Belgrave once again.

C. Lancashire,
Belgrave , Vic.

The machinery remains at Kookaburra.

Dear Sir,

Typos and Factos LR 117 and 118

The cover photograph on LR 117 shows Kerr Stuart locomotive 1290/1915, while that on page 8 shows KS 1290 at left with KS 1053/1909 at right. The gauge, shown on page 15, was 30 ins not 40 ins.

John Browning's letter in LR 118 does, however politely, highlight a real problem in the production of LR: typograpnical errors due to inadequate proof reading. The reputation of LR for publishing thorough and well documented research is lessened by the numerous printing errors, particularly as they often relate to company names, dates, dimensions and locomotive builders' numbers. As John Browning's corrections relate, in the main, to letters of mine I can confirm all of them, including the correct spelling 'S.S. Menelaus'. In the past I have refrained from sending corrections to the editor (whose efforts I greatly admire) on the basis that the meaning was self-evident and mis-spelt names would be apparent to those with a detailedinterest in the subject. However, the final sentence of my letter in LR 118 on the gauge of the Hartley Vale Shale Railways has had, in printing, its meaning totally altered. I actually wrote that Dubs (spelt with a diaeresis over the u) & Co records are quite unequivocal in showing one metre (sic) as the gauge of their 1442 of 1881, the 2-4-0T. My letter on Kitson tram engines in LR 118 referred to Dr Whitcombe's 'History of the Steam Tram'.

I wonder if it would be possible for a small team of LRRSA members to help the editor by providing a proof-reading service?

R.T. Horne, Surry,
England.

[Editors usually only ever receive critical letters so there is no need for a correspondent to soften the blow - editors are used to it! Point taken. LR 118 was plagued with disc setting problems and large slabs of text had to be re-keyed in a hurry, hence the mistakes. Please keep those critical letters rolling in for the sake of accuracy. NH]

Dear Sir,

Beechy Follow Up

I have just finished reading 'The Beechy' from cover to cover and wish to congratulate you and thank you for the huge amount of research involved in preparing such a book. Two 'what next's' come to mind after finishing the book.One is - there are a lot more photos of the line than have been published hitherto, particularly toward the end of its life - many in colour. I would like to see in print more photos of G42s trips to Crowes dismantling track.

Are there plans to publish a photographic pictorial of the railway, perhaps similar to Stephen Watson's efforts on the Walhalla Line? It would be a wonderful idea before some of the prints disappear or are accidentally destroyed, and to bring as much visual history as possible to those who love the train.

Secondly, I have in my possession the odd recordings of G42 on the line on various records and wondered how many more tapes exist mouldering away in boxes. I have copies of 'Steam on the 5'3"', 'Souvenirs in Steam' and 'Whistles in the Hills' (do you know of any more recordings published?). Again I wondered if LRRSA might investigate publishing a sound recording CD of workings on the line - specifically sounds of G41 and the NAs (14A) on the line. All the tracks on the above records are of G42.

Thanks again for a wonderful book.

John Robin,
Meander, Tasmania.

[There are no specific plans for a Beechy pictorial or sound recording but reader follow up is sought. Do you have photographs or tapes that could be used for such projects? NH]

Above: Sailor Salt Loco, LR 112 p. 10. This recently unearthed photograph shows the Purcell loco at work on the tramway near Linga.

Below: Garratt G42 a long way and a long time from Colac and dismantling trains. Shot at Walhalla in 1926. Photo: Ellis Collection.

THE BUSH TRAM LINE

L. J. Gray

From The Melbourne Walker Vol. 19, 1948

Do you recall it? the old timber tram line
Shaded by myrtle, and bordered by vine
Kind to the feet were the fraying sleepers
Clear was the path save for vagrant creepers.

Trail ever winding by tree-fern and mistle-toe
Sidling the spurs with the clear stream below
Dext'rously guided, cheating the ridges
Spanning the gullies on high trestle bridges.

Onward and upward to the mill site advancing
Each bend revealing a scene more entrancing
Parallel rails bring the traveller to rest
Deep in the forest by the range's crest.

Musing, we picture the creaking old trolley
Drawn by lean horses, Bluey! Polly!
High up the driver on sap scented freight
Skilfully braking, easing the weight.

Hark! how discordant that whining and creaking
Why are our feathered friends wheeling and shreiking?
Surely the dozer will never invade
Never seek to defile this beautiful glade.

Yes! Look at it! SCREAM AT IT!
Fouling the air with its fumes and its racket
Tearing asunder the green vegetation
Ah! what a trail of stark desolation.

Helpless, the sassafras, hazel and birch
Mutely protest as over they lurch
Maddened, the streams now unshaded snarl
And frenziedly gush o'er the barren marl.

Rev up you Moloch, vile son of Mars
Nothing you reek of the hideous scars
Nature endures from your merciless claws
Callous; insatiable, murderous jaws.

Farewell old tram line, victim of progress
Symbol of spacious days lost in the process
Of mechanisation - detestable word
Better the world was before it was heard.

Soon there'll be bitumen, shining and hot
Serving the demon speed, but not
Of kind Mother earth, even a track
For the leisured walker, the man with the pack.