LIGHT RAILWAYS

UNDERGROUND COAL, MATERIALS AND MAN TRANSPORTATION IN THE COALMINES OF THE NORTHERN COALFIELDS OF NEW SOUTH WALES

by Brian R. Andrews

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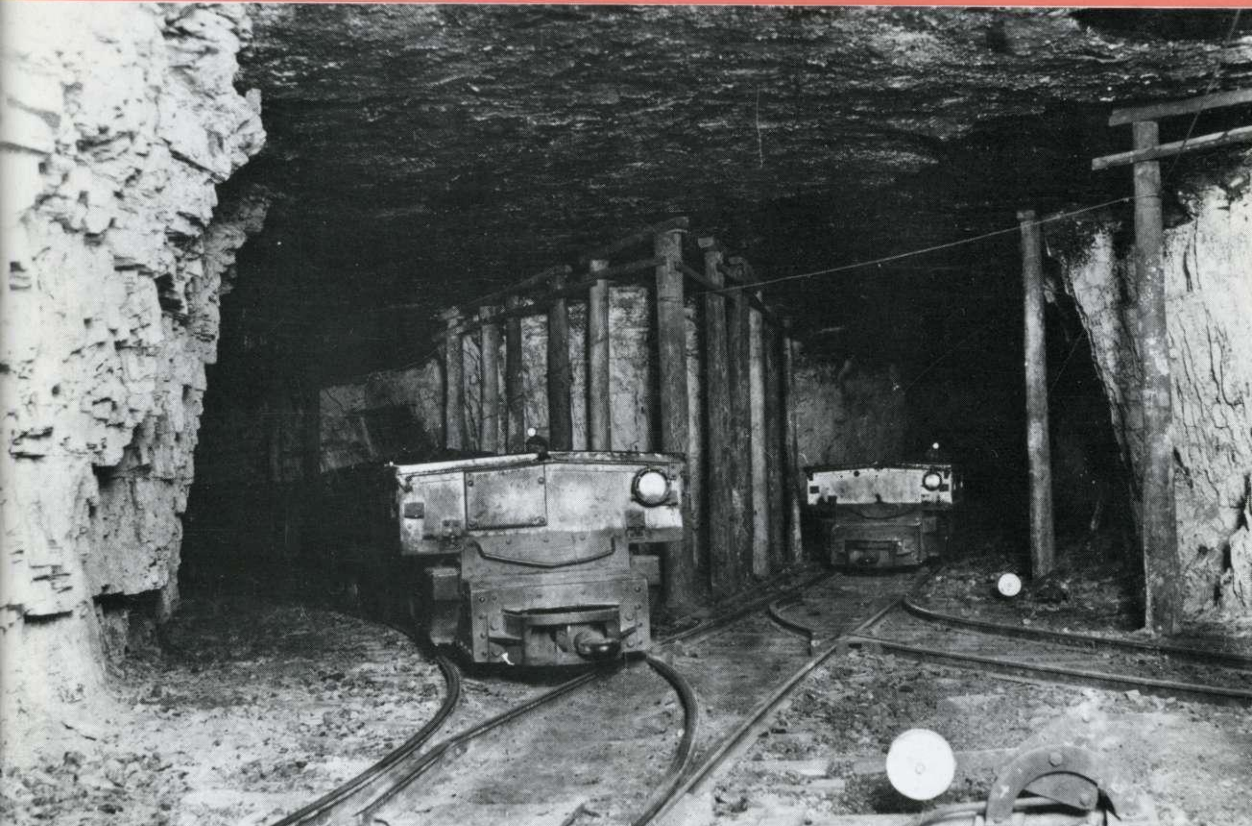

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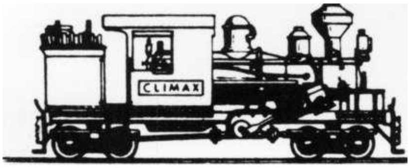

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UNDERGROUND COAL, MATERIALS & MAN TRANSPORTATION, NORTHERN NSW COALFIELDS

by Brian R Andrews

EDITORIAL

The transport of coal, materials and miners in underground locations is rarely observed by the public, but frequently involves large scale rail systems. Horse-drawn, endless rope, direct and locomotive haulage systems operated over extensive distances in underground mines.

In this issue of *Light Railways,* Brian Andrews reviews the historical development of underground transport systems in the Northern Coalfields of New South Wales. Backed by outstanding drawings and photographs, he provides a fascinating introduction to the varied and complex transport systems employed by the major collieries of the region. It offers an interesting change of scene for our journal, and one which I hope will be followed up with further articles in the future.

RFM

GLOSSARY OF MINING TEAMS

Bank to Bank: **the time the miners get in the cage on the pit top at the start of the shift, to the time they finish at the same spot The "bank" level is the level on the pit top at which the cage stops for loading or unloading.**

Bord: **the underground passageway made in the solid coal.**

Cavil: **a quarterly or half-yearly redistribution of working places in the mine made between contract parties of miners to ensure that an equitable redistribution of "easy" and "difficult" working places was achieved.**

Clipper, **person who attaches rope clips to a moving endless rope haulage.**

Darg: **output of coal (in skips) arbitarily fixed by contract miners as constituting a day's output per man.**

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

Drift: **tunnel cutting across the bedding of the strata — also known as a "cross measure drift".**

Flat: **marshalling or storage depot for full or empty skips. One flat may serve a number of working faces.**

Goaf: **an area where the coal has been removed and the roof allowed to fall.**

Headframe: **structure erected at surface above shaft to permit the rope of the winding engine to pass down or up the shaft via sheaves placed on top of the structure.**

Heading: **roadways forming the openings in the direction of development of the panel.**

Heapstead' **elevated building from shaft to over-rail tracks and housed skip tumblers, picking belts and skip rail tracks.**

Holding: **the area the colliery has the right to mine.**

Miner's rail: **a rail used by contract miners from the end of permanent laid rails. They were butted together and fishplates were not used to join them. The rails were spiked to sleepers and easily removed for further use.**

Monkey: **skip stop in cage.**

Panel **portion of the mine workings mainly isolated by barriers from the next district**

Pillar: **the block of coal left to support the roof. It is later extracted**

Section: **actual working area (as in panel headings).**

Token: **identification used to label a skip for a contract miner to enable the contents to be correctly credited to the miner. It usually consisted of a leather tag, about 25-30mm, with a length of marlin (waterproof rope) to enable attachment to a skip. A number was stamped in the leather and this number corresponded to the number allocated to the miner by the colliery.**

Tommy Dodd Roller: **roller placed between rails or between rail and rib to support haulage rope.**

Undercut: **to cut below or undermine the coal face by chipping away the coal by a pick or mining machine.**

Wheel: **the movement of skips of coal by horse or locomotive. In modern day, the movement of coal in shuttle cars from the coal face to the belt**

Cover: Underground junction with battery locomotives and trains of mine cars at Elrington Colliery, 27 July 1933. The locos were built by A Goninan & Company of Broadmeadow under licence to Atlas Car & Manufacturing Co, USA.
Photo: BHP Collieries

1. TRANSPORT SYSTEMS

INTRODUCTION

The coalmines of New South Wales are one of the largest users of rail transport systems in the state, both on the surface and underground In many cases the colliery had extensive standard gauge rail operations on the surface to move the production from the mine. More significant, were the narrow gauge rail systems used underground to move the product from the coal face to the surface. This article outlines the historical development of these underground transport systems on the northern coalfields of New South Wales.

Coal was laid down in seams of varying thicknesses and depths known as measures. The number of seams in these measures varies considerably, with up to eight seams in some cases and only one in others. These seams lie over vast areas and are subject to many physical deformities, such as dykes and faults, which all add to the difficulties in extracting the coal.

The Northern Coalfields of New South Wales embrace an area extending from Newcastle to the southern shores of Lake Macquarie, then northwest to Cessnock, north to Branxton, east to Maitland and back to Newcastle. Three different coal measures are contained in the area and are known as the Newcastle, the Greta and the Tomago coal measures. The Newcastle measure is the uppermost, the Greta is the middle, whilst the Tomago is the lowest of the group and has been worked extensively in the East Maitland area.

Development of the Northern Coalfields

Early records indicate that coal was first discovered at Newcastle on 9 September, 1797 and that the first cargo of coal exported from Newcastle was loaded on the barque *Hunter* which sailed for India in 1799. In the early days, most of the coal was raised from collieries working in close proximty to the Port of Newcastle. These mines were

Hand mining at Abermain No.2 Colliery, 1949. Photo: B Andrews Collection

Government owned and worked by convict labour. During 1829 the Australian Agricultural Company (AA Co) took over the mines from the Government on the condition that the company had the exclusive right to mine coal in the district for a period of thirty years.

By 1844, with other parties involved in mining coal in the area (the most notably being Messrs James & Alexander Brown), the AA Co made an attempt to enforce its rights. Accordingly, in fulfilment of its obligations, the Government implemented proceedings to stop the Browns from mining coal. The celebrated action, Attorney General V Brown, followed in 1846. The Browns lost the case. A new trial was sought, granted and heard in the full court in 1847. Again the Browns lost In true fighting spirit, the Browns took their case to England, where the Imperial authorities, seeing that the AA Co had the whole of the coalfields in their hands, effected a comprimise and this enabled the Hunter District coalfields to be opened up. The Browns stepped up their mining operations at Burwood and later at Minmi, whilst others entered the coal trade in earnest

During 1860, the Newcastle Wallsend Coal Company was formed to mine coal in the Wallsend District, whilst the Scottish Australian Mining Company commenced mining operations at Lambton. These companies, like the many to follow, constructed standard gauge railways to connect their collieries with the Port of Newcastle. Over the following decade, many coal companies were formed and opened collieries to tap the rich Borehole Seam of the Newcastle measure. The early 1880's saw the establishment of the delta collieries working under the tidal waters adjacent to the Port of Newcastle, whilst by the 1890's collieries were being developed southwards along the coast towards Redhead and inland The West Wallsend Coalfield contained four collieries tapping the Borehole Seam, West Wallsend Colliery (1888), Monk-Wearmouth Colliery (1890), Killingworth Colliery (1897) and Seaham No. 2 Colliery (1905). This group of collieries was the last to mine the Borehole Seam coal, prior to the rapid development of the Greta measures during the early 1900 period.

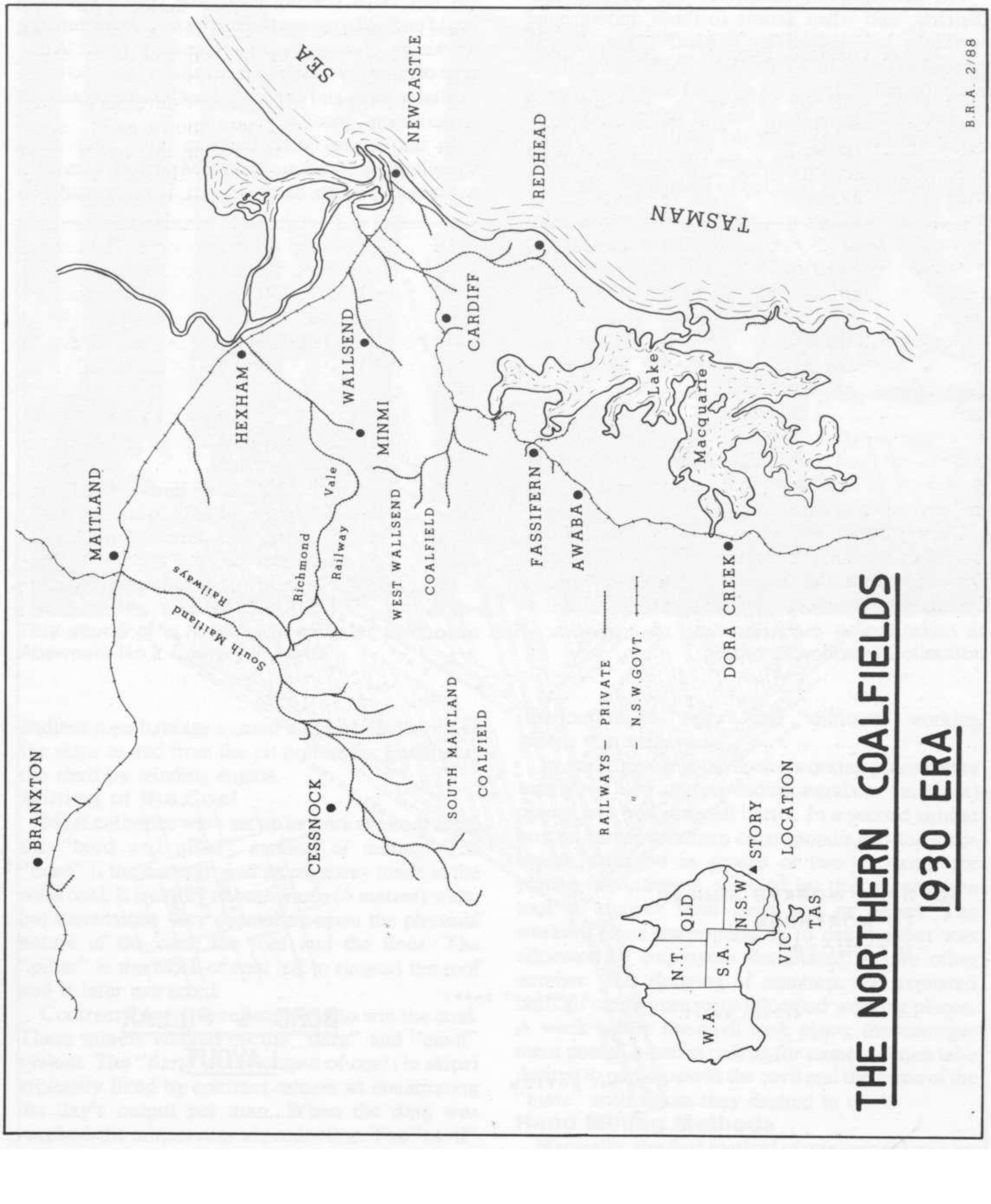
The Greta Measure

Although the main Greta seam was discovered as early as 1864, it wasn't until 1886 that a detailed geological survey was commenced to prove the existence of tne Greta coal measures in the Cessnock area. Accordingly, the seam was proved in that year in a creek at Abermain, not far from where Abermain No. 1 Colliery was later established. Some five years later, the East Greta Coalmining Company was formed and, during 1894, this company opened their East Greta Colliery near Maitland. This was the beginning of the exploitation of the Greta coal measures.

From 1900 to 1912 intensive development took place within the area now known as the South Maitland coalfields and during this period some eleven major collieries were established. Companies working the Newcastle measures transferred their operations to the South Maitland field as their old collieries worked out their reserve. The Browns supplemented their Minmi production with coal from Pelaw Main (1900) and eventually constructed the Richmond Vale Railway to transport the coal produced from both Pelaw Main and Richmond Main (1914) to the riverside at Hexham for shipment

The AA Co opened Hebburn Colliery (1902) and the Seaham Colliery Co Ltd formed Abermain Collieries Ltd to develop Abermain Colliery (1901), Abermain No. 2 Colliery (1912) and Abermain No. 3 Colliery (1923), whilst the Caledonian Coal Company Ltd opened their famous Aberdare collieries between 1905 and 1917. Other companies operating at Newcastle transferred to the South Maitland field as their mines became uneconomical to operate. The Wickham & Bullock Island Coal Company opened Neath Colliery (1906), the Hetton Coal Company developed Bellbird Colliery (1912) and the Newcastle Wallsend Coal Company opened Pelton Colliery (1916).

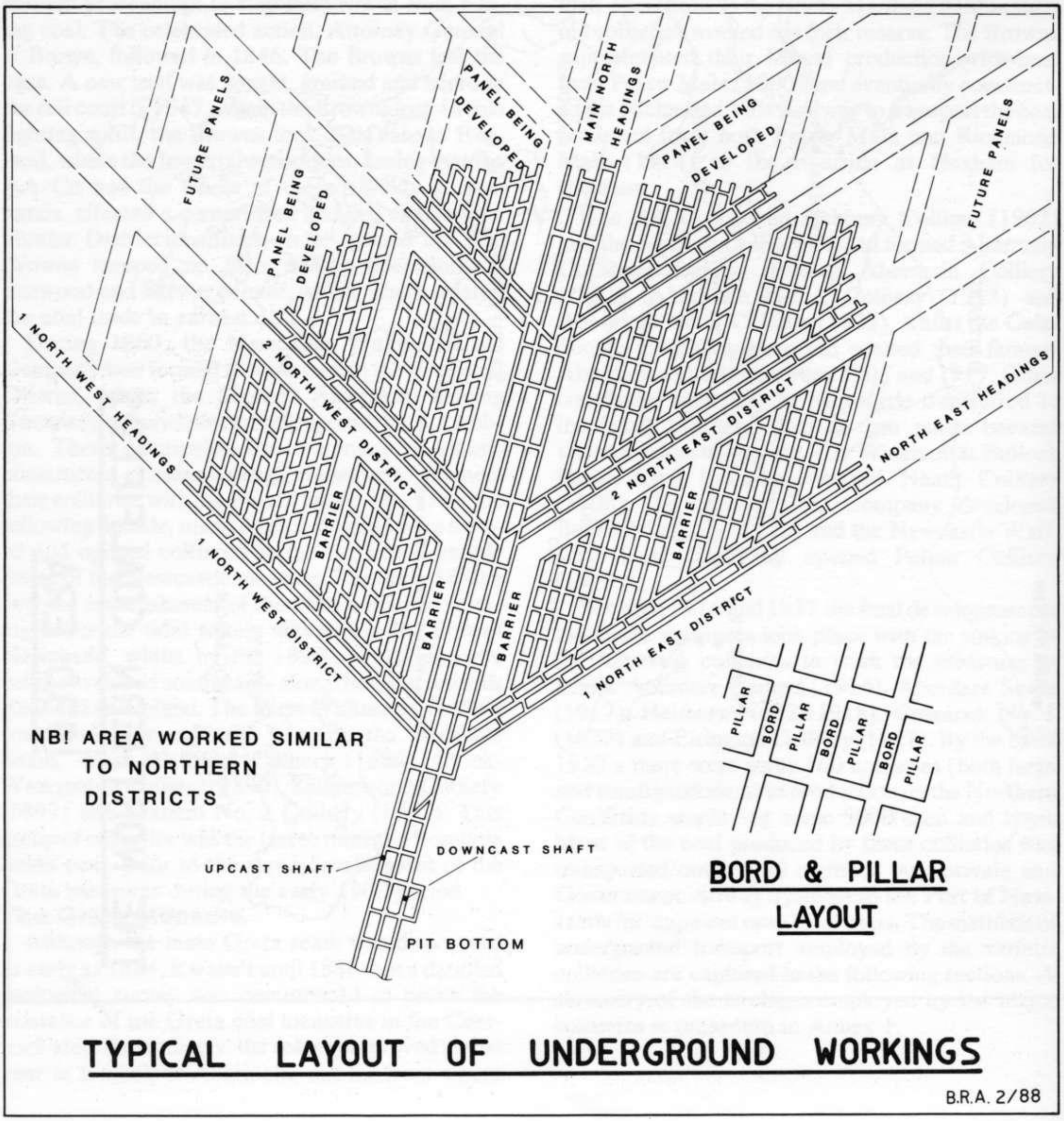
Between 1914 and 1927 the final development of the Greta measures took place with the sinking of the following collieries to work the measures at depth: Aberdare Central (1914), Aberdare South (1917), Hebburn No. 2(1918), Cessnock No. 1 (1922) and Ellington Colliery (1927). By the early 1930's there were some 160 collieries (both large and small producers) in production on the Northern Coalfields employing some 9000 men and boys. Most of the coal produced by these collieries was transported out by rail methods over private and Government railway systems to the Port of Newcastle for shipment or to local users. The methods of underground transport employed by the various collieries are explored in the following sections. A summary of the haulages employed by the major collieries is presented in Annex 1.


THE NORTHERN COALFIELDS
1930 ERA
NEWCASTLE
SEA
TASMAN
REDHEAD
CARDIFF
WALLSEND
HEXHAM
MINMI
MAITLAND
BRANXTON
CESSNOCK
FASSIFERN
AWABA
DORA CREEK
Lake
Macquarie
Richmond Vale Railway
WEST WALLSEND COALFIELD
SOUTH MAITLAND COALFIELD
South Maitland Railways
RAILWAYS — PRIVATE
" — N.S.W. GOVT.
▲ STORY LOCATION
N.T.
QLD
W.A.
S.A.
N.S.W.
VIC
TAS
B.R.A. 2/88

MINING METHODS
Underground Layout

All underground coalmines are divided into districts, and when access to these underground workings was gained by vertical shafts, it was normal practice to locate these shafts centrally in the colliery holding. This allowed coal to be won in all four directions from the pit bottom. In some cases the company sank the vertical shaft in the corner of the dip of the seam (deepest part of the coal seam over the holding) to assist the haulages in moving skips to the pit bottom. In such cases, the skips ran under gravity and the energy generated by the full skips coming down the travelling roads could be used to move the empty skips back into the workings. There were two major draw backs in this type of mine layout the deeper shafts required extra capital to sink, and coal could not be won on all four directions at once.

In the central shaft location mine, four main travelling roads radiated from the pit bottom mainly to the north, south, east and west In these roads, an



TYPICAL LAYOUT OF UNDERGROUND WORKINGS

B.R.A. 2/88

This scene of a horse and wheeler symbolise early underground coal transport. It was taken at Abermain No.2 Colliery in 1949. Photo: B Andrews Collection

endless rope haulage system was installed to move the skips to and from the pit bottom for hauling up the shaft by winding engine.

Mining of the Coal

Most collieries were set up to work the coal using the "bord and pillar" method of mining. The "bord" is the underground passageway made in the solid coal. It is usally about 6 yards (6 metres) wide, but dimensions vary depending upon the physical nature of the coal, the roof and the floor. The "pillar" is the block of coal left to support the roof and is later extracted

Contract miners were employed to win the coal. These miners worked on the "darg" and "cavil" system. The "darg" is the output of coal (in skips) arbitarily fixed by contract miners as constituting the day's output per man. When the darg was reached, the miners ceased production. The "cavil" is a quarterly or half yearly redistribution of working places in the mine made between contract parties of miners to ensure that an equitable distribution of "easy" and "difficult" working places was achieved

In carrying out a cavil, the working places were numbered and corresponding numbers (marbles) placed in a box or small barrel. In a second similar box or barrel, numbers corresponding to the employees arranged in groups of two or more, are placed Scruitineers selected by the miners then took a number from each box or barrel. The working place corresponding to one number was allocated to employees designated by the other number. The drawing of numbers was repeated until all employees were allocated working places. A week before the cavil took place, the management posted a notice calling for names of men who desired to participate in the cavil and the name of the "mate" with whom they desired to work.

Hand Mining Methods

Naturally, the first method of mining coal was by hand, which involved a great deal of physical effort by the workers involved The miners undercut the coal face by hand using a pick, drilled the face with hand drills, stemmed the holes with explosives, fired the charge and then shovelled the coal into skips. In very early mining, the coal was picked from the face and loaded into wheelbarrows and hand-pushed from the mine. Later small skips, of nominal one ton capacity, were run on wooden rails and hand-pushed from the mine. Eventually horses were used to haul the skips from the coal face, which reduced the physical effort in mining coal.

As technology progressed, mechanical operated haulages were invented to move the skips of coal underground and, in some cases, these haulages brought the skips through to the surface. In other cases a combination of different types of haulage eventually got the coal out into the daylight after being underground for many millions of years.

ROPE HAULAGES: 1890-1920

By the beginning of the century, the major coalmines of the Northern Coalfields were operating mechanical haulages underground to move the skips to and from the working places. Until the advent of electricity, steam engines worked these haulages from the surface. In the case of shaft mines, a band strap engine on the surface worked an endless wire rope which ran down one of the vertical shafts and turned gearing on the pit bottom, which in turn was connected to the endless rope haulage and, accordingly, drove this haulage system In the cases of tunnel or drift mines, the haulage was situated on the surface and a reciprocating steam engine was coupled directly to the haulage. With the advent of electricity, electric motors were coupled to the haulage underground

Endless Rope Haulage System

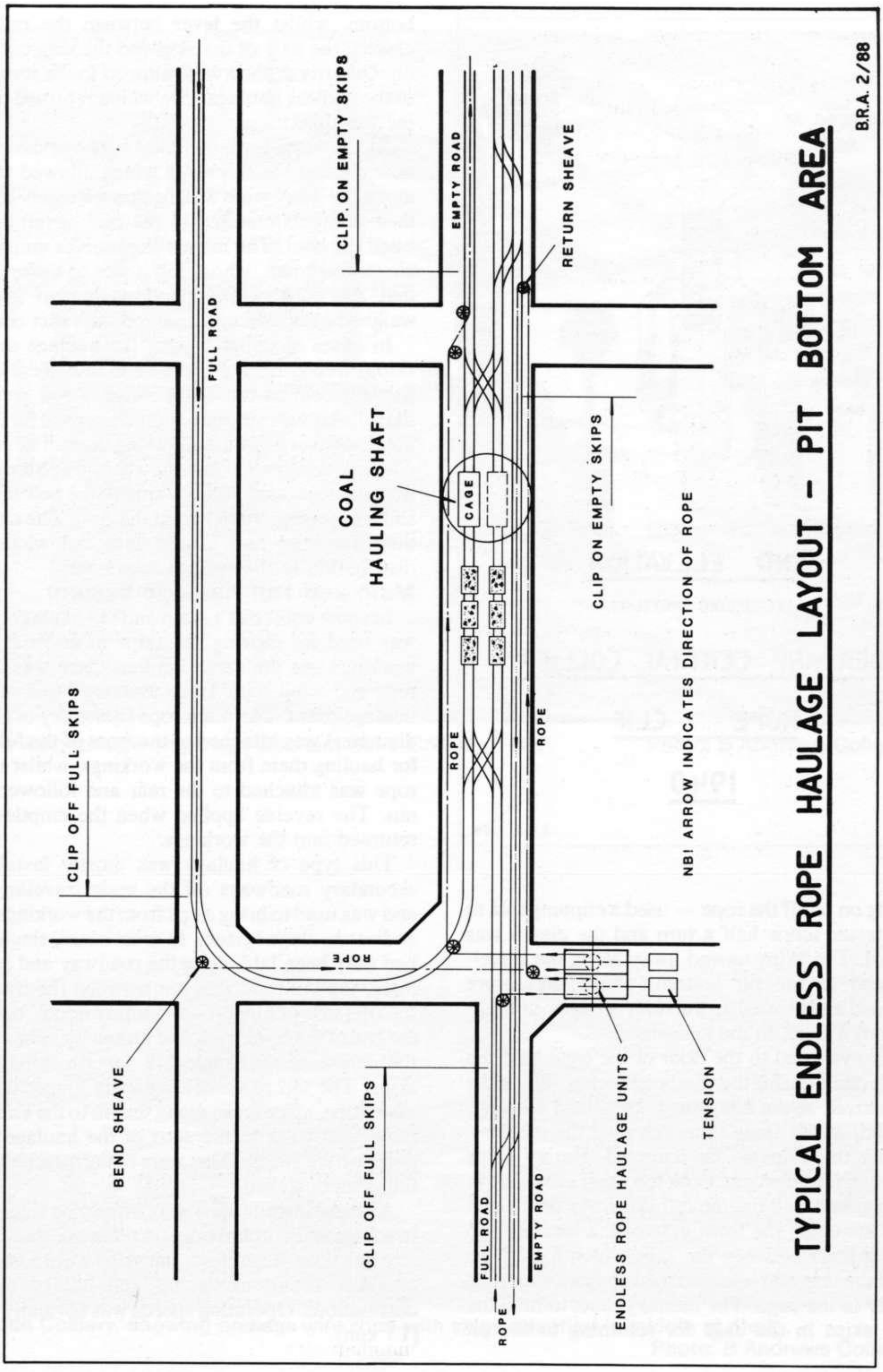
The endless rope haulage system consisted of several wire ropes spliced together and wrapped around a haulage drum. The drum is normally a "C" profile which allows the rope to wind on and off without becoming locked together. The rope winds onto the drum on one side and, after winding around the drum for a couple of turns, winds itself off on the other side. The "C" shaped profile of the rope drum allows the rope to slide down the drum, thus allowing another turn of rope to follow on the drum.

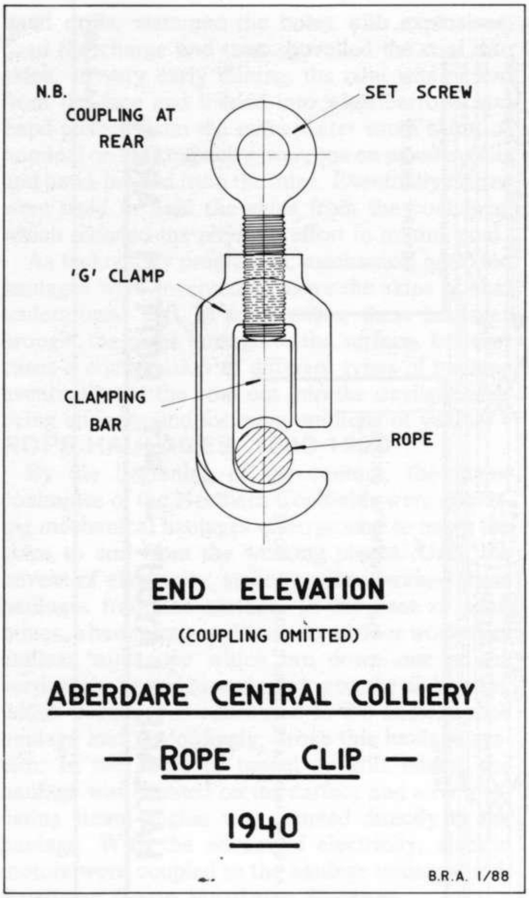
After leaving the drum, the rope is directed by sheaving onto the centre of the trackwork and, after arriving at the end of this track, is turned by sheaving to follow the trackwork in the opposite direction. At the pit bottom the rope is directed onto the drum and continues this process going round and round. The empties are taken into the workings by one track and the full skips are hauled back on the other. Operating speeds were normally 1.5-2 mph (2-3 kph).

As the main travelling roads progressed, panels were developed off these headings and from these panels, sections were subsequently worked To enable coal won to be moved out by skips, rails were laid along the headings and into the "bords" (tunnels in the coal) up to the coal face. In the main travelling roads of the various districts, permanent rails were laid using mainly 20-30 lbs/yard rails (8.5-13 kg/m). Temporary rails into the bords were laid using "miners rails", which were laid by the pair of contract miners working the bord When the bord was completed, the miners reclaimed their rails for reuse in their next working place. The permanent rails in the travelling roads were laid by road layers who were responsible for the upkeep of the travelling roads.

After the skips had been filled by the miners, they were "wheeled" by a horse to a flat area on the main travelling road for attaching to the endless haulage. Each pair of contract miners was given a number for identification purposes and leather tags with the corresponding number stamped on, known as a "token", were allocated to these miners. A token was attached to each skip to enable the contents to be credited to the right pair of miners after weighing. The token was attached before the skip was filled through two holes in the end by a length of marlin (rope) about 12 in. (30 cm) long. The marlin was inserted through the two holes, then looped through itself. Once loaded, it was impossible to insert a new token, thus preventing other miners removing the token and replacing it with his own. When the skip arrived at the surface for weighing, the token was removed, the number recorded against the skip and its weight was credited to the miners with the corresponding identification number.

On arrival at the endless haulage rope, the filled skips were assembled mainly in rakes of three for attaching to the rope. Since the haulage rope was always in motion, the skips were attached by the use of a rope clamp and coupling chain. The rope clamp consisted of a "G" shape casting which allowed the rope to slide through. A coupling chain attached to an arm on the clamp allowed the skips to be attached to the rope clamp. A set screw with eye fitted passed through the top of the casting and worked against a clamping bar. The set screw, when tightened, engaged the clamping bar against the rope and, in turn, against the casting. When this had been completed, the rope clamp moved away along the rope with the skips following. Although it may sound complicated, it was a simple operation as the rope clamps were adjusted to slip over the rope with minimum clearance. The "clipper" — the person


TYPICAL ENDLESS ROPE HAULAGE LAYOUT - PIT BOTTOM AREA
B.R.A. 2/88
NB! ARROW INDICATES DIRECTION OF ROPE
COAL HAULING SHAFT
CAGE
CLIP ON EMPTY SKIPS
CLIP ON EMPTY SKIPS
CLIP OFF FULL SKIPS
CLIP OFF FULL SKIPS
FULL ROAD
EMPTY ROAD
FULL ROAD
EMPTY ROAD
RETURN SHEAVE
BEND SHEAVE
ROPE
ROPE
ROPE
ROPE
ENDLESS ROPE HAULAGE UNITS
TENSION



clipping on or off the rope — used a clipping tool to give the set screw half a turn and the clamp was engaged. The skips moved away along the travelling road to the pit bottom, where they were unclipped and hoisted up the shaft in cages, normally two at a time, to the heapstead.

Monkeys fitted to the floor of the cage held the skips in place during the winding process. When the cage arrived at the heapstead, keps held the cage firm and, at the same time, released the monkey, enabling the skips to be removed. Empty skips gravitated into the cage from the other side and, in so doing, knocked out the full skips. As they came out of the cage, the front axle of the leading skip struck a lever between the rails which fouled the axle of the skip and released the kep from under the monkey in the cage. The monkey reset to hold the empty skips in the cage for returning to the pit bottom, whilst the lever between the rails now cleared the axle of the skip and the skip continued on. On arrival, they were clipped to the return side of the endless haulage rope which returned them to the workings.

At the heapstead, the lever between the rail had now cleared the full skips which allowed them to move on. They were weighed on a weighbridge and their contents credited to the pair of miners who filled the coal. The miners themselves employed a checkweighman, whose job it was to make certain that the colliery employed weighman correctly weighed each skip and credited the exact contents.

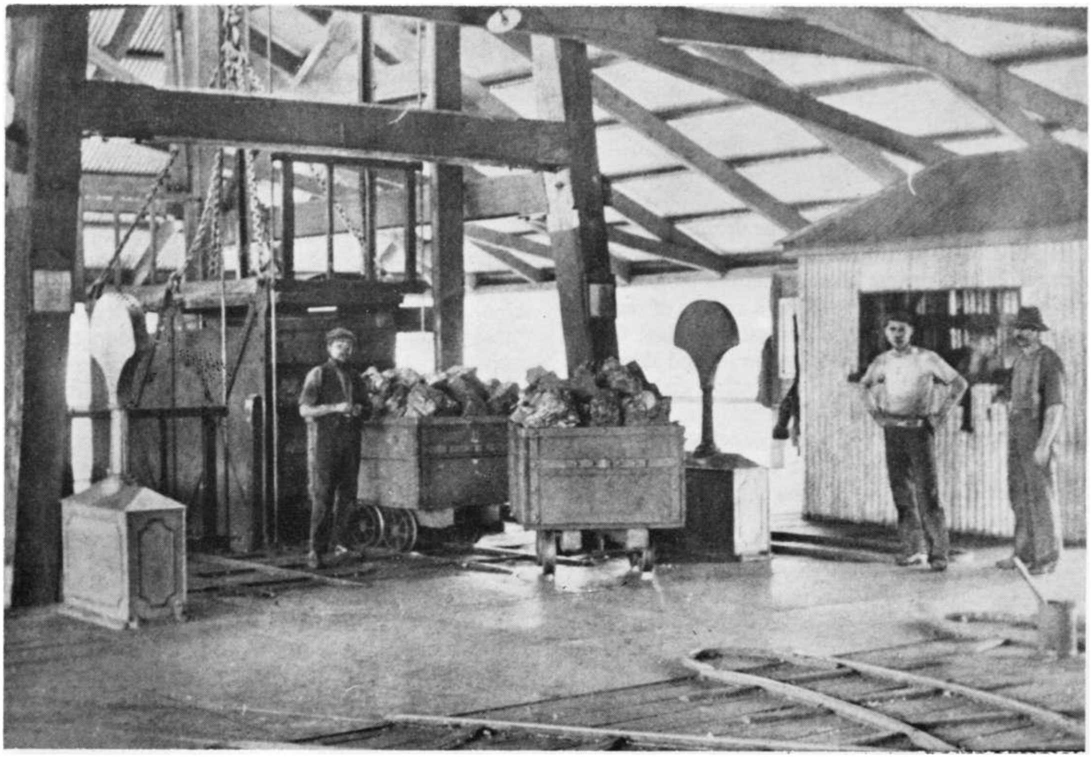
In cases of tunnel mines, the haulage took the skips directly from the mine and they were undipped adjacent to the weighbridge. After weighing, the full skips gravitated to tumblers, used for turning the skips over and thus emptying them The coal fell onto a picking belt, which slowly moved along while workmen situated on each side of the belt removed shale or foreign matter from the coal. The coal was then screened and loaded into rail wagons for distribution to the various consumers.

Main and Tail Haulage System

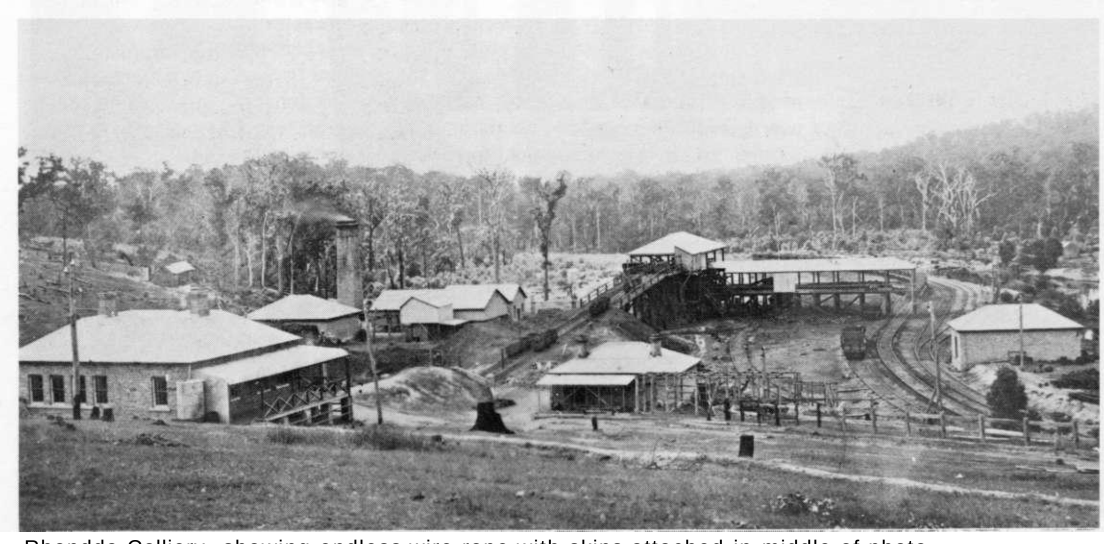
In some collieries a main and tail haulage system was used for moving the skips in and out of the workings. As the name implies, there was a main rope and a tail rope. Each was fitted to a separate haulage drum. The main rope (normally of a larger diameter) was attached to the front of the full skips for hauling them from the workings, whilst the tail rope was attached to the rear and followed them out The reverse applied when the empties were returned into the workings.

This type of haulage was mostly installed in secondary roadways off the main travelling road and was used to bring skips from the workings to the endless haulage system In most cases, single track had only been laid along the roadway and accordingly, the tail rope was run between the track and the rib (side of tunnel) on "tommy dodd" rollers to the end of the trackwork and turned by a sheave into the centre of the trackwork for attaching to the skips. The tail rope was naturally longer than the main rope, since it ran along the rib to the end of the track then back to the start of the haulage at the point where empty skips were being attached or the full ones detached.

As these installations were mostly on single track headings, skips could only travel in one direction at any one time. Therefore, the skips were assembled in rakes of up to twenty and hauled to their destinations. Operating speeds was normally 8 mph (13 kph).



Skip on weighbridge on pit top, Seaham No. 2 Colliery, 1907. Photo: B Andrews Collection



Rhondda Colliery, showing endless wire rope with skips attached in middle of photo.
Photo: B Andrews Collection

Jig Haulage

In some mines where the coal seam was steep and the coal was being won on the "rise" (mining uphill), use was made of the grade to pull the empty skips up the incline by the loaded ones coming down. A jig haulage was installed at the top of the grade. This could either be a drum or a sheave of "C" section, to allow the rope to wind on and off without locking. In the case of the drum, two ropes were fitted, one coming off the top and the other the bottom. In the sheave arrangement, a single rope was wrapped around the sheave a couple of times, the rope going on one side and off the other. One end of the rope was attached to the loaded skips at the top of the incline, whilst the other end (other rope in the case of the drum haulage) was attached to the empty skips at the bottom of the incline. A brakeman operated a brake on the haulage system and controlled the speed of the skips accordingly.

Direct Haulage

Where access to the coal seam was gained by a drift (tunnel sloping downwards), it was common to use direct haulage to move the skips from the pit bottom up the drift to the surface. In direct haulage systems, a single rope is wound onto a drum which is coupled to an engine in some form, either mechanical or electrically operated.

Since most drifts had only a single track, this meant that skips could travel in one direction only at any one time. Accordingly, the skips were assembled in rakes of up to twenty and hauled from the pit bottom up the drift to the surface. Upon arrival, the full skips were detached, a rake of empty skips attached and lowered down into the mine. The skips pulled the rope off the drum under gravity conditions and the brake on the haulage controlled the speed of the empties travelling down the drift. A set rider rode on the leading skip to stop the haulage in case of a derailment

As in the endless haulage systems, when the skips arrived at the surface they were weighed, the contents credited to the miners who won the coal, the skips turned and the coal screened and loaded into rail wagons.

Clipping off and on flat underground, with empties on the left and full skips on right. The photo was taken 30 years after the system had finished operation Photo: B Andrews

Set rider on set of skips at Abermain direct haulage about 1904. Photo: B Andrews Collection

Engine Plane Haulage

Where access to the coal seam was by a tunnel and the seam was on the dip (sloping downwards), a winding engine was erected in front of the tunnel to raise the full skips of coal and at the same time lower the empty skips into the mine. This method of haulage was known as "engine plane" and used the same principle as the vertical shaft winder as far as the haulage drum and engine was concerned One rope was wound on the top of the drum, whilst the other was wound off the bottom

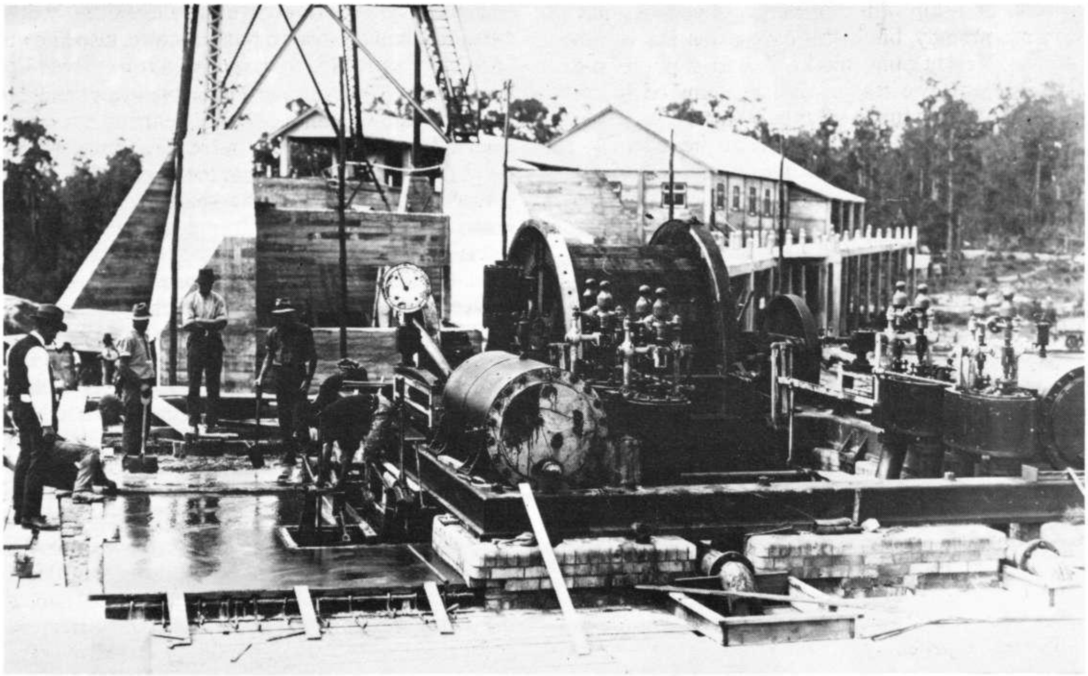
The full skips were attached to the rope at the pit bottom in sets of up to 30 skips and hauled from the mine as the empty set was lowered in on the other rope. In this type of operation, two sets of rail tracks had to be laid in the tunnel This method of winding "balanced out" and the engine was only required to lift the coal as the skips and rope "balanced". When the wind was completed, the engine was reversed and the wind carried out again.

Vertical Shaft Winding Engines

Where vertical shafts were used to gain access to the coal seam, winding engines were installed and used to haul the coal up the shaft. A headframe was erected over the shaft and two sheaves were installed, whilst the winding engine was erected at the base of the stay bracing the headframe. In most cases this brace was constructed into the foundations of the winding engine. After 1890, most headframes were of steel construction.

Ropes wound around the winding engine drum were directed up over the sheaves and down the shaft, connecting to cages. These winding engines were "balanced" winding operations. One cage was at the bottom of the shaft when the other was at "bank" level (uppermost stopping position of the cage). When hauling, the winding engine was only required to lift the weight of the coal, as the weights of the skips, ropes and cages balanced each other out during the wind.

Since the drum was turning in one direction only, the ropes were wound onto the drum on opposite sides at the top and bottom This allowed one to go down as the other came up. When the wind was



Installing a steam winding engine at Hebburn No. 2 Colliery about 1918.
Photo: B Andrews Collection

complete, the engine was reversed and the wind carried out again with the cages travelling in the opposite direction.

At most collieries, single deck cages were used carrying two skips each, although several collieries used double deck cages capable of carrying four skips. There was a proposal to install tripple deck cages at Aberdare Central Colliery, but as the colliery never reached its potential due to an underground fire, these were not installed Guides, consisting of either ropes or rails, were fitted in the shafts to enable the cages to run vertically. Guides fitted to the cages ran down these ropes or rails. In the case of rail guides, these were joined by a dowel, as fish-plates could not be used due to the fact that the guide ran under the head of the rail.

Initially the winding drum was direct coupled to a pair of horizontal reciprocating steam engines. Steam for these engines was generated in the colliery's boiler plant which, in most cases, consisted of a bank of Lancashire tube boilers.

The winding engines were mostly obtained from Britain, being built by firms such as Grant & Ritchie of Kilmarnock; The Grange Ironworks, Durham; Frazer & Chalmers of Erith; Kent & Yates & Thom of Blackburn. A winding engine from this latter firm was installed at Hebburn No. 2 Colliery, near Weston and had the honour to be not only the last steam unit in operation, but was also the last winding engine in Australia to haul coal in skips. This event occurred in June, 1972.

Australian builders included Walkers Bros of Maryborough, Clyde Engineering Co, Sydney and Rogers Bros of Newcastle. Electric winding engines were installed at new mines developed after 1920 and Aberdare Colliery had its steam winder replaced with an electric one during the late 1920's. Ironically, the mines using electric winders were the first to close when hit by the hard times of the late 1950's.

Coal was wound, in most cases, in the downcast shaft (intake airway), whilst the upcast shaft (return airway) was used as a second means of egress. In these cases, a single cage was run in the shaft and the winding drum was fitted with only one rope. For the sake of accuracy, several collieries operated two cages in their upcast shaft and some also hauled coal in these shafts.

Alligator Haulage

At least one company— RW Miller & Company at its Northern (Rhondda) and Ayrfield Collieries — used an "alligator" to transport the coal from the underground workings to the surface. An "alligator" consists of a skip with a capacity of five tons (may vary accordingly, but in this case it was 5 tons) run on two different gauge tracks. The front part of the skip is open. The rear of the skip runs on broad gauge, whilst the front end runs on a narrow gauge. A rope is fixed to a pivot attached to the rear of the skip. The alligator operated up a two in one incline. At the top the narrow gauge track levels out to become horizontal, whilst the broad gauge continues up the incline.

When loaded underground, the skip is hauled to the surface by a direct haulage. When it nears the top of the incline, the front set of wheels follows the narrow gauge track and levels out, while the rear set continues up the incline, discharging the coal into a bin.

Bulk Haulage

The final phase of winding coal in vertical shafts occurred during the 1960's when the Electricity Commission installed bulk winding mechanisms at two of their Northern Collieries. These were installed at Newvale Colliery (1965)[1] and Newstan Colliery (1967)[2] and used electric winding engines formerly in use at Cessnock No. 1 and Aberdare Collieries respectively.

Instead of the normal cage carrying skips or mine cars, bulk haulage used a box structure, also known as a "skip" attached to the end of a rope. This skip holds 6 tons (Newstan) or 9 tons (Newvale) and the loading and unloading of coal is carried out automatically at the pit bottom and at the surface. At the pit bottom the coal is fed into the "skip" from a bin constructed adjacent to the shaft and discharges into a bin at the surface.

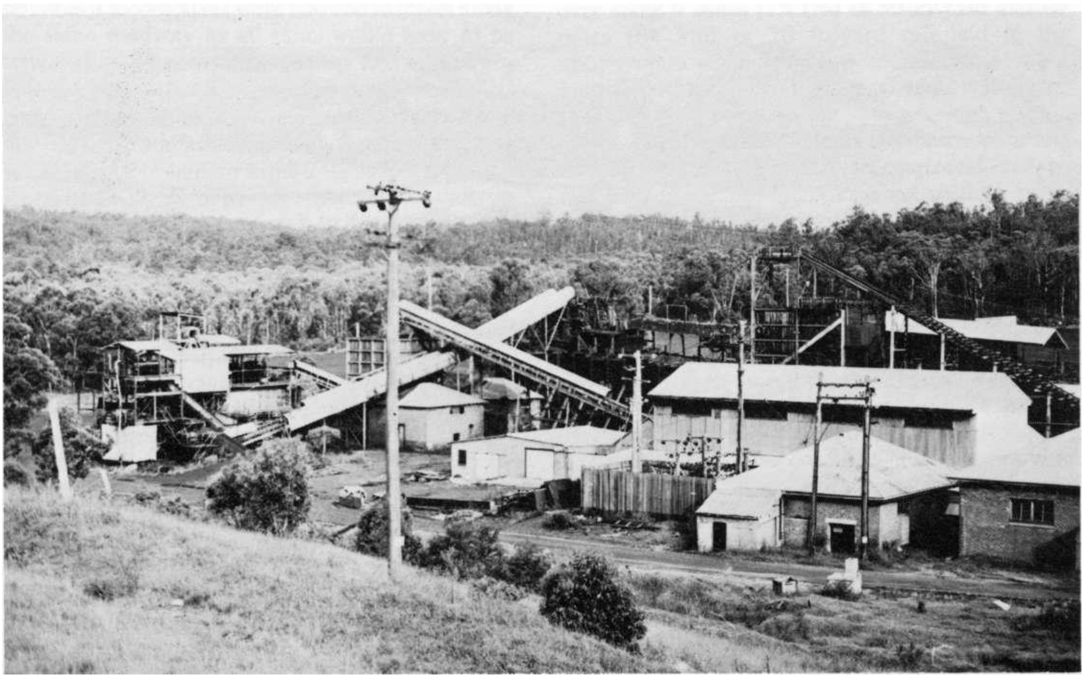
Man Riding Elevators

Man-riding elevators were installed at several collieries to drop the workmen into the underground workings. The first of this type of installation was at Burwood No. 6 Shaft (1958)[3]. Similar elevators are in use at West Wallsend No. 2 (now West Wallsend Colliery) Pacific, Wallarah and Ellalong Collieries.

EARLY LOCOMOTIVE HAULAGE: 1920-1950

Use of Electricity in Coal Mines

With the increase in the use of electricity in the coal mines of New South Wales during the early 1900's, a committee was set up in the latter part of 1906 to prepare rules for the use of electricity in these coal mines. Paragraphs 62-67 inclusive of the



Surface view of Northern Colliery In 1970. The"alligator" gantry is on the right. Photo: B Andrews

Final Rules (published in 1907) covered the use of electric locomotives[4]. It is interesting to note that par. 62-66 deal with the installation of trolley wire systems, while par 67 is the sole reference to battery locomotives.

Although the rules were formulated during the early 1900's, it was many years before a trolley wire system was actually commissioned on the Northern Coalfields of NSW. The East Greta Coal Mining Company had these rules specially printed in 1919 for issuing to their employees.

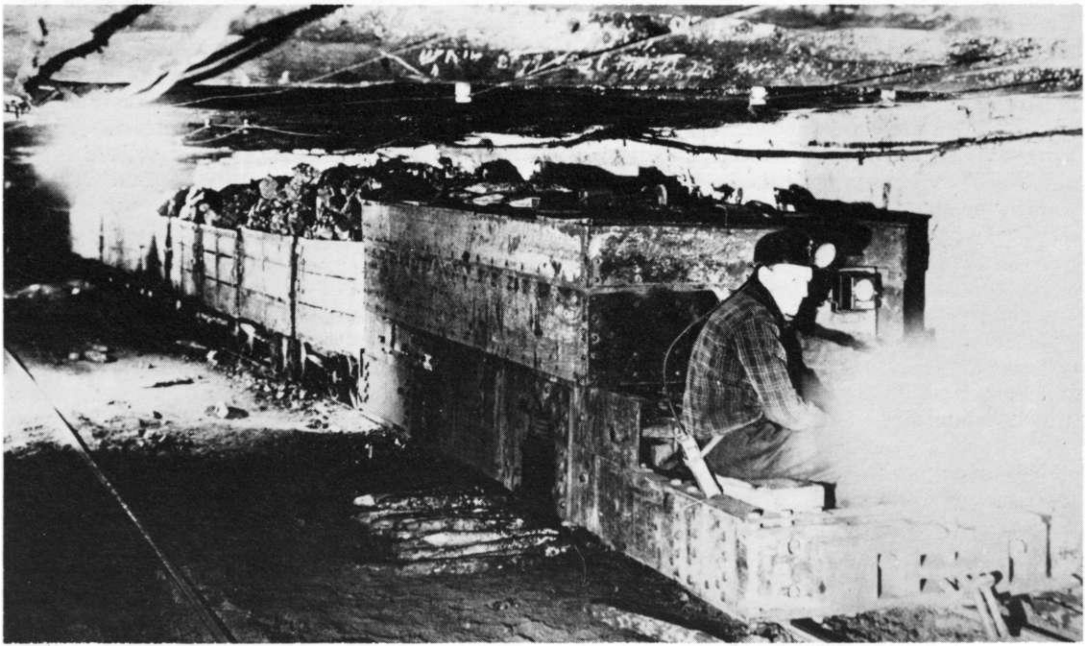
Locomotive Haulage

The exact date when electric locomotive haulage was introduced into the mines of the Northern Coalfields is not known, but it would appear to be the early 1920's. The Jeffery Manufacturing Co, USA supplied four battery locomotives to Abermain Seaham Collieries Ltd in 1922 for use at the Abermain Collieries and trials with these locomotives were undertaken that year[5]. By 1927, the Abermain No. 1 Colliery was using endless wire rope and electric locomotives (storage battery) as their means of coal transportation, while at Abermain No. 2 Colliery battery electric locomotives had replaced endless rope haulage in four districts[6].

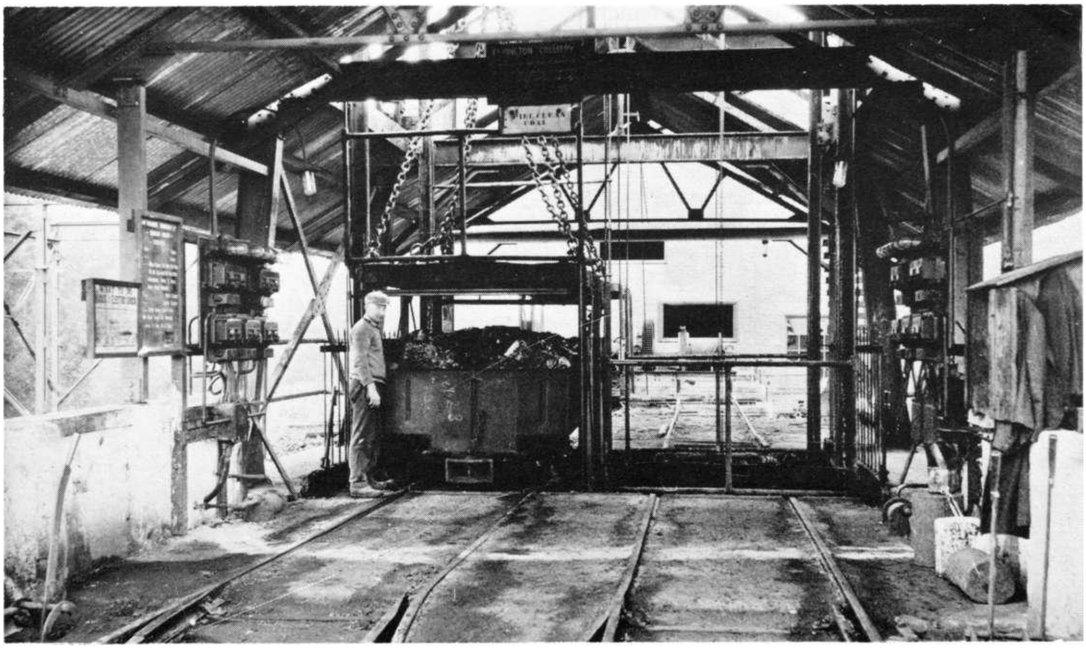
Also by 1927, Stanford Merthyr No. 2 (later Stanford Main No. 2) Colliery had a Jeffery battery locomotive operating on the main heading to the north of the main shaft to deal with all coal from these sections[7]. At Aberdare South Colliery (closed in 1927) haulage was by means of an electric locomotive, with horses conveying the coal from the working faces to the main travelling way[8].

Since collieries were operating rope haulages on their main travelling roads, locomotives could only be used for "wheeling" purposes in most cases. Since horses were more suitable for this work near the face, the skips were assembled in rakes at the flat and hauled by locomotive to the various rope haulage systems. This alleviated the need to extend the rope haulage systems, but it was not until the introduction of partial mechanisation in the 1930-1940 period that any great number of locomotives were placed in operation.

In some mines, a travelling road adjacent to the rope haulage road was driven to enable locomotive transport of materials and workmen into the workings. Locomotive haulage along the various rope haulage systems was not practical as the rope haulage system kept the mine in production and it had to be kept in motion at all times. This was not



Battery locomotive and rake of skips in Burwood Colliery. Photo: BHP Collieries



Mine car skip in cage at bank level, Elrington Colliery. Photo: B Andrews Collection

possible if locomotives were allowed to travel along the same roadway as all skips would have to be removed to allow the locomotives to travel.

Mixed Haulage Systems

It was possible for collieries to operate more than one type of haulage system in the underground workings. The Richmond Main Colliery near Kurri Kurri had a capacity of 3000 tons of coal daily in one shift of eight hours, bank to bank in 1947[9]. Haulage systems in operation included endless rope haulage for the main travelling roads, while subsiduary haulage was by means of electrically driven endless ropes, main and tail and compressed air-driven direct haulage winches in the steeper sections of the mine. Storage battery electric locomotives and horse haulage, from the face of mechanised and contract sections respectively, was used to deliver the skips to the endless rope haulage system. Electric locomotives and fast moving endless rope haulage with special man-riding transport cars took the workmen to and from the working places underground, while on the surface they were brought to and from the mine by steam power over the private railway line between Pelaw Main and Richmond Main collieries.

The Aberdare Extended Colliery at Cessnock had 1313 skips in operation in 1943. They operated over some 9 miles (15 km) of 30 lb/yard and 40 miles (64 km) of 20 lb/yard rail laid in the underground workings.

Locomotive and Large Capacity Mine Car Haulage Systems

The American practice of using locomotives and large capacity mine cars for underground haulage was introduced into the Northern Coalfield in the late 1920's and early 1930's. Elrington Colliery near Cessnock was the first to introduce this system. Here, 3 ft 6 in gauge track was laid and mine cars of all-steel construction and 3 ton capacity were either hand or mechanically filled Trains of between 14 and 20 mine cars were assembled at the face and hauled by 8-ton battery-operated locomotives to the pit bottom for hauling up the shaft

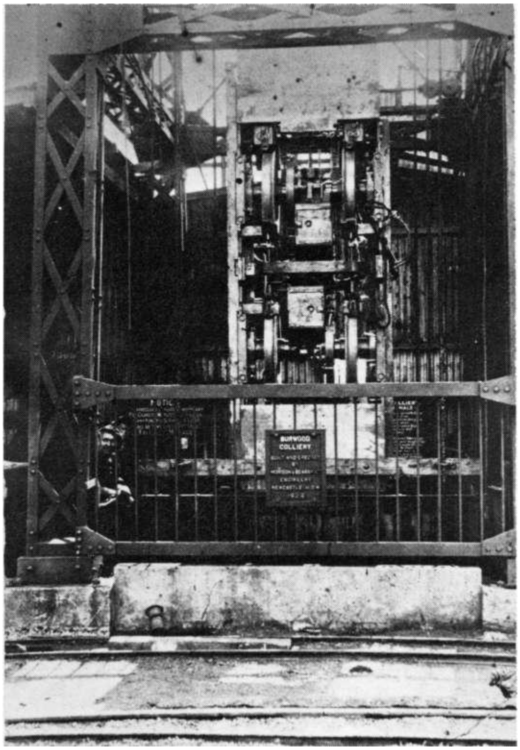
In mines using locomotives, battery charging rooms were established underground to enable charging of the storage battery and the complete maintenance of the locomotives. Major overhauls were undertaken underground and, in most cases, once a locomotive had been taken underground, it remained there until the mine closed or its economic life was completed In this case, the locomotive was shunted into a "goaf' area and left there after all spare parts had been removed

Only very rarely were the locomotives removed from the underground workings due to the massive effort involved in getting the locomotive up or down the shaft The cage had to be removed and the locomotive lowered in two sections (chassis and battery box) in place of the cage. Special pulling equipment was needed on the pit bottom to pull the locomotive from its vertical position in the shaft to the operating horizontal position and to locate the unit on the rails. This lowering or raising of the locomotive was normally carried out on week-ends, as the operation tied up the shaft and prevented coal winding.

MECHANISATION OF HAND MINING COLLIERIES: 1940-1960

BHP's Modernisation Programme

During the early 1940 period, the Broken Hill Proprietary Co Ltd(BHP) commenced a programme of introducing mechanical methods for cutting and loading coal in their Northern mines. Large capacity mine cars were placed in operation in conjunction with electric battery and trolley wire locomotives for haulage purposes. Usually, battery locomotives were used to position the mine cars at the loader and assemble these cars in rakes of up to 12 for hauling to the pit bottom by 20-ton trolley wire locomotives.



Lowering chassis of a battery locomotive down the shaft at Burwood Colliery.
Photo: BHP Collieries

Battery locomotives were usually only used where the grades favoured the loaded mine cars, as there was only sufficient charge in a battery to last a shift under these conditions. Such a case was Lambton Colliery where battery locomotives were initially used on main road haulage. Later trolley wire locomotives were also introduced at the colliery for main road haulage.

1950 Period Mechanisation

During the 1950's a programme was commenced to mechanise, where possible, the collieries operating on the Northern Coalfields. This involved the introduction of machines for cutting the coal and loading into shuttle cars for delivery to a panel belt for delivery to the pit bottom. In shaft mines, the coal still had to be loaded into skips for hauling up the shaft Under mechanised mining methods, the rope haulages were placed out of use and battery locomotives were purchased for material and man transport

New collieries developed during this period followed the American practice of using large capacity mine cars and locomotive haulage. The majority of these used trolley wire locomotives, including Awaba State Mine, Stockrington No. 2 Colliery No. 3 tunnel, and Northern Colliery (Rhondda). Mine cars varied in capacity between *6-12.5* tons and these collieries used Jeffery 20-ton trolley wire locomotives for mainline haulage along 3ft 6 in gauge track. Cessnock No. 1 Colliery used Hunslet diesel locomotives, whilst Stockton Borehole Colliery placed Huwood Hudswell diesel locomotives in service[10] when the Young Wallsend seam was developed as a mechanised seam. In the latter colliery, large capacity mine cars were loaded and delivered to the pit bottom where they were dumped into an underground bin for reloading into small capacity skips for hauling up the shaft

Some of the collieries using locomotive haulage had printed a set of rules governing the use and operation of the locomotives in the mine. These were normally pocket size and printed on stiffened cardboard These rules mainly covered safety aspects of the locomotive's operation and listed the "do's" and "don'ts" of their use.

"Piggy back" materials transport. A tractor pulls rubber tyred materials car of a flat top rail car.
Photo: B Andrews

MODERN TRANSPORTATION METHODS: 1960 ONWARDS

New Transport Modes

As the long distance transportation of coal was proven by conveyor belts, mines were established using this method of moving coal from the working places to the surface. Collieries using a shaft drove a cross measure drift from the surface to the coal seam and a belt conveyor was installed in the drift.

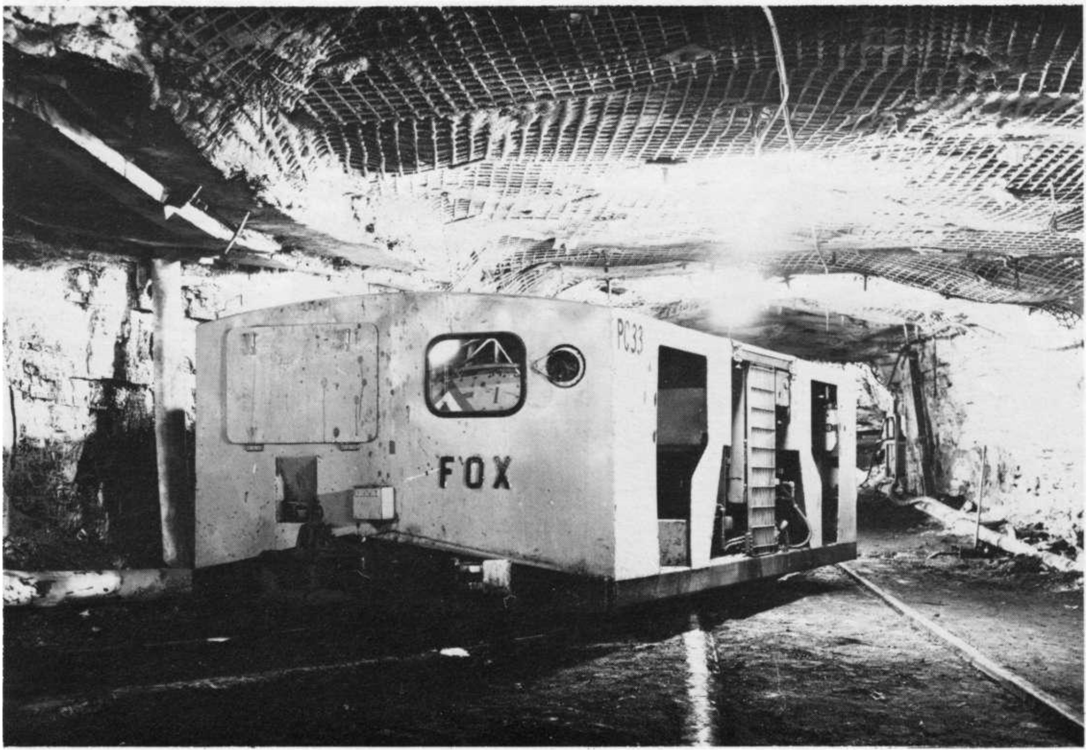
New mines developed from 1970 onwards, drove a cross measure drift and installed a conveyor belt to bring the coal through to the surface whilst at the same time, a direct haulage was installed in the drift to lower men and materials into the workings. The haulage unit was located, in most cases, some 300 metres from the tunnel entrance to allow the installation of the necessary shunts to enable the marshalling of the materials adjacent to the tunnel mouth. Most haulages are automated and a car known as a "dolly" car is attached to the end of the rope. Electronic equipment in this car sends instructions back to the haulage. Manually operated haulages, use either the "dolly" car method or a bell system operated at the different stopping locations to send signals back to the haulage driver.

Rail Transport

Although conveyor belts took over coal transport, materials and workmen still had to be taken to the working face. For this purpose, rails were installed along the main travelling roads and into the sections for delivering the materials and workmen by rail transport to these locations. In the early 1970's a "piggy back" system was introduced, whereby the materials are loaded onto a rubber-tyred material-carrying car which in turn is loaded onto a flat top and transported by rail into the mine. At the end of the rails, a ramp was constructed and a tractor-type machine pulled the car off the flat-top and up to the working face. With this method, it isn't all that important that rail laying keep abreast of the mine workings.

Man Transport

In mechanised collieries, the coal face advances much faster than it did under hand-mining operations.



Fox PC car on pit bottom, West Wallsend No.2 Colliery. Photo: B Andrews

This creates a need to transport the miners into the workings more quickly to enable maximum production in the time available. Accordingly self-propelled diesel personnel carriers (PC car) were developed to transport the miners in the underground workings. These vary between 14 and 22 man capacity.

Normally a car is allocated to each production section and takes the miners to the end of the rails, where it is stored in a convenient shunt It remains in the section in case it is required for emergency transport of an injured miner. At the end of the shift, the miners use the PC car to return to the pit bottom.

Pod Systems

Some of the mines developed after 1980 do not even use rail transport for delivering materials to the working places. Rubber tyred vehicles transport the materials using "pod" systems. The various pods are loaded with the materials required underground and the multi-purpose vehicle (MPV) picks up the pod, transports it into the mine to the working place, drops off the pod, picks up an empty pod and returns it to the surface for reloading.

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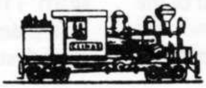


2. ROLLING STOCK AND LOCOMOTIVES

ROLLING STOCK

Skips

The various collieries used a variety of skip capacities and gauges for underground haulage. In the pre-mechanised era, gauges varied from 1ft 11 in to 2ft l0in, with 2ft (610 mm) being the most common. With the advent of mechanisation, 3 ft 6 in (1067 mm) became the standard gauge.

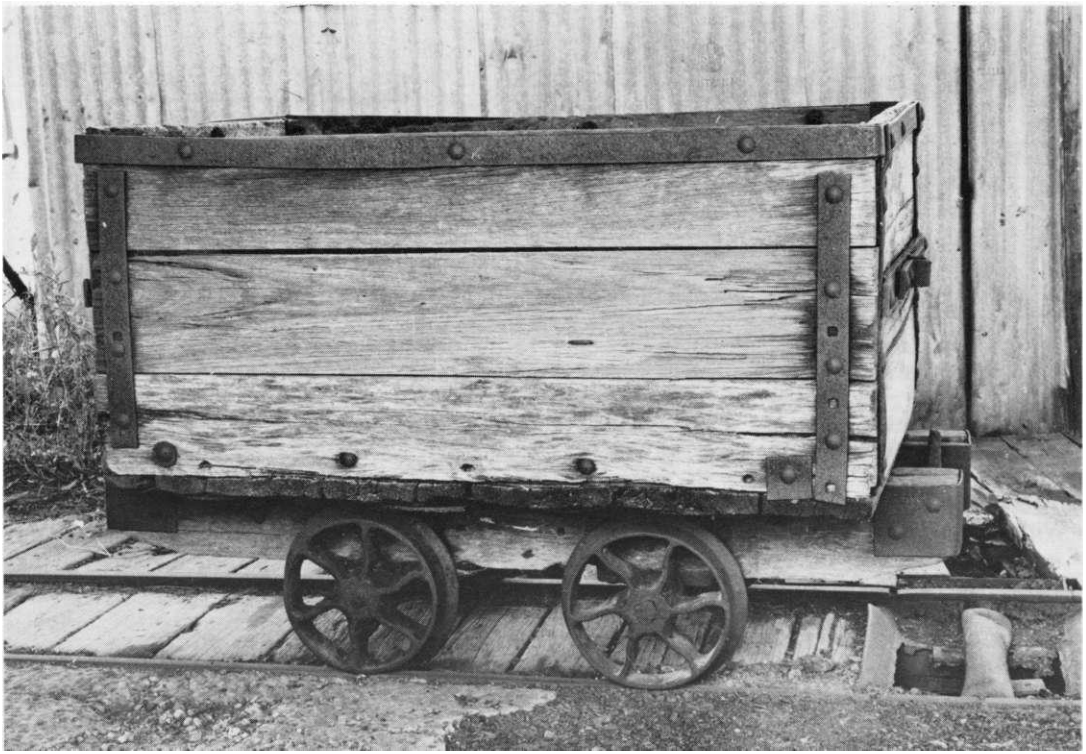
Skips were initially constructed of timber and later reinforced with strips of flat steel along their tops and corners. A bracket of "U" shape construction was fitted to each end of the skip for attaching the limber which was fitted to the horse for wheeling purposes. The limbers fitted to the horse was at the same level as the bracket on the skip, and a pin attached to the end of the limbers fitted through the bracket on the skip. Very rarely were the skips wheeled by using the drawbar attached to the skip and a chain attached to the horse.

Most timber skips were constructed in the colliery workshops or at the central workshops for the company's group, such as the Hexham Workshops for J & A Brown & Abermain Seaham Collieries Ltd or West Wallsend Extended Colliery for the Caledonian Collieries Ltd group.

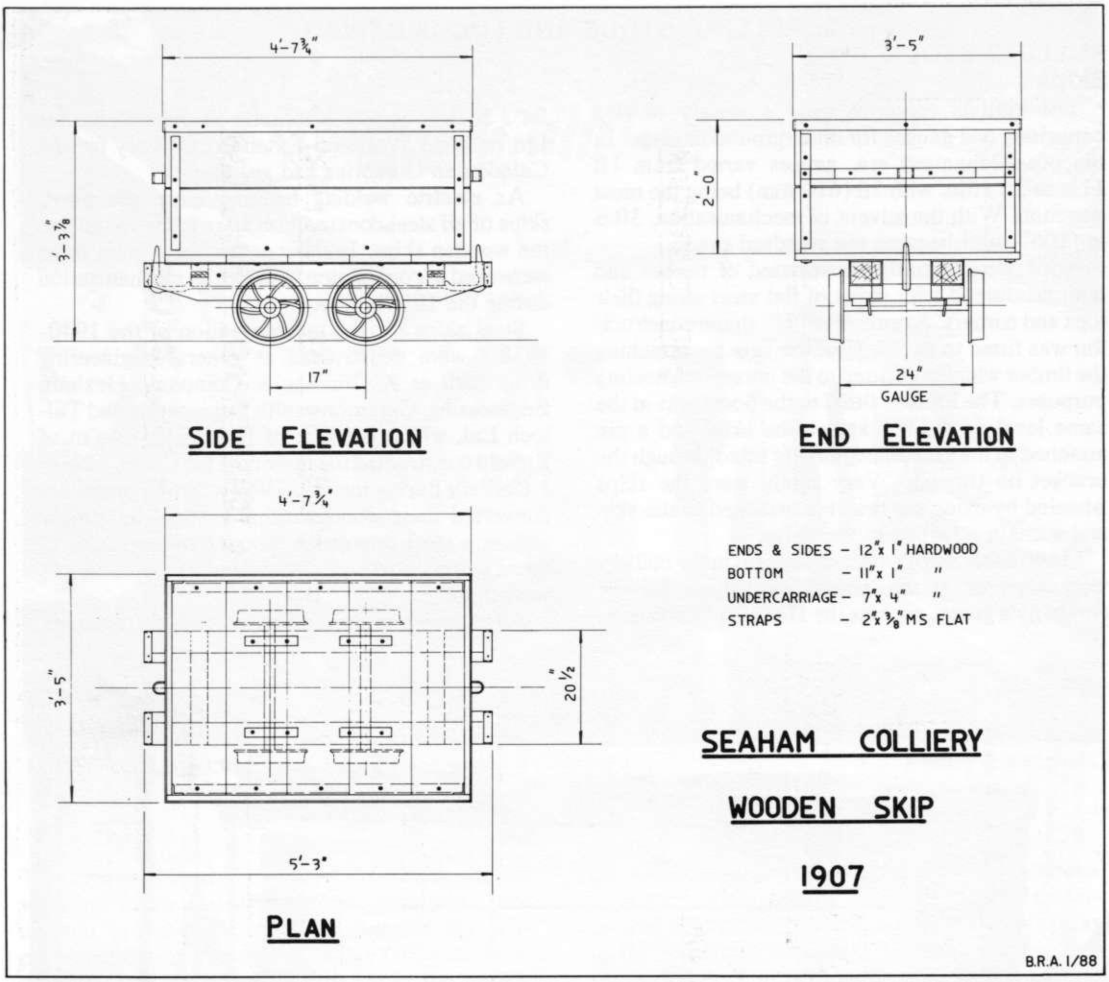
As electric welding became more prevalent, skips of all steel construction were made to replace the wooden skips. In most cases, these steel skips were used in conjunction with partial mechanisation during the 1950's.

Steel skips for the mechanisation of the 1940-1950's were constructed at general engineering firms such as A Goninan & Company, Hexham Engineering, Commonwealth Engineering and Tulloch Ltd, whilst the firm of H & E Crossman of Enfield constructed the mine cars for Cessnock No. 1 Colliery during the mid-1940's. Small operators converted their wooden skips to steel by simply adding a steel box to the wooden underframe. In these cases, most were fabricated in the colliery's workshop.

All collieries employed a number of skip repairers,



A typical wooden skip. Photo: B Andrews



whose job it was to repair and maintain the fleet of colliery skips. This involved the manufacture of new skips, to the replacement of broken boards, bent axles and broken pedestals, along with any other type of repairs required to keep the fleet in operation.

Large Capacity Mine Cars

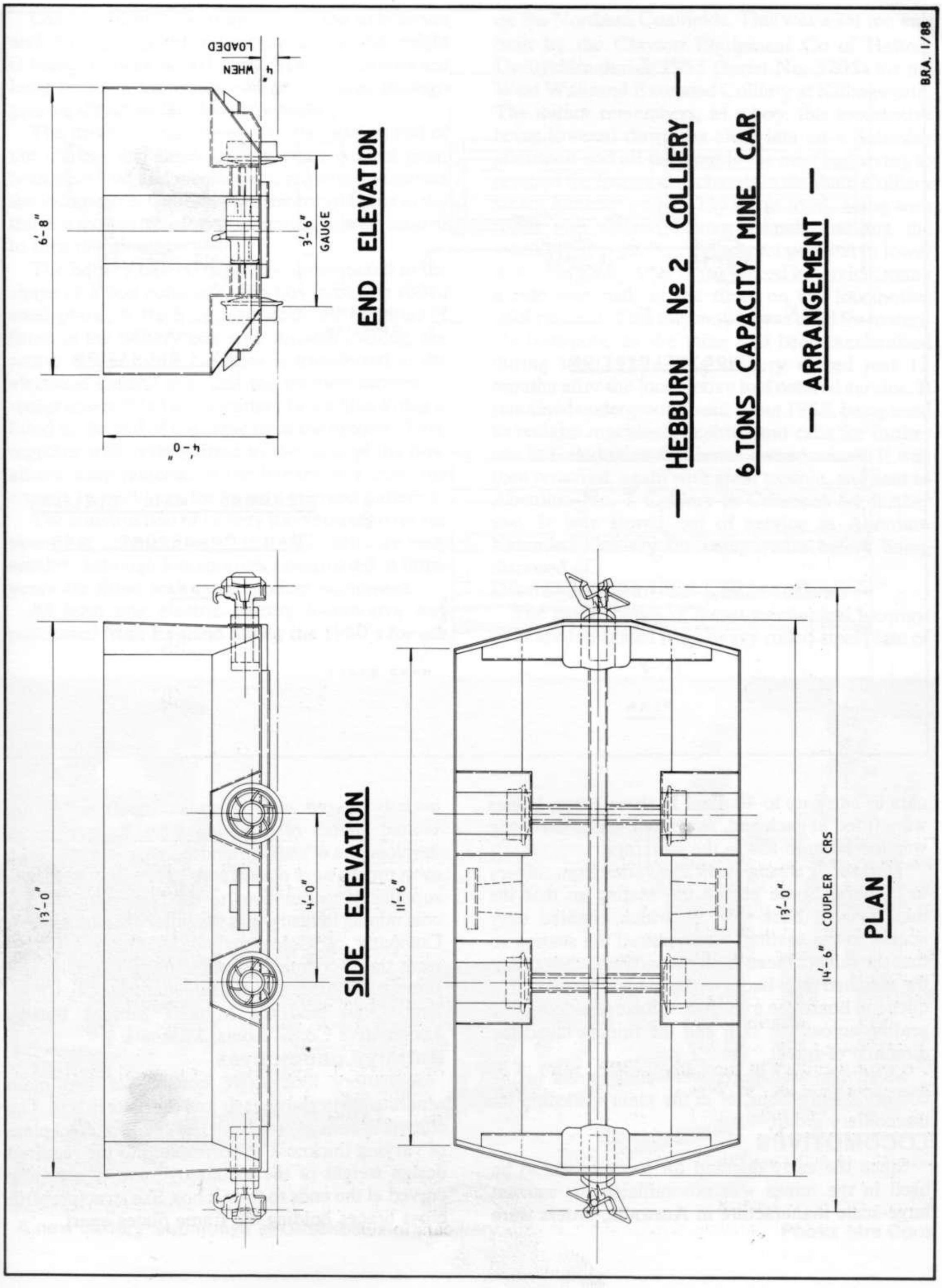
With mechanisation, American type mine cars of larger capacity were introduced The first, at Ellington Colliery in the early 1930's, were of 3 tons capacity. Later mine cars of 6-12.5 tons were introduced The mine cars for Awaba State Mine and Stockrington No. 2 Colliery No. 3 Tunnel were constructed in the workshops of Hexham Engineering Pty Ltd.

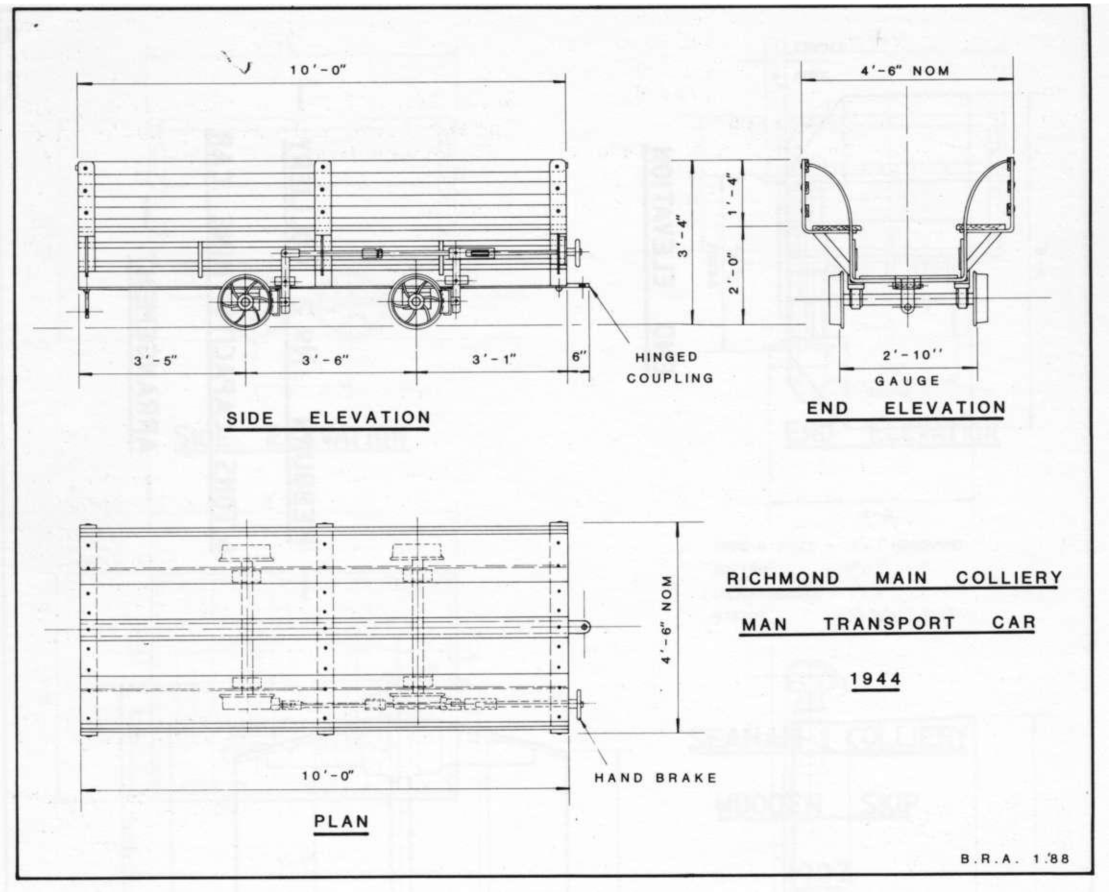
Other Rolling Stock

As well as coal carrying skips, timber trollies, cable trollies, tea trollies and personnel carriers were used on underground rail transport systems to take supplies and miners to the work place. The personnel carriers were attached to the endless rope haulage (or other types of haulage system in use at the particular mine) and transported the miners to the end of the haulage system, where the carrier was removed and shunted into a convenient shunt until the end of the shift It was then reattached to the rope to take the miners out of the workings to either the pit bottom or the surface.

Man Transport Skips

These normally consisted of a skip underframe fitted with hardwood seating and varied from colliery to colliery. No normal standard was adopted and each colliery designed their man transport cars to suit their individual needs. Some even had


HEBBURN No 2 COLLIERY —
— 6 TONS CAPACITY MINE CAR —
— ARRANGEMENT —
END ELEVATION
6'-8"
4'-0"
3'-6" GAUGE
4" WHEN LOADED
SIDE ELEVATION
13'-0"
4'-0"
11'-6"
PLAN
13'-0"
14'-6" COUPLER CRS
B.R.A. 1/88



cars to carry up to 40 men. In these cases, bogies were fitted at each end, as a fixed wheel-base skip was too large to use in the workings.

The seating arrangement also varied from colliery to colliery. Some placed the seating so that the miners were back-to-back, which enabled easy access to the seating. Some placed the seating so that the miners faced each other, which meant that the men had their backs to the tunnel rib and had to queue to board the transport Others positioned the seating across the skip and the miners faced the direction of travel.

Most man transports were constructed in the colliery's workshops, or at the main workshop for the colliery group.

LOCOMOTIVES

Since the early demand for locomotives to be used in the mines was not sufficient to warrant large-scale manufacture in Australia, orders were initially placed with overseas suppliers. As the United States of America were leaders in the development of underground locomotive technology, most orders were placed with US firms. The largest supplier of locomotives to the New South Wales coal mining industry was the Jeffery Manufacturing Company of Colombus, Ohio. Other suppliers were the Goodman Manufacturing Co, Chicago, Illinois; the Atlas Car & Manufacturing Co, Cleveland, Ohio; and the Mancha Storage Battery Locomotive Co, St Louis, Missouri.

Battery Locomotives

A battery locomotive consists of two main separate parts, the chassis and the battery box. The chassis is constructed from heavy rolled steel plate of varying thickness to correspond to the required design weight of the locomotive and is normally curved at the ends to form a box-like structure with cross braces holding the frame plates apart

Guides cut into the frame house the axle boxes and, through rigging or direct springing, the weight is transferred to the axle sets. Traction motors are hung between the frame and are coupled through gearing direct to the driving wheels.

The drivers compartment is fitted at one end of the chassis and houses the various control gear, both electrical and mechanical, required to operate the locomotive. Cabling from the control gear to the traction motors transfers the electrical power required to turn the motors.

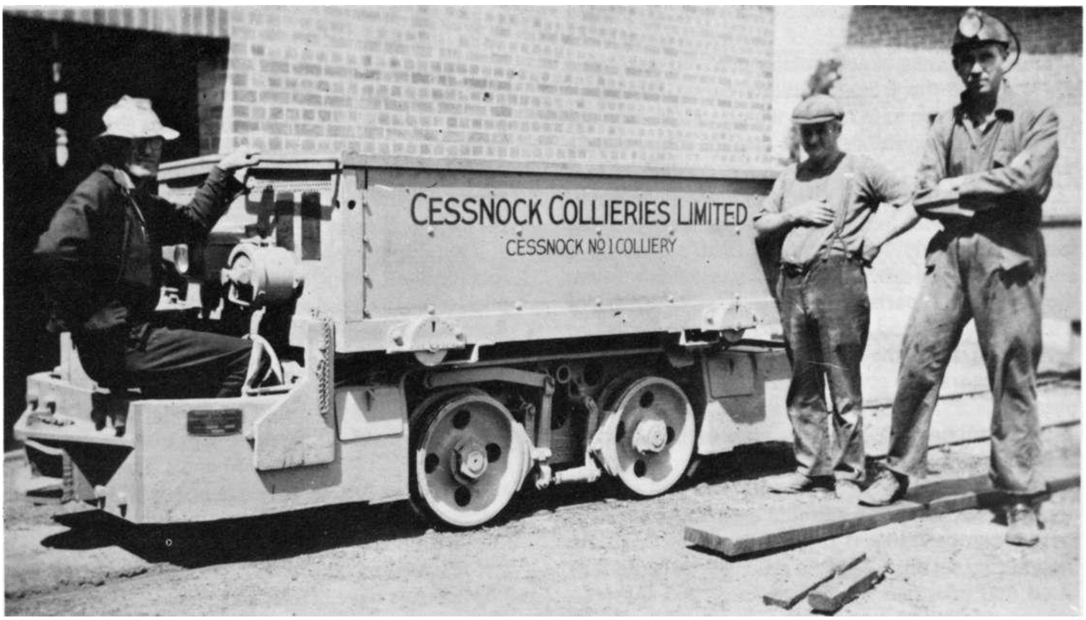
The battery box is, naturally, constructed in the shape of a box complete with lids from thin rolled steel plate. A bank of lead acid-cell batteries is fitted in the battery box and, through cabling, the power stored in the batteries is transferred to the electrical control gear and the traction motors. A receptacle is fitted to the battery box whilst a plug is fitted to the end of the cable from the chassis. This, together with rollers fitted to the base of the box, allows easy removal of the battery box from the chassis in exchange for freshly charged batteries.

The construction of battery locomotives over the years has changed very little. All units are very similar, although locomotives constructed in latter years are fitted with more modern equipment

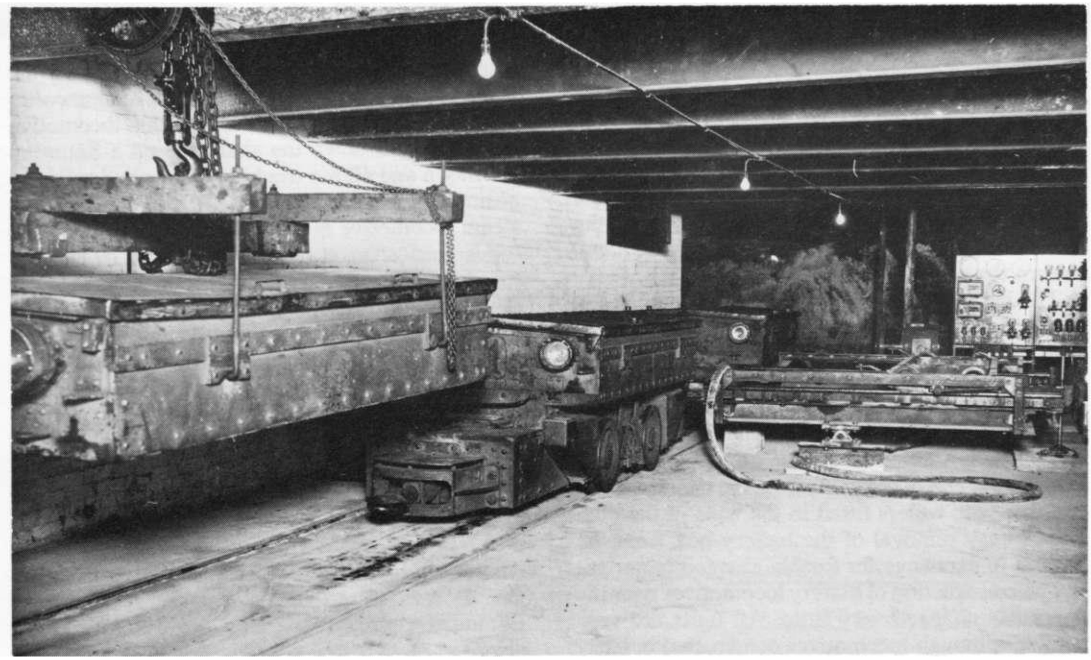
At least one electric battery locomotive was purchased from England during the 1950's for use on the Northern Coalfields. This was a 7.5 ton unit built by the Clayton Equipment Co of Hatton, Derbyshire during 1955 (serial No. 3205) for the West Wallsend Extended Colliery at Killingworth. The author remembers, as a boy, this locomotive being lowered down the shaft late on a Saturday afternoon and all the trouble the men had trying to position the locomotive chassis in the shaft. Colliery steam locomotive No. 2553 was used, along with ropes and sheave blocks to pull and tug the locomotive to get it in the correct position to lower down the shaft. After being placed in service, many a ride was had, at the time, on the locomotive underground This locomotive was used for materials transport, as the mine had been mechanised during late 1950. This colliery closed just 12 months after the locomotive had entered service. It remained underground until about 1958, being used to reclaim machinery, cables and rails for further use in Caledonian Collieries owned mines. It was then removed, again with great trouble, and sent to Aberdare No. 7 Colliery at Cessnock for further use. It was stored out of service at Aberdare Extended Colliery for many years before being disposed of.

Diesel-Mechanical Locomotives

The main frames of diesel-mechanical locomotives are fabricated from heavy rolled steel plate of



A new battery locomotive at Cessnock No.1 Colliery. Photo: Mrs Cook



Two locomotives in the underground charging room at Elrington Colliery. A battery is ready for changing.
Photo: B Andrews Collection

varying thickness between 37-75 ram, depending on the designated weight of the locomotive. The frames are cross braced using plate to the same thickness as the frame. Guides cut in the frame plates house the axle boxes, which in turn transfer the loads via rigging from the springs into the axle sets.

A suitable heavy-duty diesel engine is mounted in a convenient location above or between the frame. On early locomotives (1950's period) a clutch is situated on the transmission system between the engine and gearbox and is operated by means of a foot-pedal or hand lever to allow the gear ratios to be selected. From the gearbox, the drive is transferred through gearing to give the final reduction required onto the jackshaft The final drive of the locomotive onto the traction wheels is by means of the jackshaft and connecting and coupling rods.

The exhaust scrubber box, fuel tank and various controls are fitted in a suitable location, whilst the drivers compartment is provided at one end of the locomotive. In most cases, a mechanical brake was fitted and operated by a handwheel and screw in conjunction with brake rigging. Some locomotives were fitted with air-brakes as well.

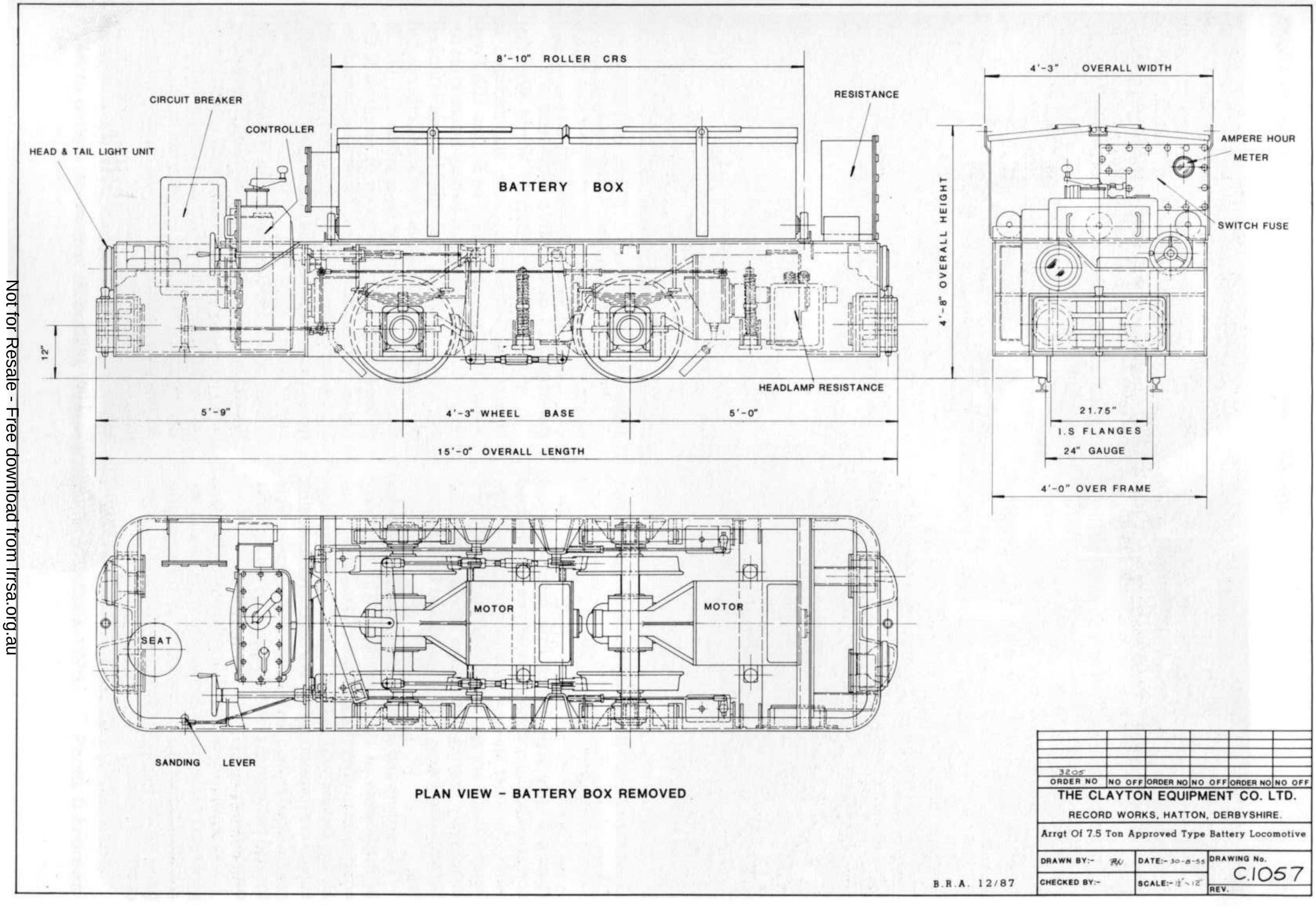
Diesel locomotives designed and manufactured from the mid-1960's onwards are fitted with an automatic gearbox and hydraulic torque converter driving a cardan shaft arrangement to transmit power to the driving wheels through gearing, doing away with the clumsy jackshaft and connecting rod arrangement Air brakes are fitted, whilst hand-operated brakes are fitted for emergency and parking purposes.

Two English manufacturers of underground diesel locomotives, Hunslet and Huwood Hudswell, supplied units to Cessnock No. 1 Colliery and Stockton Borehole Colliery respectively.

Trolley Wire Locomotives (Jeffery)

Trolley wire locomotives have a frame constructed of heavy rolled steel plate (50-75 mm thick) stiffened to form a rectangular box-type structure with gently curved ends. The side plates are cut away to take the axle boxes which work in machine guides of hornplate construction. The cast steel axle boxes are fitted with roller bearings and are designed to take both vertical and side thrusts. These boxes have machined guides which work in a vertical direction in the slots of the main frame.

The frame is supported on two axle sets by



8'-10" ROLLER CRS
CIRCUIT BREAKER
CONTROLLER
HEAD & TAIL LIGHT UNIT
BATTERY BOX
RESISTANCE
HEADLAMP RESISTANCE
12"
5'-9"
4'-3" WHEEL BASE
5'-0"
15'-0" OVERALL LENGTH
4'-8" OVERALL HEIGHT
4'-3" OVERALL WIDTH
AMPERE HOUR METER
SWITCH FUSE
21.75"
I.S FLANGES
24" GAUGE
4'-0" OVER FRAME
MOTOR
MOTOR
SEAT
SANDING LEVER
PLAN VIEW – BATTERY BOX REMOVED
3205
ORDER NO
NO OFF
ORDER NO
NO OFF
ORDER NO
NO OFF
THE CLAYTON EQUIPMENT CO. LTD.
RECORD WORKS, HATTON, DERBYSHIRE.
Arrgt Of 7.5 Ton Approved Type Battery Locomotive
DRAWN BY:-
DATE:- 30-8-55
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C.1057
CHECKED BY:-
SCALE:- 1½"-12"
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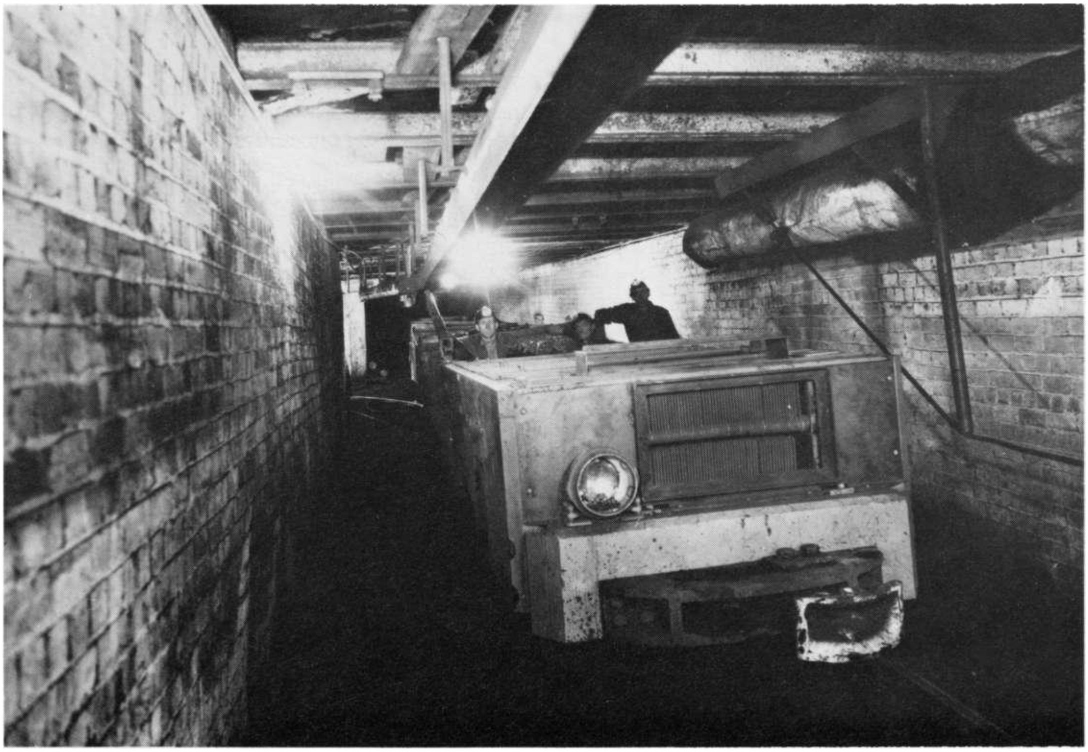


Goodman 20-ton trolleywire locomotive at Burwood Colliery, August, 1941. Photo: BHP Collieries

rigging to the axle boxes from double helical springs. The outer spring normally carries the load whilst the inner spring comes into operation when heavier loads are applied. The traction motors are coupled by gearing to the axle sets and are fitted between the frame. They are cooled by a blower fan.

The drivers and shunters compartment is fitted at opposite ends of the locomotive. The necessary equipment to drive the locomotive is naturally fitted in the drivers end, whilst the air compressor to supply compressed air for the braking and sanding gear is fitted in the shunters end. The air reservoir is located between the frame adjacent to the shunters compartment

The resistor banks used for dispensing the heat generated whilst under dynamic braking conditions are fitted above the air reservoir. A collector arm picks up the power to operate the locomotive from overhead wiring.

Australian Locomotive Builders

It was not until the Second World War that underground locomotives were manufactured in Australia in any numbers. The Broken Hill Proprietary Co Ltd constructed battery locomotives for use in their collieries, while the Hexham workshop of J& A Brown & Abermain Seaham Collieries Ltd also constructed battery locomotives for use in mines belonging to their group. A Goninan & Co Ltd of Broadmeadow, near Newcastle, manufactured locomotives for use in various coal and metal mines under licence to the Atlas Car & Manufacturing Co.

During the 1950's the firm of Tulloch Ltd of Rhodes in Sydney and Commonwealth Engineering (Qld) Pty Limited each constructed a diesel locomotive for use in the NSW coal mining industry. Unfortunately their products were not as successful as their overseas competitors and no other locomotives of this type were built

It was not until the upsurge in the export coal industry during the 1960's and the subsequent mechanisation of collieries remaining in production, that Australian manufacturing firms became actively involved in the supply of underground locomotives. EM Baldwin & Sons Pty Ltd of Castle Hill, near Sydney and Fox Manufacturing Co, Sydney became successful diesel locomotive builders, while George Moss & Co of Western Australia supplied a range of electric battery locomotives under the tradename *Gemco.*

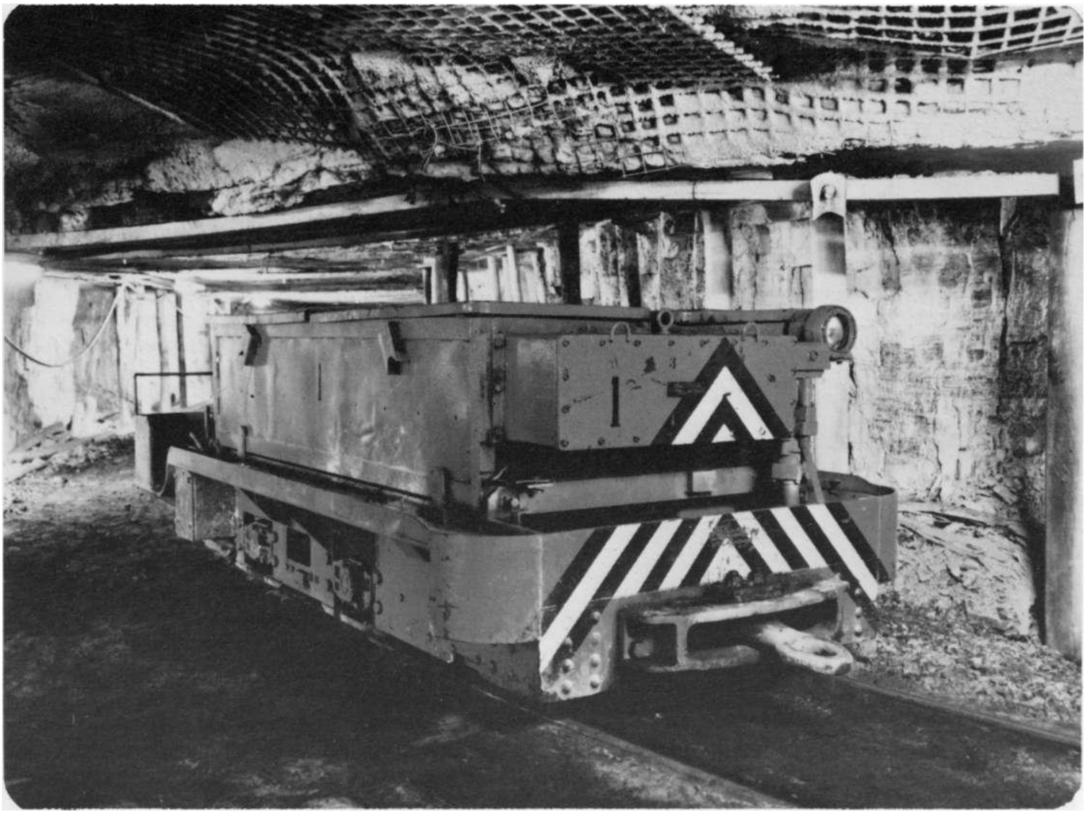
During December, 1985, Hexham Engineering Pty Limited, a subsidiary of Coal & Allied Industries Ltd, entered the locomotive building business again, when they purchased the "Baldwin" industrial locomotive business from EM Baldwin & Sons. Due to one of the take-over conditions, the first six locomotives were delivered under the name "Hexham Baldwin". All subsequent locomotives carry the name Hexham Engineering.

Personnel Carrier Cars

With the advent of mechanisation, self-propelled diesel personnel carrier cars (PC car) were developed to transport the miners in underground workings.

Builders include EM Baldwin of Castle Hill and Fox Manufacturing Company, Sydney. Hexham Engineering began manufacture with the purchase of the "Baldwin" locomotive division in 1985.

These PC cars vary between 14-22 man capacity and are driven by a diesel engine coupled to the wheels. The man riding compartments are at each end, whilst the diesel engine is fitted to the centre part of the car. They are able to travel at speeds of up to 30 kmph and are very useful for officials to flit from one section to another, which may be many kilometres apart in modern mines.



A Jeffrey battery locomotive, pit bottom, West Wallsend No.2 Colliery, 1978. Photo: B Andrews

3. CONCLUSION

The preceding sections cover the methods of coal, materials and man transportation used in the northern mines over the last 100 years or so. It traces the evolution of railed transport from horse-drawn operations, through mechanical haulage methods to modern locomotive operated systems. Now conveyor belts have taken over coal haulage. Although materials and man transportation is changing, rail methods should still continue for many years to come in the older mines, provided they can weather the current economic downturn in the coal mining industry.

Suggested Further Reading

1. **F Danvers Power, *Coalfields and Collieries of Australia,* 1912.**
2. **NSW Department of Mines, *Mineral Resources No.37,* "The Coal Resources of the Southern Portion of the Maitland-Cessnock-Greta Coal District (Northern Coalfield)", by Leo Jones. *(Note:* dated 1939, although actually compiled during the 1920's).**
3. **Elford and McKeown, *Coal Mining in Australia,* 1947.**
4. ***Australian Coal, Shipping, Steel & The Harbour.* A monthly publication, with issues of mid-1940's-1960 being mainly of interest**

Acknowledgments

This article is based on the general knowledge the author has gained with over 30 years association and experience in the coal mining industry on the Northern Coalfields. It must be emphasised that certain details, such as numbers of skips being hauled, are of a general nature only. In most cases these figures varied from colliery to colliery and the average, so to speak, has been given.

Thanks are due to my friend, Ed Tonks, for supplying photographs of the locomotive haulage operations in the BHP group of collieries.

Surface scene at Stockrington No.2 Colliery. On the left, endless rope haulage skips are emerging from and entering the mine; on the right, a battery locomotive and man transport are emerging from the back heading. Note: tracks for materials are not connected with ERH tracks.

Photo: B Andrews Collection

ANNEX 1
SUMMARY OF UNDERGROUND TRANSPORT SYSTEMS, NORTHERN NEW SOUTH WALES COALFIELDS

Colliery	Method of Entry	Haulage Through To Surface	Underground Haulages Used for Coal Transportation: Endless Rope	Direct	Main & Tail	Jig	Locomotive	Was Colliery Mechanised?	Haulages Used To Move Coal To Pit Bottom	Remarks
Aberdare Extended	Drift	Initially Engine Plane Endless Rope	✓					Yes	Conveyor Belt to Surface	
Awaba State Mine	Drift	Conveyor Belt					✓	Yes	Trolley Wire Locomotive and Mine Cars to Pit Bottom	System Finished 1983 - Conveyor Throughout
Abermain No. 1	Drift	Direct - Changed to Engine Plane - " " Endless Rope	✓				✓	No		Locomotive to End of E.R.H.
Back Creek	Tunnel	Engine Plane		✓	✓			No		
Bellbird	Tunnel	Endless Rope	✓	✓		✓		Yes	Conveyor Belts through to Surface	
Co-Operative	Tunnel	Main & Tail	✓		✓			No		
Duckenfield	Tunnel	Engine Plane						No		
Hebburn No. 1	Drift	Endless Rope	✓		✓			No		
Northern Extended	Drift	Direct				✓		Yes	Conveyor Belts through to Surface	
Northumberland	Drift	Endless Rope						Yes	Conveyor Belts through to Surface	Reorganised as Newstan
Pacific	Drift	Main & Tail			✓			No		
Pelaw Main	Drift	Endless Rope	✓	✓	✓			No		
Pelton	Drift	Endless Rope	✓		✓			Yes	Conveyor Belts through to Surface	
Rhondda (later Northern)	Tunnel	Endless Rope	✓	✓			✓	Yes	Locomotives and Mine Cars to Pit Bottom Locomotives and Mine Cars to Pit Bottom	Direct Hauled to Surface (G.N.S.) Alligator to Surface ((F)
Stanford Main No. 1	Drift	Endless Rope	✓			✓		No		Jigs and Cages Underground
Stockrington No. 1	Tunnel •	Endless Rope	✓					Partial		Machines Used to Cut and Load Coal
Stockrington No. 2	Tunnel	Endless Rope	✓					Partial		
Stockrington No. 3 T	Tunnel	Locomotives and Mine Cars					✓	Yes	Trolley Wire Locomotives and Mine Cars to Surface	Conveyor Belts 1984
Wallarah (E Tunnel)	Tunnel	Endless Rope	✓					Yes	Conveyor Belts to Surface	Re-organised at Wallarah Colliery

Colliery	Method of Entry	Type of Winding Eng. D.C.	Type of Winding Eng. U.C.	Decks/Cage D.C.	Decks/Cage U.C.	Coal Hauled in U.C. Shaft	Underground Haulages Used For Coal Transportation: Endless Rope	Direct	Main & Tail	Jig	Locomotive	Was Colliery Mechanised	Haulages Used to Move Coal To Pit Bottom	Remarks
Aberdare	Shaft	S *	S	2	1	No	✓		✓	✓		Yes	Conveyor Belts - Skips Up Shaft	* Electric Winder Installed 1927
Aberdare Central	Shaft	S *	S	2	1	No+	✓		✓			Yes	Conveyor Belts - Skips Up Shaft	* Electric Winder Installed + Proposed - Never Carried Out
Aberdare South	Shaft	S	S	1	1	No					✓	No		Horses to Flat - Locomotive to Pit Bottom
Abermain No. 2	Shaft	S	S	1	1	No	✓				✓	Yes	Locomotive and Mine Cars Conveyor Belts	
Abermain No. 3	Shaft	S		1			✓				✓	Yes	Conveyors	
Burwood	Shaft	S	S	2	1	No	✓				✓	Yes	Trolley Wire Locomotives, Battery Locomotives to Bin - Conveyor to Surface	- Conveyors Throughout
Cessnock No. 1	Shaft	S *	S+	1	1	No					✓	Yes	Battery Locomotives and Mine Cars Conveyors to Pit Bottom and Mine Cars	* Electric Winder Installed 1957 + Converted to Electric Operation
Dudley	Shaft	S	S	1	1	No						No		Horse Only
Elrington	Shaft	E	E	1	1	*					✓	Yes	Battery Locomotives and Mine Cars	Proposed to Install Bulk Winder * In U.C. Shaft - Never Installed
Hebburn No. 2	Shaft	S	S	1	1	No	✓				✓	Yes	Locomotives and Mine Cars Conveyor then into Mine Cars	
Hetton	Shaft	S	S	1	1	No			✓			No		
John Darling	Shaft	S	S	1	1	Yes	✓				✓	Yes	Trolley Wire Locomotives and Mine Cars then into Skips	Cross Measure Drift to Surface Conveyors throughout
Killingworth	Shaft	S	S	1	1	No	✓		✓			Yes	Conveyors to Pit Bottom then into Skips	
Lambton B	Shaft	S	S	2	1	No	✓				✓	Yes	Battery and Trolley Wire Locomotives to Pit Bottom then into Skips	Cross Measure Drift to Surface Conveyors throughout
Neath	Shaft	S	S	1	1	No	✓					No		
Richmond Main	Shaft	E	S	2	1	No	✓	✓	✓		✓	Yes	Locomotive to E.R.H. Conveyors to Pit Bottom then into Skips	
Seaham No. 1	Shaft	S	S	1	1	No			✓			No		
Seaham No. 2	Shaft	S	S	1	1	No	✓					No		
Sea Pit	Shaft	S	S	1	1	No			✓			No		
Stanford Main No. 2	Shaft	S	S	1	1	No	✓		✓		✓	Partial		
Stockton Borehole	Shaft	S *	S	2 *	1	No			✓		✓	Yes	Locomotive and Mine Cars to Pit Bottom Skips Up Shaft - Cross Measure Drift and Conveyors throughout	* Electric Winder Installed & Single Deck Cages Replaced Double
Waratah	Shaft	S	S	1	1	No	✓					Yes	Cross Measure Drift - Conveyor throughout	
West Wallsend	Shaft	S	S	1	1	No	✓					No		

FOOTNOTES

This is not intended to be a complete listing of all the haulages used at a particular colliery as these varied over the years. It is intended to give the reader an indication of the actual haulages used at various stages of the colliery's life.

Horse haulage was used at all the mines working on hand mining operations. Horses were never used at Elrington or Awaba State Mine.

Abbreviations used:

S = steam operated E = electric operated D.C. = downcast - intake air U.C. = upcast - return air G.N.S. = Great Northern Seam F = Fassifern Seam

A mechanised colliery is a colliery that has the coal cut mechanically, loaded mechanically and moved by conveyor belts or mine cars.

Partial mechanised = the coal was mechanically cut and loaded by a skip loader into skips — in other words the full operation of mechanically won coal was not carried out.

As far back as the early 1900's coal cutters were employed to undercut the coal face, but all other operations were done by hand and accordingly, these collieries are referred to as hand mined coal mines.

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