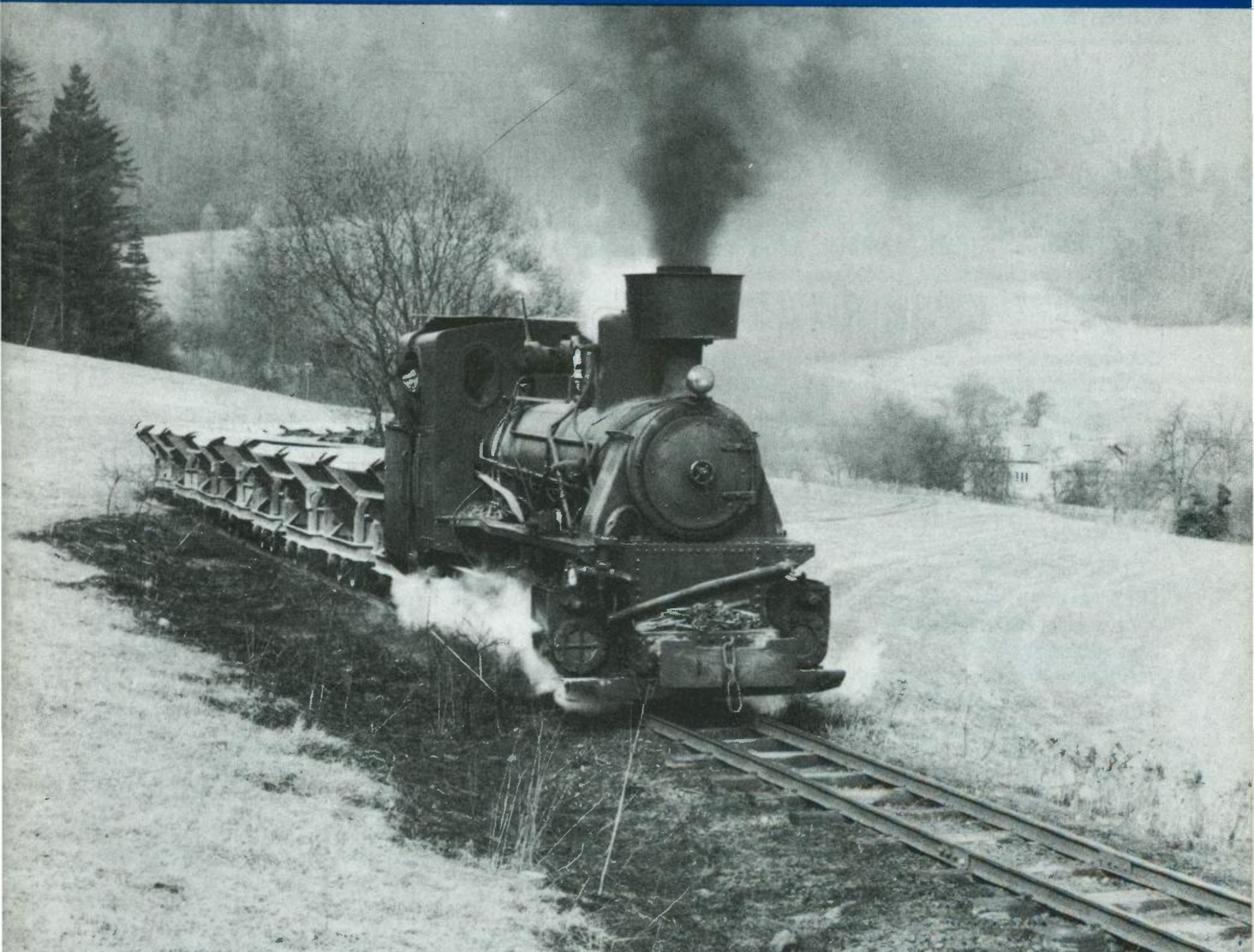
THE NARROW GAUGE

No. 94



NARROW GAUGE RAILWAY SOCIETY

NARROW GAUGE RAILWAY SOCIETY

Serving the narrow gauge world since 1951

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The Society was founded in 1951 to encourage interest in all forms of narrow gauge rail transport. Members interests cover every aspect of the construction, operation, history and modelling of narrow gauge railways throughout the world. Society members receive this magazine and Narrow Gauge News, a bi-monthly review of current events on the narrow gauge scene. An extensive library, locomotive records, and modelling information service are available to members. Meetings and visits are arranged by local areas based in Leeds, Leicester, London, Malvern, Stoke-on-Trent and Warrington. Annual subscription £6 due 1st April.

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No 94 WINTER 1981/82

Cover: A typical scene showing locomotive 5 hauling a train of empty wagons on the Mladejov-Hrebec fireclay railway in Czechoslovakia, still working in 1981, photographed by Pascal Pontremoli in March 1977. The railway is described in this issue.

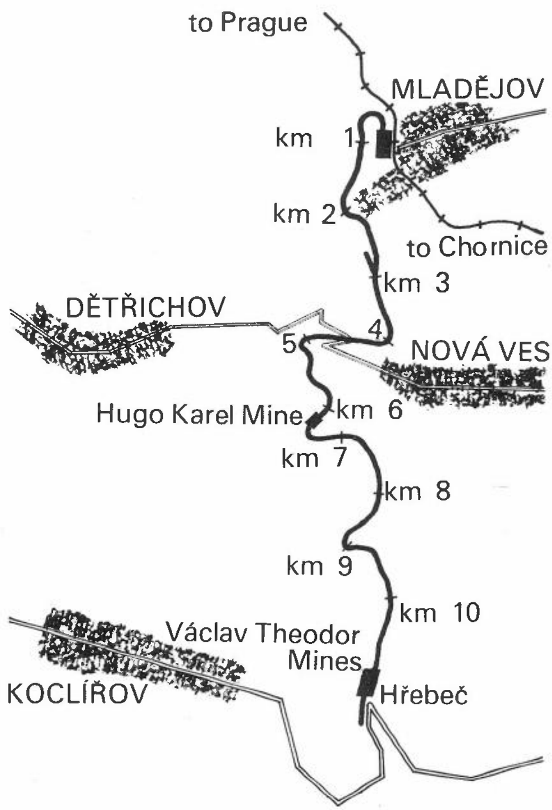
THE MLADĚJOV-HŘEBEČ INDUSTRIAL RAILWAY

Pascal Pontremoli, Keith Stretch & Ron Cox

Located in north central Czechoslovakia at the small locality of Mladějov, the Mladějov-Hřebeč industrial railway is a 600mm gauge system still operating steam in 1981. The village of Mladějov is on the Č.S.D. secondary line between Třebovice and Chornice (Č.S.D. table 276). The locality stands on the border of the provinces of Bohemia and Moravia. The Moravian highlands extend eastwards from Mladějov to the river March. The line exists to serve the fireclay workings of the Hřebeč area and the comparatively recent kilns and refractory works at Mladějov. The course of the line follows the eastern slopes of the Hřebečov ridge and runs generally north/south.

The local communities of Mladějov, formerly Blosdorf, and Nová Ves, formerly Neudorf, are villages with much of the local employment concentrated in the fireclay and refractory industries. The railway starts at an altitude of 425 m, and climbs to the Hřebeč terminus at some 502 m above sea level at a maximum gradient of 1 in 34. Starting from Mladějov, the line turns through 180° on a rising gradient of 1 in 40 and after some 2.5 km enters the forest. Between 2.4 km and 2.9 km, the rising gradient stiffens to 1 in 39 and finally 1 in 34. Just prior to the 3 km point, the gradients ease and much of the upper part of the line is fairly easily graded to the 6.25 km point, where a rising gradient of 1 in 126 through mixed woodland brings the line to the Hřebeč terminus at 11.25 km. There are no civil engineering features of note.

The line was constructed to a plan put forward in 1897 by a company then named *Fürst Liechtensteinische Kohlen und Tonwerke in Blosdorf.* Many disputes between the owners of the pits in the Hřebeč area and the lord of the manor, Prince Liechtenstein, had forced the prince to form this company. The mines' output was at

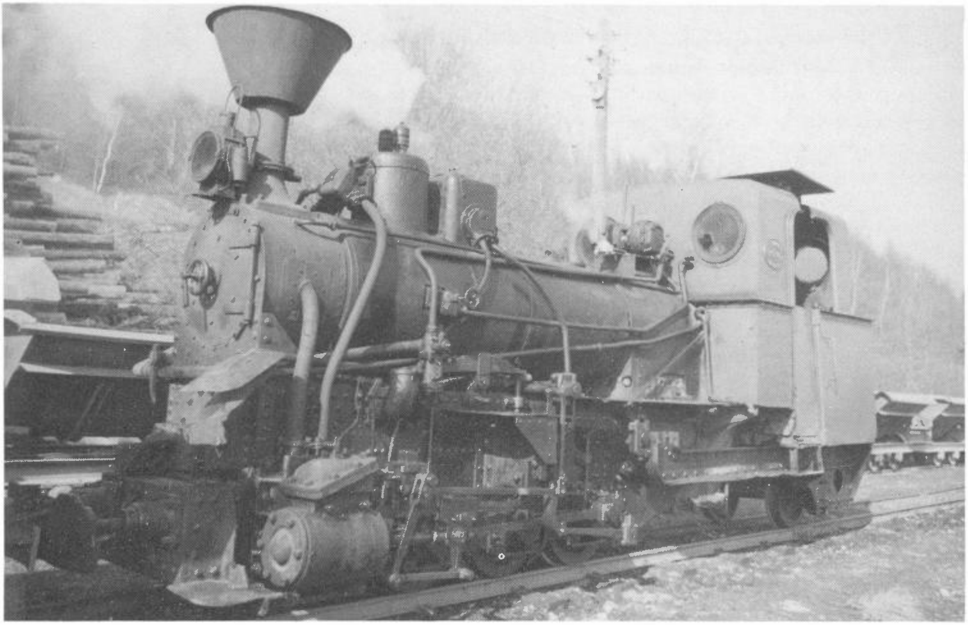


that time both fireclay and low-grade coal. The production was first transported to the standard-gauge railway, and later to the Mladějov power station, by means of a cable incline, the upper terminus of which was close to the present 2.9 km siding. According to records of the time, production was in the region of 1,300 tonnes per annum, mainly slate-like coal for local use. The coal seam was quite near the surface, approximately 1 metre thick, and was worked by means of drift mines. The 1897 plan called for a rail link between the Wenzel Theodor pit in Hřebeč and the upper terminus of the cable incline, some 9 km; the line would also serve the Josefi Barbara and Hugo Karel pits. Maximum gradient was fixed at 1 in 166. The plan was eventually authorised, but before work commenced on building the line the company proposed to extend it direct to Mladějov railway station. The extension would leave the originally proposed route some 400 m from its terminus at the cable incline and descend at 1 in 40 to the transhipment siding at Mladějov. The plans as put forward were approved by the Brno authorities in September 1918. Construction of the line commenced immediately, using prisoners of war for labour; the line was completed some 14 months later.

The generally unstable political situation and the collapse of the Austro-Hungarian Empire and the subsequent founding of Czechoslovakia delayed the inauguration until 24th May, 1924. By this time, the railway had been operating for some four years. The cable incline was dismantled a few years later; the line to the upper terminus is however still in use as a siding for stabling empty wagons as well as for crossing trains. The political upheaval of the next twenty years had little effect on the industrial life of the area. After the Second World War, a new company was formed: *Moravské závody kaoline a hlinné se sídlem v Blansku, správa Mladějov* ("The Moravian kaolin and clay works in Blansko, Mladějov section"). Shortly afterwards, the existing company was formed: *Moravské šamotové a lupkové závody n.p.* (The "Moravian fireclay works"); the company is a state undertaking.

During the early years, the main works and kilns were at Hřebeč. In 1965, however, a new factory and kilns were constructed at Mladějov; almost the entire production was concentrated on the new kilns and much new traffic was generated as a result. Records for 1949 show a total traffic flow of some 35,000 tonnes of fired clay. These figures increased to 75,000 tonnes for 1958 and a record 90,000 tonnes of fired clay and 35,000 tonnes of

On one of the steepest sections of the line 5 strives to keep an empty train on the move, March 1978. *(Pascal Pontremoli)*



Locomotive 1, an Engerth 0-6-2T, at Mladějov in February 1974. *(Zdenek Bauer)*

untreated clay in 1970; the latter figures represent some 62,000 wagon loads. The transport of coal has always been of purely local significance, and since the Mladějov power station closed in the 'fifties this traffic has virtually ceased.

There have been plans in recent years to replace the line with road transport; as yet, no definite moves towards this end have been made. In 1979, it was planned to replace the steam locomotives by diesel power; apart from short workings and shunting, steam remains the motive power.

Present-day operations call for two return workings daily, Monday to Friday. These depart from Mladějov at 07.00 and 11.00, the usual round trip taking three hours. On Saturday, a single trip is made, departing Mladějov at around 07.30. The outward workings are usually in two sections: the first diesel-hauled trip is followed some five minutes later by the steam-worked section; these two sections are combined at the 2.9 km siding and the steam locomotive hauls the whole 40 wagon train forward to Hřebeč. The upper section of the line has at times been diesel-powered but high running costs and unsatisfactory performance has meant s'eam being retained to the present day. An empty wagon working at the end of the day is quite usual, powered by whatever is available. More often than not, this is steam. Again this train only goes as far as the 2.9 km siding, where the wagons are stabled.

The locomotives are maintained by the Mladějov factory workshops, where even overhauls are tackled. They present a very interesting selection. The following descriptions are in number order.

1 0-6-2T Engerth type Krauss & Co, Linz 7485/20

Ordered in 1918, this locomotive was required to operate over the more heavily graded lower section of the line. The vast experience of Krauss, Linz, led them to design an 0-6-2 locomotive with the trailing axle carrying the two-wheel tender articulated on the Engerth principle. This locomotive was based on the highly successful RIIIc type, and was originally built in the early part of 1918 to a War Ministry order. Allocated to Military Railways and numbered 116, the locomotive was not then needed since hostilities had ceased, and was therefore stored at Wegscheid. Krauss then reclaimed the locomotive and rebuilt it from its original form as a 0-6-0 tank to its present appearance, completing this rebuild in April 1920. The engine retained its original works number, but the date was altered to 1920; the works plate carries evidence of this alteration to this day. The cab and articulated tender were built to a similar pattern to locomotives delivered to the Bosnian Railways. The locomotive remains serviceable; the only alteration made has been replacement of the original stovepipe chimney by a spark arresting version.

2 0-6-0WT Krauss & Co, Linz 7493/18

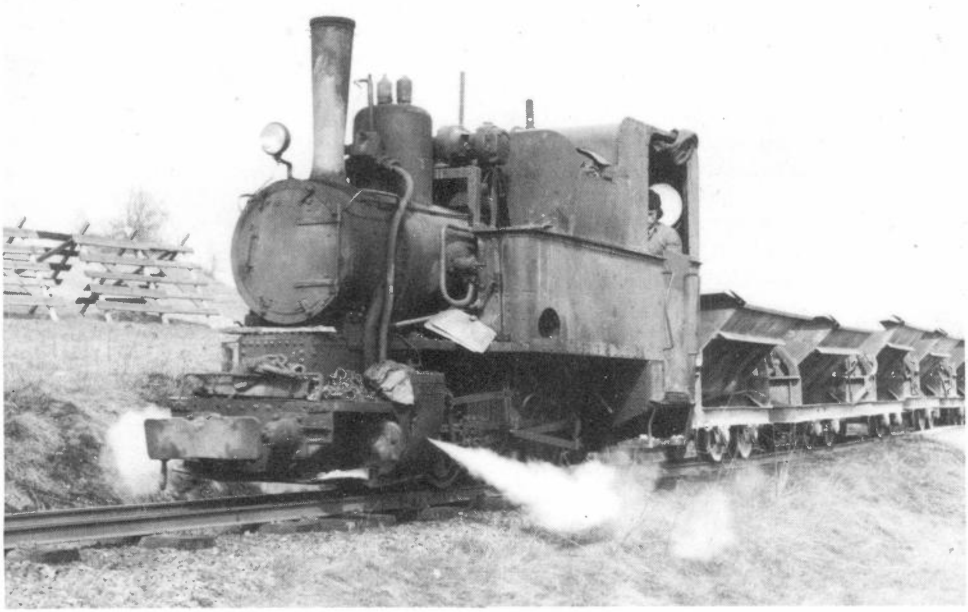
Another locomotive based on the RIIIc type, more than 300 of which were built for the Imperial Military Railways towards the end of World War I. Production was continued after the war at almost all the Austro-Hungarian Empire manufacturers as well as a number of German firms. The locomotive was equipped with outside Helmholz valve gear and a water tank was carried between the frames. No.2 was first leased from the Central Transport Department of the Imperial War Ministry in Vienna, and delivered direct to Mladějov from the Linz works in May 1918. After the Czechoslovak Republic was established, the locomotive became the property of the new state. The lease was later amended to a hire purchase agreement and the locomotive became the property of the Mladějov company in 1923, remaining at Mladějov until 1971. During this time, the firebox was renewed twice; in 1967, the engine was fitted with a type D air compressor to work a *Dake* type air brake. This huge piece of apparatus on such a small locomotive gave No. 2 something of a "plumber's nightmare" appearance. The experiment with air brakes was not a success and the equipment was removed from both locomotive and wagons during the early 'seventies, and No 2 was scrapped.

3 0-6-0WT Breitfeld-Daněk 165/19

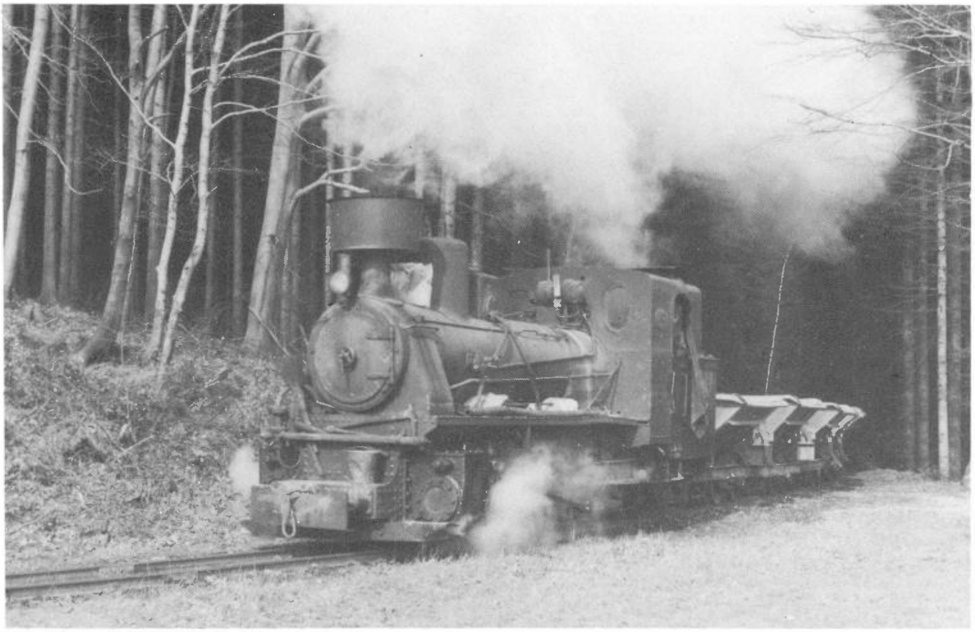
Once again an RIIIc type built by Maschinenbau A.G. (formerly Breitfeld Daněk Co, Slany and Blansko). Originally No 321 of the Imperial Military Railways, the locomotive was fitted with Heusinger valve gear. Built in the spring of 1919, the locomotive was not delivered to the Military Railways and was offered for sale to various industrial concerns before coming to Mladějov. This is the sole representative of its type left in Europe.

4 (first) **0-4-0T Orenstein & Koppel 1835/06**

The smallest of the locomotives to operate at Mladějov, this engine was a typical contractor's locomotive and was used in the construction of the line. It was originally built for stock for O&K's Cairo agent. Nothing more is known of its history until it arrived at Mladějov. The locomotive was retained as a spare engine until the arrival of No 5 in 1929; No 4 was then sold to a construction company.



Breitfeld Daněk 0-6-0T struggles towards the mines with empty tip wagons in March 1977.
(Pascal Pontremoli)



The largest locomotive on the line, 0-6-2T 5, blasts out of the forest in March 1978.
(Pascal Pontremoli)

4 (second) **0-4-0WT** **Č.K.D. Prague** **2992/51**

Taking the place of the first No 4, this locomotive was a BS80 class four-coupled engine, one of nearly eighty similar locomotives built in the early 'fifties. A modern engine with an all-welded boiler, rocking grate, and a steel firebox, No 4 is fitted with Heusinger valve gear and sleeve valves. Delivered in 1951, the locomotive was built by *Československé stavební n.p.*, Prague, and was first employed on the construction of the Košice steelworks. Transferred in 1954 to the *Hornobřízské kaolinové závody n.p.*, Horní Bříza, it finally arrived at Mladějov in December 1964. The locomotive proved unstable; the high axle loading and high centre of gravity caused a number of derailments in service, and No 4 was therefore relegated to spare engine.

5 **0-6-2T Engerth type** **Krauss & Co, Linz** **1518/29**

Ordered from Krauss in June 1929, this locomotive was completed in August of the same year. Of similar design to No 1, though slightly enlarged, it is the most powerful at Mladějov. During the 1930's, the locomotives were fitted with a complex water softening apparatus following problems with the local hard water. A large cylindrical container was mounted vertically alongside the boiler and in this soda was added to the feed water. The whole apparatus with its maze of pipes looked very grotesque. The equipment was removed during the 1950s when soft water became available from the power station supply. Since the closure of the power station, chemical treatment has been re-introduced.

The rolling stock for the Mladějov line was originally wooden-bodied wagons of 1 cubic metre capacity. Some of these were constructed at Mladějov, but most were manufactured by outside builders. A larger all-steel wagon of 2.9 cubic metres capacity was introduced around 1935. For the most part, the latter type are in regular service whilst a few wooden-bodied examples still remain on the system, though not in regular service. For the coal traffic, steel skips of 1 cubic metre capacity were used; a few of these skips are still on site to this day. Since 1919, a small wooden-bodied carriage has been used to transport workers; the workers for whom the coach was built were required to contribute towards its cost. All in all, some 70 wooden-bodied fireclay wagons were in service; the smaller steel skips numbered some 35, mostly constructed by the Ferrana company in Prague. In 1933, there were 167 steel and 70 wooden wagons in service on the line. Of these, approximately 25% were fitted with hand brakes. Present-day stock consists of 200 steel wagons plus a few skips and wooden-bodied wagons for permanent way and other uses.

One of the two Czech-built diesel locomotives used for shunting duties at Mladějov. March 1978. *(Pascal Pontremoli)*

In everyday service, the loading for locomotives is generally as follows:

—locomotives No 1 and No 3, up to a maximum load of 25 wagons from Mladějov to the 2.9 km siding.

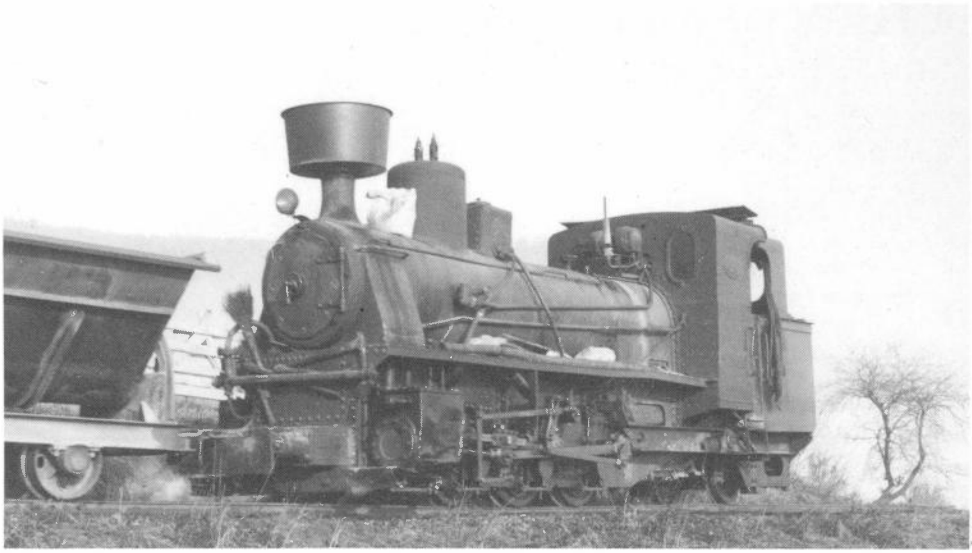
—locomotive No 5, up to a maximum load of 40 wagons from Mladějov to the 2.9 km siding.

In practice, trains are usually formed of two sections on the steeply-graded section to the 2.9 km siding, where longer trains of up to 50 wagons are made up for working the upper section. On the downhill run, the loading is entirely dependent on the availability of brakesmen. Working practices require at least a quarter of the train to be braked on the lower section. A brakesman usually has control of 15 to 20 wagons.

During the 1960s, four small four-wheel diesel locomotives have handled all shunting duties at Mladějov and Hřeběc. These locomotives are of BNE50 type equipped with Skoda engines and electrical equipment. For "main line" service, two BN60H type four-wheel diesel locomotives have been purchased, the first example in 1969 with a second in 1973. These were built by *Turčianské strojárne n.p. Martin, závod Hliník nad Hronom.* Both locomotives are fitted with air-cooled Tatra diesel engines of type 924A-8; these are 60 h.p.units driving through a type ČKD-H-70L hydraulic transmission, final drive being by jack shaft. The wheelbase is 1200mm and weight in working order is 10 tonnes. In 1975, a third locomotive of the same type was purchased. These engines have proved themselves inadequate for hauling trains on the lower section of the line, and are now generally restricted to heavy shunting duties and short empty wagon train workings to the 2.9 km siding. The prevailing harsh conditions and problems with spare parts and maintenance difficulties have proved their downfall for main line service.

The last report on the line was for June 1981; kindly supplied by Keith R. Chester, through the Continental Railway Circle. At this time traffic was operating as described above. The visiting railway enthusiast is generally well treated. Photography is not restricted save in the works at Mladějov. Suitable overnight accommodation in the area exists at Česká Třebová and Moravská Třebová.

Obviously, the old problem of worn-out steam locomotives and shortage of spares will play a more important part in motive power thinking over the coming years. There are rumours of a large diesel being ordered to tackle the steeper gradients; considering the failures with small diesel power in the past, one would suspect this would be at least a bogie design.



5 heads effortlessly downhill with a loaded train for the works in March 1978.
(Pascal Pontremoli)

MORAVSKÉ ŠAMOTOVÉ A LUPKOVÉ ZÁVODY N.P., MLADĚJOV NA MORAVE:
STEAM LOCOMOTIVE SPECIFICATIONS

Locomotive No	:	1	2	3	4	4	5
Type	:	0-6-2T	0-6-0T	0-6-0T	0-4-0T	0-4-0T	0-6-2T
Builder	:	Krauss Linz	Krauss Linz	Breitfeld Daněk	O&K	ČKD Prague	Krauss Linz
Works No	:	7485	7493	165	1835	2992	1518
Year	:	1920	1918	1919	1906	1951	1929
Class	:		RIIIc	RIIIc		BS80	
H.P.	:	50	45	50	30	80	70
Working pressure Kp/sq m	:	12	12	12	12	14	12
Boiler dia. mm	:	720	720	780		980	820
Boiler tubes. No. × dia. mm	:	51 × 44.5	56 × 41.5	69 × 41.5		90 × 44.5	77 × 44.5
Length mm	:	2450	2000	1900		2000	2600
Heating surface: Tubes sq.m	:	17.5	14.6	17.1		24.86	27.67
Firebox sq.m	:	4.1	1.56	2.22		3.82	4.96
Total sq.m	:	21.6	16.55	19.32	10.05	28.68	32.63
Grate area sq.m	:	0.78	0.37	0.48		0.75	1.01
Cylinders: dia × stroke mm	:	200 × 300	200 × 300	220 × 300	165 × 300	250 × 300	250 × 320
Coupled wheel dia. mm	:	600	600	600	580	700	640
Rigid wheelbase mm	:	1320	1320	1500	1000	1400	1600
Total wheelbase mm	:	4320	1320	1500	1000	1400	4600
Trailing wheel dia. mm	:	600					600
Weight: empty t	:	11.5	8.2	7.9	5.3	10.0	12.3
in working order t	:	14.0	10.2	10.5	6.6	12.45	15.9
Water capacity cu m	:	0.8	0.8	1.0		0.8	1.3
Coal capacity cu m	:	1.0	0.38	1.4		0.57	1.5
Tractive effort Kg	:	1440	1440	1742	1014	2250	2245
Min. radius curve m	:	50	50	30		15	50
Max. speed Km/h	:	20	20	20		25	20
Overall length mm	:	7117	5018	5400		6150	8020
Overall width mm	:	1704	1704	1900		1800	1850
Overall height mm	:	2980	2980	2832		2650	2950

A CENTURY OF MINIMUM GAUGE

Rodney Weaver

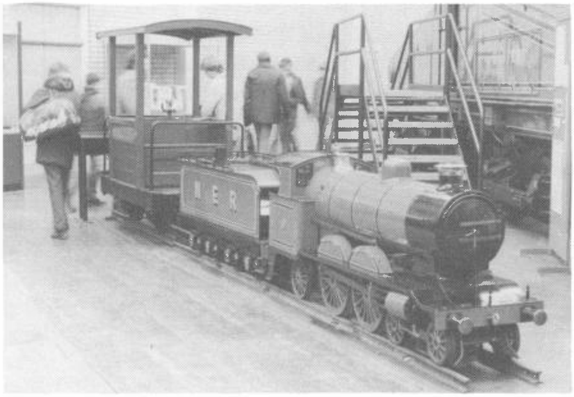
In October 1981 there opened at the National Railway Museum, York, a small exhibition of historic 15in gauge equipment, to mark the centenary of Sir Arthur Heywood's public demonstration of the Duffield Bank Railway. Much has been written about the Heywood railways, not all of it accurate, and I do not propose to repeat their history here. Instead, a few words about the minimum gauge principle and its development would seem appropriate.

Arthur Heywood recognised the basic principle in the work of Charles Spooner, Robert Fairlie, Charles Holland and others who contributed to the successful transformation of the Festiniog Railway from mineral tramway to public railway during the 1860s. He visited Portmadoc in the early 1870s, possibly during the Fairlie locomotive trials, and while he found much to admire he did not become a convert to the idea that narrow gauge is a good thing in itself. Instead he recognised the inherent disadvantages of using too narrow a gauge for the traffic to be carried and the plain fact that the F R succeeded because its equipment was carefully designed to overcome those disadvantages. On the other hand, the line had been ideally proportioned to the traffic carried when it was first built. From this came the idea of designing a minimum size railway system to carry low volumes of traffic over comparatively short distances.

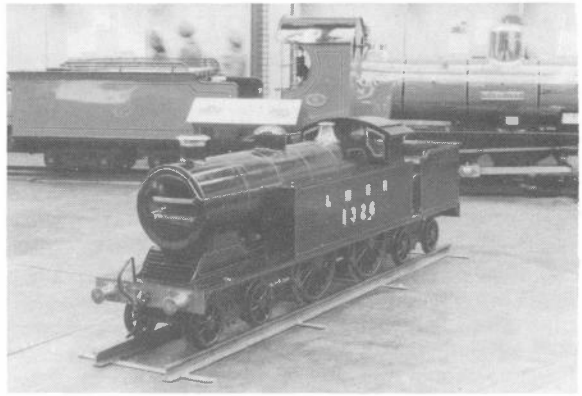
One may argue that such an approach leads to the sort of multi-gauge disorganisation seen in Australia. Heywood did not suggest widespread application of this concept, however. His concern was the filling in of gaps in the British railway network, in other words bridging the remaining distance from a reasonably large source of traffic (such as a large estate or a small quarry) to its nearest railhead. Given the state of the roads, the high cost of horse-drawn transport and the relative cheapness of manual labour it was quite an attractive idea. If one wanted to convey 10,000 tons per annum over a distance of three to five miles, Heywood calculated that a railway of minimum size could operate at one-third the cost of road transport and thereby save around £1000 a year.

Use of a narrow gauge was not the only feature of a Heywood minimum gauge railway. All details were carefully worked out to give long and reliable service at minimal cost. Thus he advocated the use of simple flat wagons capable of taking a number of detachable body types rather than the building of single-purpose vehicles, to maximise utilisation and reduce capital cost. He was never satisfied with the behaviour of wooden sleepers and eventually devised an all-metal track which, if laid correctly in the first place, should give years of trouble-free service with no more than routine maintenance. His locomotives were likewise designed for simplicity of construction, maintenance and operation. That was the reason for using launch boilers: a locomotive that is not going to undertake long runs nor work at maximum power for more than a few minutes at a time does not need a fast-steaming boiler. It is important to recognise that the classic Heywood articulated locomotive did **not** form part of the minimum gauge package as it was first presented. ELLA was built to explore the potential of 15in gauge, but Heywood did not consider that any commercial line would ever need such a complicated and expensive machine. In his opinion, a minimal railway needed only minimal locomotives, in other words simple 0-4-0s. Nor was 15in gauge regarded as essential, except for a railway of absolutely minimum capacity. He expected commercial builders to use the established 18in or even 2ft gauges. In short, the Duffield Bank Railway with its articulated locomotives hauling bogie carriages round amazingly sharp curves and up gradients as steep as 1 in 10 was a demonstration of the ultimate potential of 15in gauge. It was not intended as a prototype of a commercial railway!

Eaton Railway bogie brake van 32, part of a train of Heywood vehicles displayed with RIVER IRT at the National Railway Museum.
(Vic Nutton)



LITTLE GIANT, built by Bassett-Lowke, was exhibited with the Heywood brake van used during its trials on the Eaton Railway in May 1905. *(Vic Nutton)*



BLACOLVESLEY was the only internal combustion locomotive built by Bassett-Lowke. In the background is the gleaming RIVER IRT. *(Vic Nutton)*

For some reason, Heywood's ideas underwent a significant change between 1896, when he completed the Eaton Railway, and the publication of his book *Minimum Gauge Railways* in 1898. His judgement, too, seems to have been less impeccable than in earlier days. He had not wanted to build the railway himself, but no commercial builder was willing to work within his exacting specifications. He managed to complete the railway within his estimate, without giving his time free as is sometimes assumed, but I suspect that he had to cut a few corners to do so. It was nevertheless a good railway, and in its first two years was operated within a few pounds of his estimated figures. But he had used ash ballast, probably for cheapness, and the track needed rather more attention than he had expected. This he blamed not on the ballast but on his use of a four-coupled locomotive and declared that in future he would use nothing but articulated machines. It was in my opinion a most unjust criticism of a perfectly good locomotive, and KATIE was doomed to carry this notoriety throughout her career. Indeed, he seems to have taken a dislike to KATIE from the start, being apparently surprised that she needed major attention after four years continuous service. Finding the valve gear worn, he redesigned it and made the curious mistake of replacing hardened steel pins by bronze ones. This error he never rectified, yet it took Henry Greenly only a few weeks to discover the mistake when he followed Heywood's advice and used bronze pins in LITTLE GIANT. Sadly, I feel that Sir Arthur was past his intellectual peak when he wrote his book and this may explain why he made no further improvements to his railways during the remaining eighteen years of his life.

In *Minimum Gauge Railways,* Arthur Heywood left us not only a fascinating account of his work but also a highly readable introduction to railway engineering as a whole. For the builder of a small railway it can still be a valuable textbook, indeed to appreciate the book to the full one must work with it. Some of his equipment has survived, though sadly none of his locomotives survive in original condition. That MURIEL is still with us in the guise of RIVER ESK is in a way appropriate. The classic Heywood machine was meant to haul trains at low speed over a short distance and would be quite out of place on the average miniature line. Give it a conventional locomotive boiler, however, and one has a locomotive capable of doing anything that is asked of it. Henry Greenly once suggested that the ideal heavy-duty 15in gauge locomotive was a Heywood chassis with a locomotive boiler, and in RIVER IRT we see just such a combination.

Greenly himself was an able upholder of the Heywood tradition, to which he became converted on a visit to Duffield in 1904. True, his locomotives were of "scale" appearance, but as a professional designer he could only produce what his customers wanted; the advanced design of the petrol locomotive BLACOLVESLEY (1909) gives the lie to any assertion that he was merely a model engineer. Given his head, Greenly would have built something a lot closer to the Heywood style, as his unfulfilled designs show. The continuity would have been obvious had his original design for RIVER ESK not been butchered to accommodate the unsuccessful Paxman-Lentz valve gear, for then Britain's first 2-8-2 would have appeared with Heywood valve gear.

"Minimum gauge" has enjoyed something of a revival in recent years thanks to the "narrow gauge" movement in 7¼in gauge. This is essentially the application of minimum gauge principles to the design and operation of a passenger-carrying line on the narrowest gauge that can give inherent stability. Yet I doubt that Arthur Heywood would have approved of the celebrations to mark his centenary—a man who was always seeking to go forwards would be saddened to find a generation that buries itself in past glories to escape the future.

GHOSTS OF ABERGLASLYN

Rodney Weaver

The natural corridor from Portmadoc to Caernarvon by way of Beddgelert had a fascination for the railway promoter out of all proportion to its importance. From the early 1870s until completion of the ill-starred Welsh Highland Railway fifty years later there was a number of schemes to build lines along all or part of this route. When the link was complete it proved hopelessly uneconomic and lasted a mere thirteen years, a fact which may have had something to do with its northern terminus being at Dinas Junction, still three miles short of Caernarvon. Along the way this magnificent obsession had produced one of the earliest and most successful hydro-electric stations (Cwm Dyli, still active in 1982) but it left behind memories of a failed railway, of the near failure of the contractor who built the power station and of staggering rate bills for the unfortunate inhabitants of those places through which it ran. The story of the W H R and its predecessors has been recorded in several books, yet the engineering history of the Portmadoc, Beddgelert & South Snowdon Railway, of the building of Cwm Dyli and of the associated electrical distribution network has received little or no notice. Few readers will thus be aware that besides the well-known RUSSELL, there were ten other PB&SSR locomotives. Unlike RUSSELL, these never got within three hundred miles of the Aberglaslyn Pass.

To summarise the origins of the PB&SSR, a direct ancestor of the later Welsh Highland, it was a revival of an idea first mooted by Charles Easton Spooner of the Festiniog Railway in the 1870s. His North Wales Narrow Gauge Railways scheme of 1872, an attempt to counter standard gauge penetration of the Festiniog monopoly at Blaenau Ffestiniog, consisted of two separate lines using part of the corridor. The General Undertaking ran from Portmadoc through Beddgelert to Betws y Coed and Corwen while the Moel Tryfan Undertaking ran from Dinas Junction to Bryngwyn, the north edge of the Nantlle quarrying district, and Rhyd Ddu at the top of the climb out of Beddgelert. He did not envisage a link between Rhyd Ddu and Beddgelert, despite the fact that the climb over Pen y Gwryd on the main line would have been longer and steeper. Of this intended empire only the Moel Tryfan Undertaking was actually built and this soon freed itself from Spooner influence, operating quietly for some forty years as the NWNGR before the promotion of the WHR. In 1879 Spooner tried to revive the original scheme, this time including a link from Rhyd Ddu to Beddgelert, but without success.

Over the next twenty years there were a number of schemes to bridge the gap between the Croesor Tramway and the NWNGR, or merely to extend the former up to Beddgelert. The Portmadoc, Beddgelert & Rhyd Ddu Light Railway of 1898 was the last of these purely abstract schemes and doubtless inspired the more concrete attempts that followed. In 1900 the NWNGR obtained powers for an extension to Beddgelert, with a terminus on the west side of the valley. In the same year was proposed the Portmadoc, Beddgelert & South Snowdon Railway, the South Snowdon of whose title was not the station of that name on the NWNGR but the South Snowdon slate quarry with its inclines down to Llyn Gwynant. It was to run from Portmadoc to the foot of these inclines with a station on the east side of the valley at Beddgelert quite unconnected with the proposed NWNGR terminus. The most interesting part of the PB&SSR proposal was that the line would be electrified, current being generated by a power station at the foot of Cwm Dyli just beyond Llyn Gwynant. It was authorised in 1901, its powers included the generation, distribution and **storage** of electricity. The use of batteries was quite common in early direct current (d.c.) installations, so the storage powers may indicate that the original intention was to employ direct current. On the other hand, the use of three-phase alternating current (a.c.) was mentioned quite early in the subsequent manoeuvring prior to actual construction; had the original intention been to use a.c. then "storage" could only have meant pumped storage as it is now practised in these same mountains. In view of the strong prejudice against high voltage alternating current systems that existed in Britain at this time, I am inclined to the view that the original plans envisaged d.c.

Shortly after passage of the PB&SSR Act there appeared on the stage the North Wales Power & Electric Traction Company, promoters of which were also involved in the PB&SSR. It was no coincidence, as we shall see. By 1904 plans were sufficiently advanced for the signing of a formal contract and it was at this point that the fortunes of the PB&SSR, NWPT and NWNGR became enmeshed. On one hand, the generation, distribution and storage powers of the PB&SSR were transferred to NWPT, thereby saving the latter the difficult process of obtaining such powers for a purely commercial electricity supply network. It was far easier for an electric tramway or railway to get such powers than it was for a commercial undertaking, a point which may not have escaped the promoters of the NWPT! At the same time, it was proposed to take over the unfinished NWNGR Beddgelert extension, link it with the PB&SSR main line and revive earlier proposals for a line from Dinas Junction into Caernarvon. The necessary powers were obtained in 1905, under which the Dinas-Caernarvon line would be built by the PB&SSR and electrified. It was implicit that the NWNGR was to be taken over and electrified too; for all intents and purposes both the PB&SSR and NWNGR were becoming subsidiaries of NWPT, the former in fact, the latter by implication. That the primary aims of the PB&SSR and NWPT were different was to cause trouble a year or so later when money became short.

The object of the North Wales Power & Electric Company was simple. It would build one or more hydro-electric stations and sell power to slate quarries and other major customers in the area. To these ends it signed up three major quarries as pilot customers. These were the Oakeley Quarries in Blaenau Ffestiniog, Penyrorsedd Quarry in Nantlle Vale and the Dinorwic Quarries. The last of these made only token application of electric power at first, being included in order to get on the right side of the Assheton-Smiths across whose lands the NWPT pole routes would have to run. Oakeley and Penyrorsedd were full-scale electrifications, however, to be carried out by the NWPT's own contractors and supplied at a concessionary rate. It will be noted that the extensive pole routes necessary to serve these pilot schemes put most of the major slate producing areas within easy reach of NWPT supplies and there can be little doubt that their location was chosen with this in mind. Signing up Oakeley was a major step as direct current electrification was already well established in the Ffestiniog district. By 1900 Votty & Bowydd, Maenofferen, Llechwedd and even Oakeley had made experimental installations, Votty and Llechwedd being by then firmly committed to electrification. From the inception of the NWPT scheme, the use of three-phase generation and distribution was intended whatever the original intentions of the PB&SSR and it would be interesting to know whether this decision was influenced by the advocacy of three-phase in preference to d.c. by Moses Kellow, proprietor of Croesor Quarry.

The story of the NWPT power stations and allied works is of considerable interest from a technical standpoint, not least the construction of the pole routes across some of the wildest country in Wales. At the time of its inception it was one of the largest hydro-electric schemes in Europe and it was built to last. Seventy-five years after commissioning, Cwm Dyli was still feeding power into the National Grid and parts of the original distribution system were still in use. The equipment at Penyrorsedd and Oakeley, too, lasted into the recent past and would be in regular use today had those quarries survived in their original forms. The whole system is a monument to the firm that built it, Bruce Peebles & Co. Ltd. of Edinburgh.

David Bruce Peebles (1826-1899) set up Peebles & Co. in 1866. He was a gas engineer by trade, and his company soon became a leading contributor to the gas industry. By 1890 the threat of electricity was being taken seriously and although gas staged a brief come-back after the invention of the incandescent mantle Peebles saw that the new power was here to stay. He therefore started an electrical department which by the time he died in 1899 was almost as important as the traditional side of the business. Already Peebles & Co was negotiating a license to manufacture equipment designed by the famous Hungarian firm of Ganz, pioneers of three-phase electrification, and was on the way to becoming a major supplier of power station and electric traction equipment. To meet the changed status of the firm it was reorganised in 1902 as Bruce Peebles & Co Ltd.

The management of the new firm took a bold decision. Instead of merely supplying electrical equipment they would in future undertake the construction of complete electrical installations, becoming civil and mechanical engineers in addition to their existing trade. Clearly they felt that the expanding market for such work would stand a new entrant and that one or two notable successes would establish their reputation. One of the first major contracts awarded to the firm in their new role as primary contractor was the construction of the NWPT/PB&SSR system and they apparently seized the opportunity with both hands. Alas, the dream was to turn sour. That Bruce Peebles did their work soundly is plain to see, not only in the surviving electrical equipment but also in the surviving civil engineering of the PB&SSR around Beddgelert. The problem was simply that they did not, apparently, recognise the slightly different status of the PB&SSR. Outwardly it was part of the NWPT empire, as was indeed the original intention, and to a contractor with interests in electric traction it would be as important as the NWPT part of the contract. But the PB&SSR had become something of a front for the NWPT. It had served a useful purpose in acquiring the necessary powers to build Cwm Dyli, etc., but there was now rather more enthusiasm for the commercial side of the project than for the railway. Inevitably, when money began to dry up the NWPT took precedence over the PB&SSR. By 1907 it was clear that the PB&SSR was not going to be completed in full and although it was pruned, for example by abandoning the rather pointless section up to Llyn Gwynant, work stopped altogether sometime during 1908 with the Beddgelert-Rhyd Ddu section still incomplete. It was intended to be a temporary halt but in the manner of such things it became permanent.

Bruce Peebles were caught out by this. A formal contract to build the PB&SSR had been signed in 1904, but this was little more than a letter of intent. Expenditure on specific aspects of the project was authorised separately, as work progressed. In particular, expenditure on locomotives and rolling stock would be authorised when the railway was nearing completion. Nothing unusual about that, except when one is dealing with a new and relatively untried technology like three-phase traction. Bruce Peebles were clearly confident that everything was going according to plan, so they started work on the locomotives in advance of any specific authority to do so. By so doing they were simply giving themselves extra time to iron out snags. Unfortunately the necessary authority never came and when work stopped in 1908 they found themselves with ten locomotives and a large quantity of other equipment for which no specific orders had been placed and for which they were not going to be paid. It brought the company to the verge of bankruptcy. This was averted by another reorganisation which abandoned the concept of being a primary contractor and left the firm free to concentrate on its established business of building electrical equipment. At the same time, the gas side of the business was separated from Bruce Peebles & Co. Ltd. to trade under its original title of Peebles & Co. As N.E.I. Bruce Peebles Ltd. the firm is still in business today.

The novelty of the PB&SSR was its intended use of three-phase electric traction as perfected by Ganz. For the benefit of those not familiar with early electric traction systems I will give a simplified description of the underlying principles. Put rather crudely, a three phases system has three "positive" wires known as phases, each carrying an alternating current of the same frequency. The currents are out of step with one another by one third of a phase. Because the algebraic sum of three currents out of step by one third of a cycle is zero, it is not necessary to provide a separate "neutral" for each; instead the "neutral" side of each circuit can be connected to a common neutral. This produces the classic four-wire three-phase network used for domestic supply. A domestic 240 volt circuit uses one phase (i.e. **line** and the neutral of a 440 volt distribution system. The voltage of a three-phase circuit is measured between phases, hence the voltage between one phase and neutral is about 58% of the circuit voltage. A piece of three-phase machinery has three windings (or a multiple of three) which may be connected between phase and neutral (known as **star** connection) or between pairs of phases (**delta** connection). There being no balancing current because the loads on each phase are equal the neutral would not carry any current and is not needed, so the circuit is reduced to three wires; star connected windings are thus connected to a common point rather than to a common wire.

A three-phase motor has, again in rather crude terms, a short-circuited armature or rotor inside a stator which has 3**n** poles. The windings on these poles are connected to the separate phases in sequence, each third winding being across the same phase. There is thus produced a rotating magnetic field, which rotates once every **n** cycles. This field induces alternating currents in the rotor windings, which in turn react on the field to produce a torque on the rotor in the direction of rotation of the field. Because the field must be rotating slowly in relation to the rotor to induce the necessary currents, the motor cannot run at the same speed as the field and is therefore termed an **asynchronous** induction motor.

The laws governing alternating current dictate that a simple induction motor as described above will only produce a useful torque when running at full speed, i.e. around 95-96% of synchronous. If the rotor is held stationary, as is the case when starting under load, little torque is produced. The remedy for this is to increase the resistance of the rotor windings so that the phase difference between inducing and induced currents is narrowed. In practical terms, this means that instead of merely being short-circuited within the rotor, the individual windings are connected to slip rings. Brushes on these rings are connected to a variable resistance assembly. To start, full resistance is inserted; as speed rises the resistance is gradually taken out until at normal speed the rotor is truly short-circuited. Many installations, including all major three-phase locomotives built during the early years of this century, employed liquid resistances in which metal plates were lowered into a tank of very weak salt solution. The deeper the plates were immersed the lower the resistance. Apart from certain technical advantages, a liquid resistance has the advantage over a metal one that it cannot run hotter than boiling point.

Another problem with induction motors is that they will only run at a set speed. There are one or two ways of improving the situation, the one used in traction applications being pole switching. Basically this involves changing the number of poles actually in circuit, the fewer poles in use the higher the speed of the motor. At the expense of considerable complication, the best three-phase locomotives could run at four different speeds. This was the real drawback of the system. Apart from being boringly consistent, in that they would maintain a set speed regardless of gradient unless the load exceeded the maximum torque available, these locomotives had no overload capacity. Once the rated load for a given speed was exceeded, they could not accelerate to that speed and had to run at the next lower speed.

Three-phase traction enjoyed a brief spell of popularity despite these obvious limitations because a three-phase motor does not have a commutator and is therefore not subject to the wear and damage caused by sparking at the commutator. Nor does a three-phase system require anything more than a transformer in the lineside sub-stations, an important consideration when the only means of rectifying a/c current was by means of a rotary converter. Except in Italy, however, it was soon displaced by the development of low-frequency single-phase traction using series-wound motors. Modern technology has brought about a revival of the three-phase traction motor, using variable-frequency current generated by solid-state inverters. Such a motor can start easily using very low frequency current and can of course run at any speed up to the maximum frequency of which the inverters are capable. It is rather ironic that, almost at the same time as they were working on the PB&SSR's three-phase equipment, Bruce Peebles installed the world's first industrial-frequency single phase system in their own sidings.

A three-phase locomotive has two independent overhead collectors, there being two overhead wires each carrying one phase. The third phase is the track itself, this phase rather than the neutral being earthed in the case of a traction circuit. The PB&SSR was to have worked at 500 volts and the locomotives were apparently a development of an earlier Ganz design. Five complete locomotives were imported from Budapest in 1905, being given Bruce Peebles works numbers, and a further five were built at Edinburgh in the following year using drawings supplied from Hungary. The accompanying drawing is based on a General Arrangement that is unfortunately not complete with regard to controls and auxiliary equipment. From this it can be seen that they were severely rectangular affairs. Inside was a massive cast central frame carrying the electrical gear, the large motor being mounted vertically and driving the jackshaft through a pair of bevel gears. One assumes that twin pantographs rather than bows or trolley poles would have been fitted.

The motors were a Ganz design rated 160/80hp. The significance of this rating is not known, but one possible explanation is that they could be run either in star or delta. Why such provision would be deemed necessary it is hard to say at this distance in time. Nor is it known whether there was any provision for changing speed, though as we shall see the locomotives would have been quite satisfactory without it. The nearest equivalent of this motor in the contemporary Bruce Peebles range was the BS61, rated 150hp at a nominal 500 rpm. Allowing for the necessary 3% slip the actual speed on full load was 485 rpm. This motor was 1090mm overall diameter, the rotor being 848.8mm diameter × 270mm long; the complete machine weighed 6300lb. We may assume that the maximum rating of the motors was therefore 160hp at 500 nominal rpm. This would have given the locomotives a balancing speed of about 15mph, and assuming a mechanical efficiency of 80% that would represent a continuous tractive effort of about 3200lb. Having liquid resistances, the motors would have been capable of developing at least 50% more starting torque than their continuous output, so the starting tractive effort of the locomotive would have been at least 5000lb. This is a reasonable figure for a machine that must have weighted between eight and ten tons.

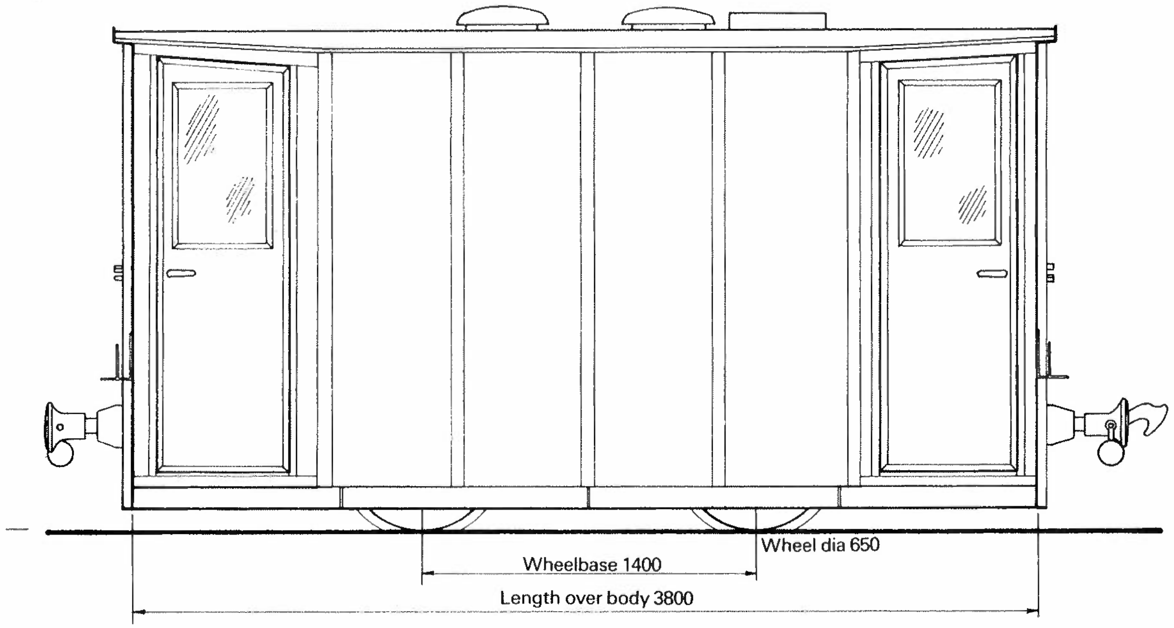
The ruling gradient on the PB&SSR would have been 1 in 28, while on the NWNGR it was 1 in 39 on the Bryngwyn branch or 1 in 47 on the main line. The locomotives could thus have handled a load of approximately 27 tons uphill to Rhyd Ddu and at least 40 tons elsewhere. 27 tons represents forty empty slate wagons, seven loaded coal wagons or three large bogie coaches and in the light of subsequent experience this would doubtless have been adequate except during the peak holiday period. I think it unlikely that any change-speed facility was provided because the adhesive weight was inadequate for a starting tractive effort much in excess of 5500lb and any increase in continuous output would have to be matched by an increase in starting effort to maintain a reasonable acceleration from rest. This makes the alternative 80hp rating even more mysterious. There is no evidence that regenerative braking was considered, but is it possible that the 80hp refers to the use of the motor as a regenerative brake?

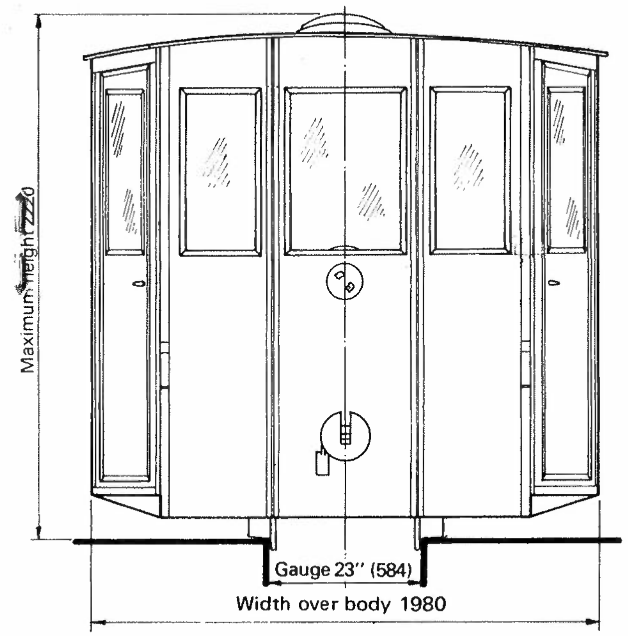
Had the PB&SSR been completed, and had it prospered as its promoters clearly hoped that it would, these locomotives would soon have been outclassed. Doubtless Bruce Peebles would have been happy to supply something larger. I once sketched out a "crocodile" with two of their giant 200hp motors; it would have been a strong rival to the Rhaetian locomotives in visual impact. As noted in an earlier paragraph, ten locomotives were built for this abortive scheme, details of which were as follows:

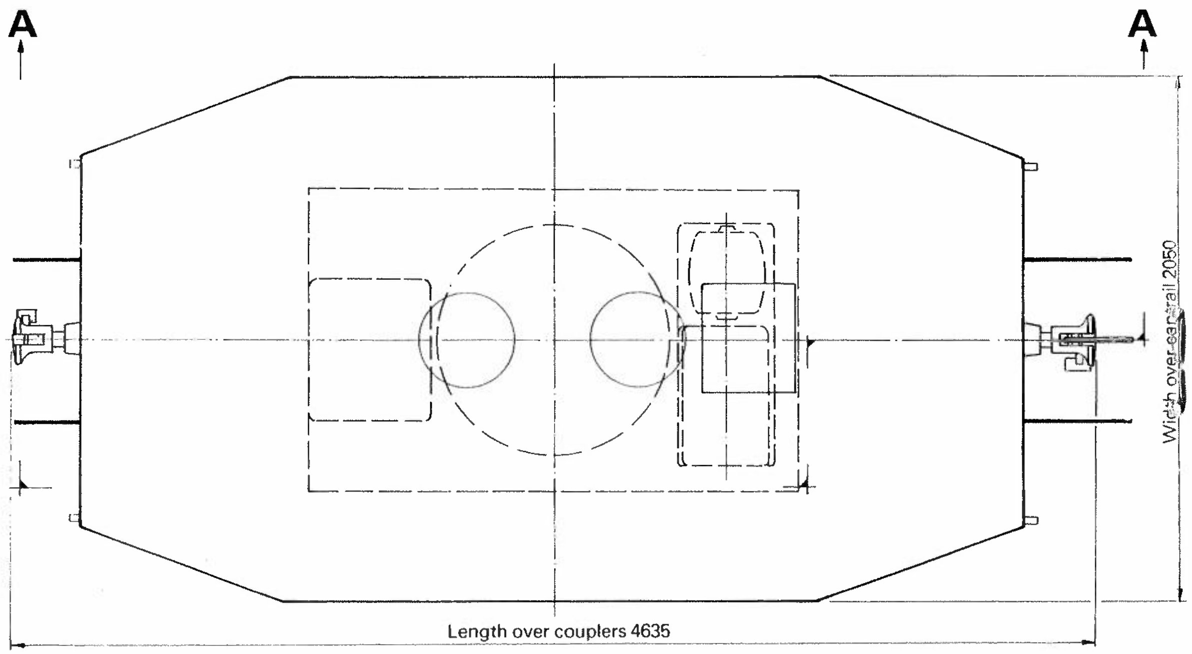
Built by Ganz, Budapest, in 1905:		Built by Bruce Peebles, East Pilton, Edinburgh, in 1906:
Ganz 12312 allocated Bruce Peebles	5086	Bruce Peebles 5379
12313	5087	5404
12334	5088	5405
12335	5085	5406
12336	5089	5653

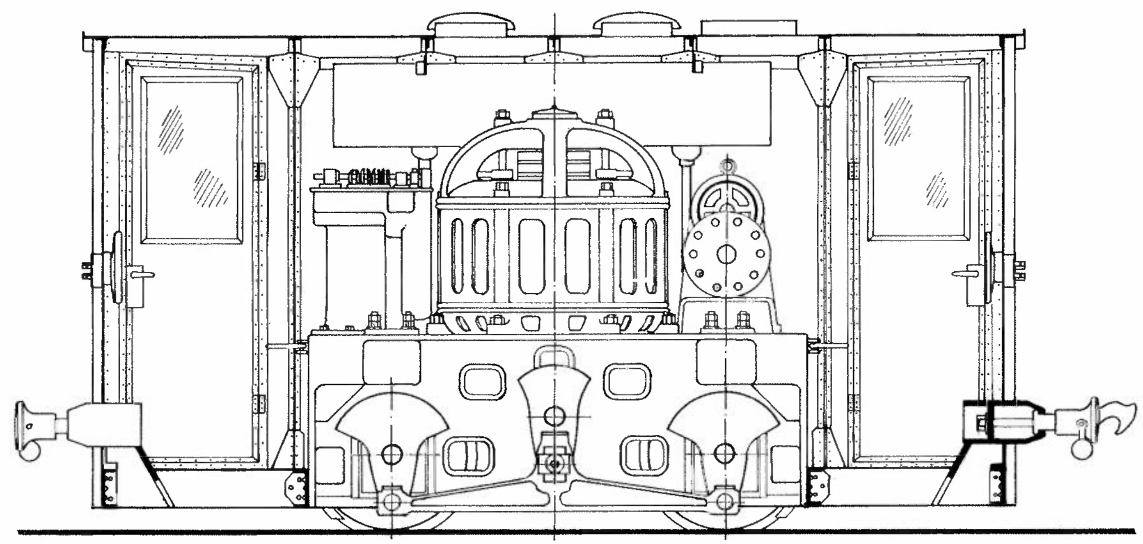
I was told that these locomotives stood in a forlorn row outside the works for about ten years until they were scrapped during World War I, probably in 1916. It is also said that a quantity of overhead equipment had been delivered to Beddgelert before work ceased and that the overhead line poles were later sold off for use as lamp standards in some North Wales towns, Holyhead being mentioned as one place that had them. Perhaps you could stand by one on a quiet winter night and hear the metallic ring of straight-cut bevels or the gentle bubbling of a water resistance.....

Acknowledgements are due to N E I Bruce Peebles Ltd. for granting access to their records, to Trevor Polding for producing the accompanying drawings and to Peter Deegan for reading through and commenting upon an earlier draft of this article.









SECTION A—A

PORTMADOC, BEDDGELERT & SOUTH SNOWDON RAILWAY ELECTRIC LOCOMOTIVE

Based on original general arrangement drawing
Prepared for The Narrow Gauge No.94 by Trevor Polding, January 1982

AUSTRALIAN BUILT CANEFIELD LOCOMOTIVES

John Browning

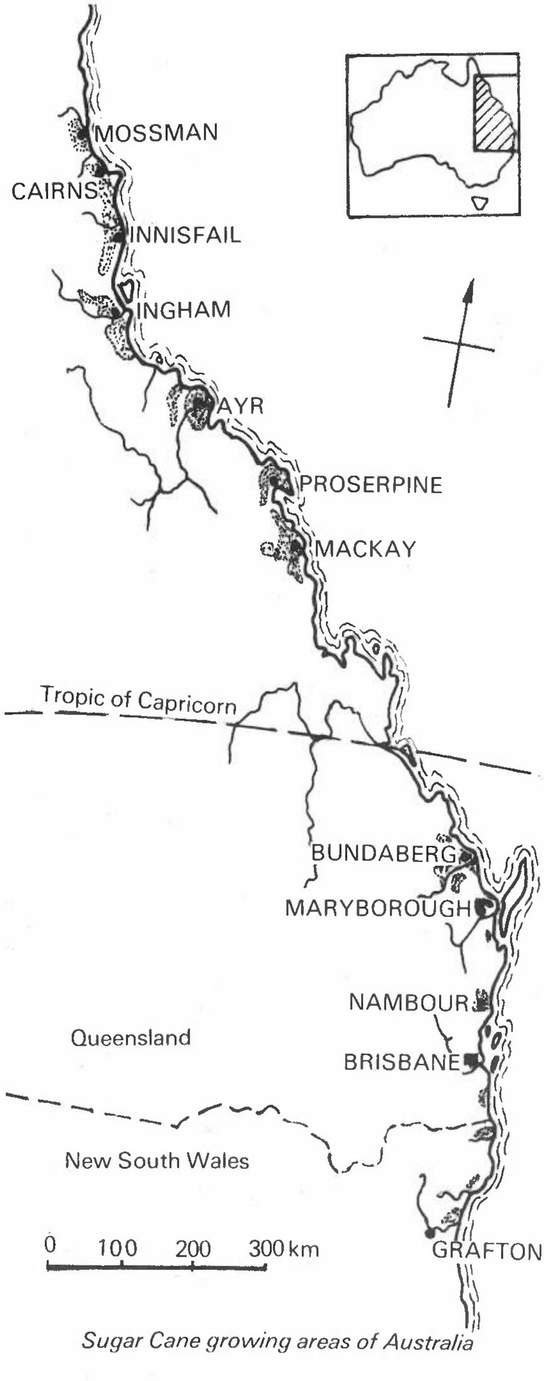
The sugar industry of Queensland and northern New South Wales represents a major part of Australia's agricultural production. Today, 7200 farmers grow sugar cane along a 2100 km strip along the east coast, on 359,000 hectares capable of producing 3 million tonnes of sugar annually from 21.2 million tonnes of cane. Most of this sugar cane is transported to the mills by narrow gauge railway. "Cane tramways" as they are known, are operated by 28 mills. One is 3ft 6ins gauge, the remainder 2ft gauge, with a total length exceeding 3400 km and new tramline construction going ahead in several areas. Of the remaining five mills, all relatively small, three once had locomotive worked tramways, since closed. These five include the three New South Wales mills, so cane tramways are now restricted to Queensland. In the past at least 48 sugar mills are known to have operated locomotive worked tramways.

The era of steam locomotion was dominated by British builders, although two Australian manufacturers did have some success in the latter years. When diesels were introduced, the first successful designs were also British, but within a few years Australian manufacturers took over, aided by protective tariff policies. This article surveys the products of the six main Australian builders of locomotives which have been used on cane tramways. All are for 2ft gauge, unless otherwise stated.

Perry Engineering Co Ltd, Mile End, Adelaide, South Australia

This firm has the distinction of building the first 2ft gauge steam locomotive constructed in Australia, in 1934. This was an 0-6-2 tank with 9½in × 14in cylinders and 28in driving wheels, and was delivered to Kalamia Mill, near Ayr, where it was named IVANHOE. Between 1934 and 1952, nineteen locomotives were built, mostly to two similar designs, one an 0-4-2 tank, and the other an 0-6-2 tank. Cylinder dimensions were 9½in × 14in for the former and 10in × 14in for the latter, except the first, and the driving wheels were 28in dia. Approximate weights were 18 tons for the 0-6-2 tank and 16 tons for the 0-4-2 tank.

In 1939, Perry constructed a locomotive quite different from its usual designs. This was an 0-4-2 tank for Inkerman Mill, near Ayr, plainly copied from a Hunslet design of which three examples were already in the mill's fleet (1149 of 1914, 1187 of 1915 & 1490 of 1925). Whether the Hunslet Engine Co knew, or approved of this is unknown. This locomotive, named ADELAIDE, had 7in × 12in cylinders and 24in driving wheels. It weighed about 12 tons.



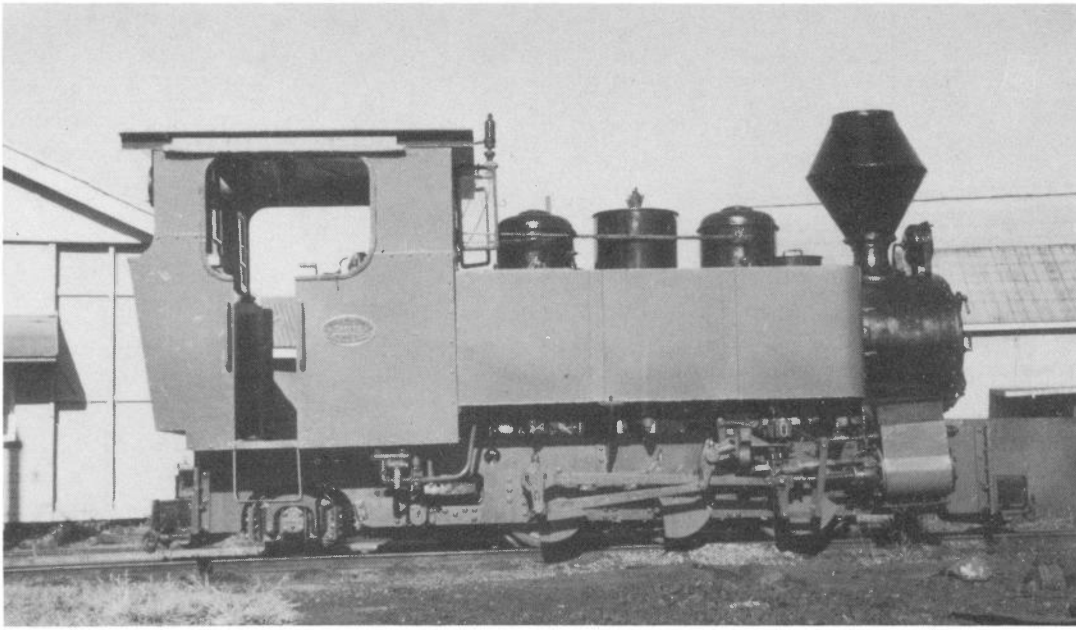
Sugar Cane growing areas of Australia

Tully Mill's No 7, a Perry 0-6-2T built in 1950 photographed hauling whole-stick cane during the 1950s.
(The Courier-Mail, Brisbane)

Perry locomotives were generally regarded in the industry as fine pieces of machinery, but possibly with rather under sized boilers. IVANHOE was unusual for a cane locomotive in having a very short plain tapered chimney, similar to that fitted to Perry's earlier contractor's locomotives. Later examples had a taller chimney which was far more in proportion. Perry locomotives had mesh spark arrestors inside the smokebox, but these could easily become clogged and so prevent them from steaming freely, so some mills fitted the familiar diamond stacks. They had Walschaert's valve gear and, unique among Australian cane locomotives, piston valves. The maker's numbers carried do not follow any particular order, and in fact relate to the drawing number to which the locomotive in question was constructed.

Only three of the nineteen have been scrapped, with most of those remaining being preserved by various groups and individuals. One 0-6-2 tank is still in service at Marian Mill, near Mackay, where it has worked as yard shunter for many years.

In addition to the 2ft gauge locomotives mentioned above, three earlier Perry 3ft 6ins gauge locomotives worked at Pioneer Mill, near Ayr. These were originally part of a batch of contractor's 0-4-0 tank locomotives built for the Victorian State Rivers & Water Supply Commission in the mid 1920s and used in the construction of the Hume Reservoir on the Murray River in north-eastern Victoria. Cylinders were 10in × 14in, wheels 30in diameter, and weight 14 tons. On completion of the project, they were disposed of in 1939. Two were purchased by Mount Morgan Mines in Queensland, while a third went direct to Pioneer Mill, to be joined by the two from Mount Morgan in the early 1950s. At Pioneer, the three locomotives were converted to 0-4-2 tanks to increase fuel capacity, increasing the weight to 16 tons. Two were later converted to oil firing, and these have been preserved.



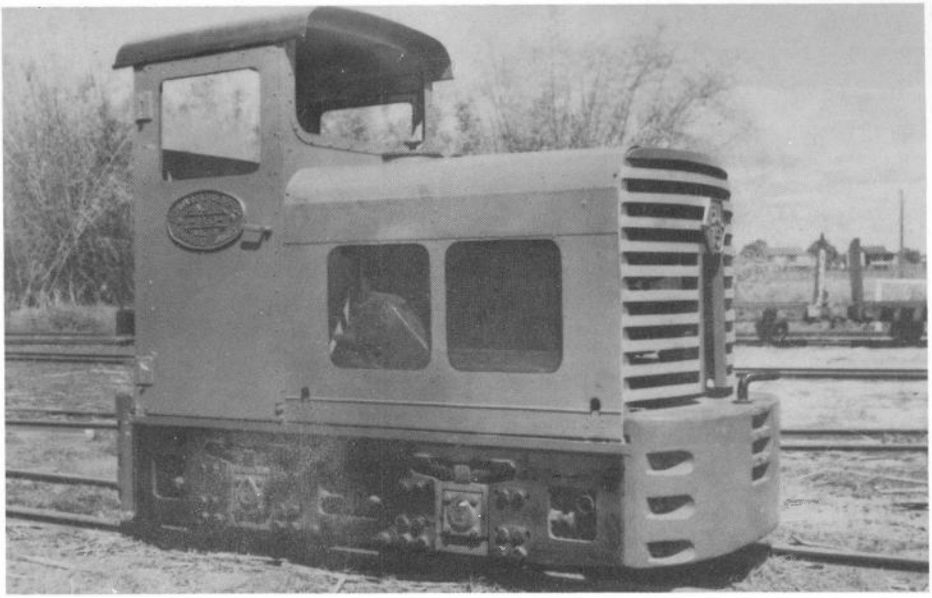
The first "Bundaberg Fowler" locomotive, built in 1952, seen here in Millaquin Mill yard after repainting on 12th June 1960. This loco is to be retained in working order by the mill.
(John Armstrong)

Bundaberg Foundry Co Ltd, Bundaberg, Queensland

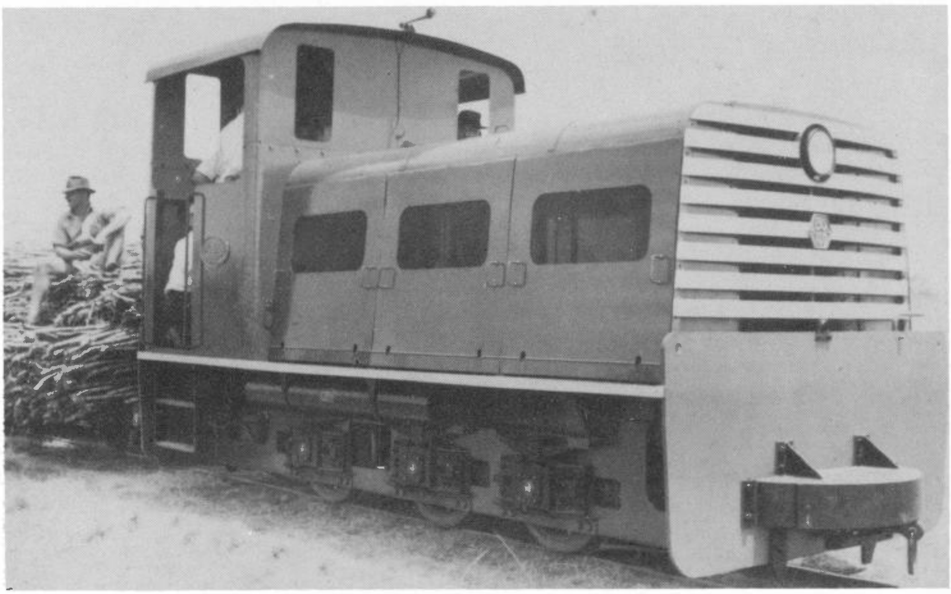
When John Fowler & Co (Leeds) Ltd ended steam locomotive construction in 1935, many sugar mills were disappointed, for Fowler locomotives were widely used and highly regarded in the industry. One subsequent "Fowler" 0-4-2 tank (22752) was built for Queensland, by Hudswell, Clarke & Co Ltd (1705 of 1938), but so great was the affection of the sugar industry for Fowler products that a local firm found it worthwhile to obtain a licence from Fowler to build more steam locomotives after World War II. The Bundaberg Foundry was well established in general engineering for the sugar industry, and had repaired steam locomotives. It appears that discussions with Fowler's and design work went on for some time before the eight "Bundaberg Fowlers" appeared in 1952-3.

There were seven 0-6-2 tanks and one 0-4-2 tank built and the design was based on that of John Fowler 0-6-2 tanks 20763 and 20764 of 1935, despatched to Queensland, and reputedly the last steam locomotives to leave the Steam Plough Works. Cylinders were 10in × 14in, and weight was about 20 tons for the 0-6-2 tanks and 16 tons for the 0-4-2 tanks. Modern features such as welded side tanks and roller bearings were fitted, and one even had a rocking grate. Walschaert's valve gear was fitted. The locomotives were a rugged design which steamed well; though not so well as the original Fowlers, it was said. All eight survive, the last three only being withdrawn from cane haulage in 1979 in their native Bundaberg, and two of these are to be preserved in working order by sugar mills, so may even haul cane again.

Upon deciding that there was a market for industrial diesel locomotives in Queensland, the Bundaberg Foundry Company concluded a manufacturing agreement with Jenbacher Werke AG, Austria to fit Jenbach engines to locomotives of their design constructed in Bundaberg. From 1951, Jenbach had sold a remarkable number of small diesels for underground use in Queensland's coal mines. Most of the eleven "Bundaberg Jenbachs" were tiny 15hp machines for use underground, but three were supplied to sugar mills. Two were externally similar, being six-wheel locomotives with mechanical transmission built in 1953 and 1954 for North Eton Mill near Mackay. However, while the first had a Jenbach 100hp engine and weighed 15 tons, the second weighed 20 tons and had a 220hp engine. The original motors have since been replaced, but the locomotives remain in service equipped with Gardner 8LW engines. The third, built in 1953, was a 15hp four-wheel diesel-mechanical fitted with a Jenbach single-cylinder engine. This tiny machine weighed 3½ tons and was fitted with a cab for working on the then short tramline of Invicta Mill, near Ayr. Following major expansion of the mill's rail system during the 1960s, it was sold for scrap in 1973.



The prototype Bundaberg Jenbach 4wDM on trial at Fairymead Mill, close to Bundaberg Foundry, in 1953. This was later delivered to Invicta Mill. Officially builder's number 11, it initially carried a plate reading "Bundaberg Jenbach No. 1". *(George Bond collection)*



Bundaberg Jenbach model BJ100 6wDM on trial at Bingera Mill in 1953. This loco was later delivered to North Eton Mill. *(George Bond collection)*

Malcolm Moore Ltd, Port Melbourne, Victoria

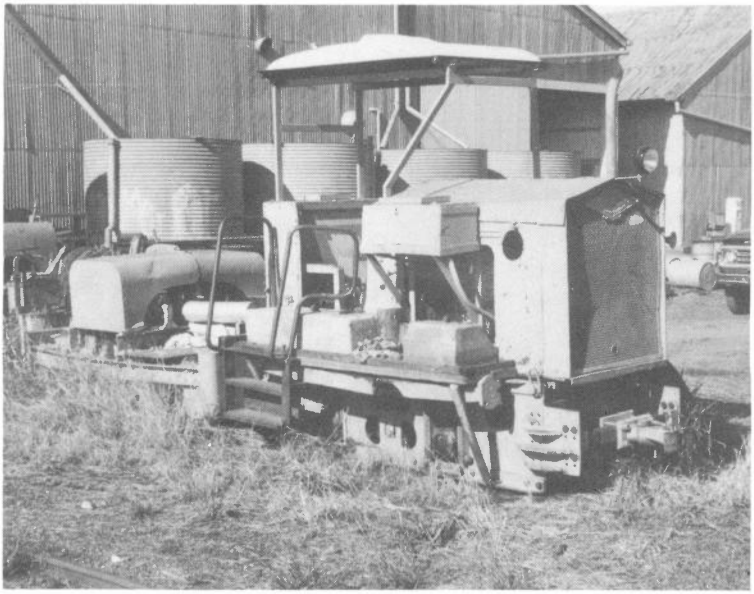
In common with other manufacturers around the world, this engineering company saw the opportunity of adapting agricultural tractors for use as locomotives by fitting them to a heavy duty chassis with four railway wheels, and providing a chain drive. These locomotives, weighing about 4 tons, were marketed from about 1924, at first under the name of T.A.C.L. (Tractor Appliance Company Ltd). Fordson power units were used, fuelled by petrol or kerosene. Some were fitted with a canopy, and a reversing gearbox was fitted to give three gears in either direction. A few of these were supplied to sugar mills, but others were used in the logging industry as well as in quarries and salt works.

Around 1936, a 3 ton locomotive was developed utilising a 65hp Ford V8 petrol engine. This was a purpose-built locomotive capable of higher speeds than the earlier type, and had four gears in each direction. A locomotive still in use at Moreton Mill, Nambour, though now re-engined, is believed to be the prototype originally supplied to a South Australian chemical works. In 1943, 92 locomotives of the same design, but fitted with canopies, were delivered to the Australian Army with the intention that they would be used to haul stores from beach-heads to storage dumps. It is not known if any were actually used for this purpose, but after the war many were disposed of in "as new" condition, and were snapped up by industry. At least 22 saw service in the sugar industry, being a very suitable machine for delivering portable track to where it was required by farmers. Many were fitted with diesel engines in later years, and a number are still in service, some extensively rebuilt and ballasted by the addition of suitable weights.

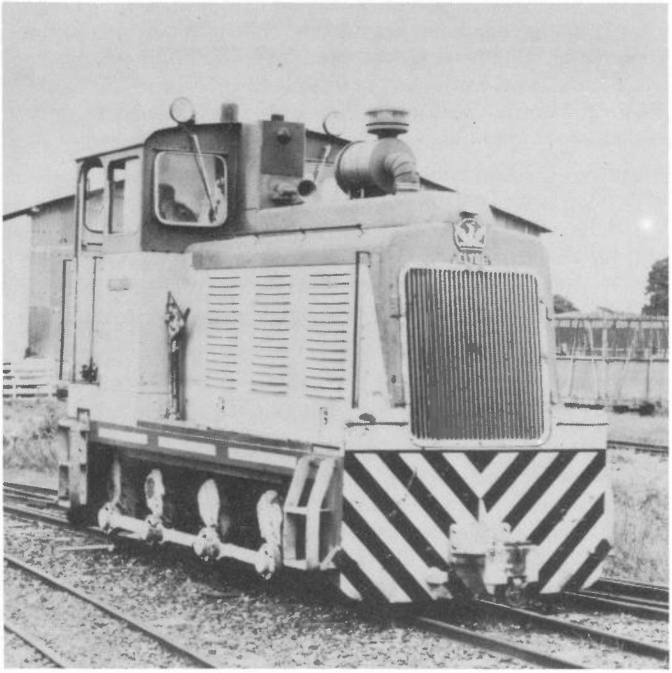
Only one locomotive was supplied new to the industry after the war. This was a 112hp 0-4-0 diesel-hydraulic supplied to the Colonial Sugar Refinery Co, Victoria Mill near Ingham in 1956. It is fitted with a Gardner 6LW engine and weighs 10 tons. Named MOORE, it operates as yard shunter.

Clyde Engineering Pty Ltd, Granville, Sydney, New South Wales and Clyde Engineering (Qld) Pty Ltd, Eagle Farm, Brisbane, Queensland.

Clyde Engineering, a long-established steam locomotive builder which turned out its first in 1907, was acquired by General Motors after the Second World War, and enthusiastically seized the opportunities made available by the dieselisation of Australia's railways. The first 0-6-0 diesel-hydraulic for the canefields was delivered in 1954. This was the model DHI-71 powered by a GM 71 series six-cylinder engine, initially of 150hp but later uprated to 170hp, and fitted with a GM type 500 torque converter. Weight is 14 to 18 tons. Fifty-one 2ft gauge machines were built for the sugar industry in Queensland, as well as five 3ft 6in gauge machines for Pioneer Mill near Ayr,



After acquisition as Army surplus, Malcolm Moore 4wPM locos were often extensively modified by sugar mills. This example at Bingera Mill in April 1981 has a replacement canopy, sand boxes and diesel engine. Running plates, concrete ballast weights, steps, and forward frame extensions have been added. *(Bob Gough)*



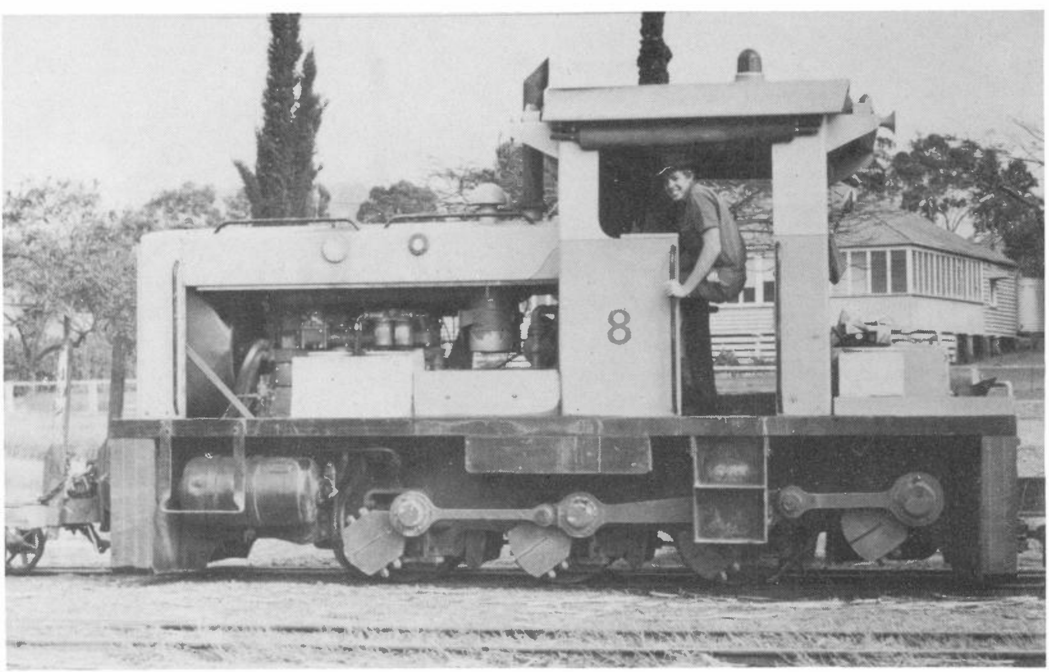
HOMEBUSH, an early Clyde model DHI-71 0-6-0DH built in 1955, seen here at Racecourse Mill in September 1978. The large air filter is a recent addition. (B.J. Webber)

A brightly-coloured Clyde locomotive hauls a rake of cane cars across Currie Street, Nambour, on the way to Moreton Central Mill. (N.G.R.S. Library) the only one currently to operate a tramway of this gauge. Another eighteen went to the Fijian sugar industry, while five 3ft gauge machines went to the British Phosphate Commission at Nauru, and there was one standard gauge example. The heavier and more powerful HG-3R design, another 0-6-0 diesel-hydraulic followed in 1961 and is a 263hp design with a GM 71 series V8 engine and GM type 500 torque converter. Weight of the HG-3R is 18 to 24 tons. Twenty-four have been supplied to Queensland, and another eight went to Fiji. One 3ft 6ins gauge example was built, and this is presently at work hauling timber in Western Australia.

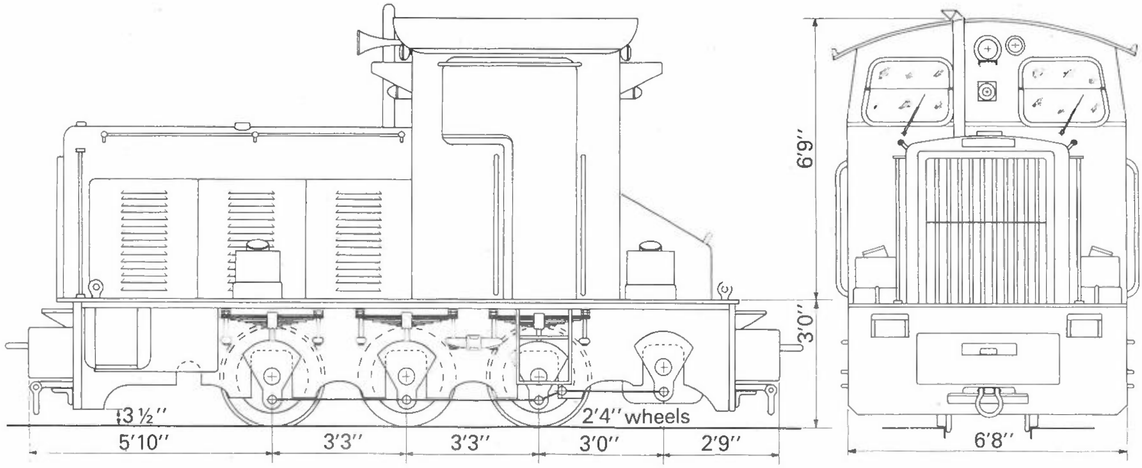
The last four Clyde locomotives for cane haulage were built in Brisbane, but all the others came from the now closed Sydney plant. All the sugar industry machines remain in service, but some have been modified by the addition of a soundproofed cab, in some cases changing the appearance considerably. Only one new locomotive has been supplied since 1970, and this was in 1975. The Clyde diesels have been very successful, but the company now seems to be concentrating on main line railway locomotives. It is believed that a bogie design has been prepared, but as yet none has been built.

Commonwealth Engineering (Qld) Pty Ltd, Salisbury North, Brisbane, Queensland

This company's first diesels were introduced in 1955, and were apparently based on the Baguley 150hp machines previously supplied to some mills. This model A design was modified in various ways, including the introduction of hydraulic transmission in 1958. Although Com-Eng had lagged behind Clyde Engineering up to this point, a keen rivalry was developing, and Com-Eng introduced their heavier 250hp model F in 1959, two years before the appearance of the equivalent Clyde HG-3R. The firm made a belated entry into the market for bogie locomotives in 1977 with its model N B-B diesel-hydraulic. Unfortunately, this unit lacked the adhesive weight to take full advantage of the bogie configuration, especially as it was put to work on the hilly tramway system of Cattle Creek Mill near Mackay. It remains the only one of this type to be sold.



This 21 ton Commonwealth Engineering 0-6-0DH loco (works number FC 3777) was built in 1964 for Plane Tree Mill. Note the spartan cab and heavy frame and buffer beams.
(John Armstrong)



Commonwealth Engineering model A diesel locomotive, redrawn from maker's drawing dated 22/1/1957. (S.L. Baker)

A large number of options were built into these designs, so that various types of engines and transmissions could be supplied. The initial design had a Gardner 8LW engine, but engines by Rolls Royce, Caterpillar and Perkins have also been fitted to locomotives supplied to the sugar industry. The six basic types used by sugar mills are listed below:

Model	*Type*	*Weight*	*Engine rating*	*Number supplied*
A	0-6-0DM	14-18 tons	150-180hp	34
A	0-6-0DH	14-18 tons	180-205hp	31
C	0-4-0DH	9-12 tons	112hp	1
F	0-6-0DH	19-25 tons	250hp-277hp	12
G	4wDH	4-8 tons	76hp	2
N	B-B DH	21 tons	280hp	1

The figures include a few second-hand locomotives in sugar mill service, most notably seven formerly owned by the Queensland Government Railways Innisfail Tramway, which hauled cane and bulk sugar in the Innisfail district until sold to local sugar mills in 1977. This line persisted with diesel mechanicals of the A model, the last one being purchased as late as 1975.

Alternative designs have been supplied to other industries for surface and underground use. All the units supplied to sugar mills are still in use, although some of them have had their appearance altered radically by the fitting of soundproofed cabs. A few originally built with mechanical transmission have been converted to hydraulic transmission. Only four new locomotives have been delivered since 1966, two in 1975 and two in 1977. The company has recently been building main line locomotives, although it has maintained an interest in supplying units to sugar mills.

E.M. Baldwin & Sons Pty Ltd, Castle Hill, Sydney, New South Wales

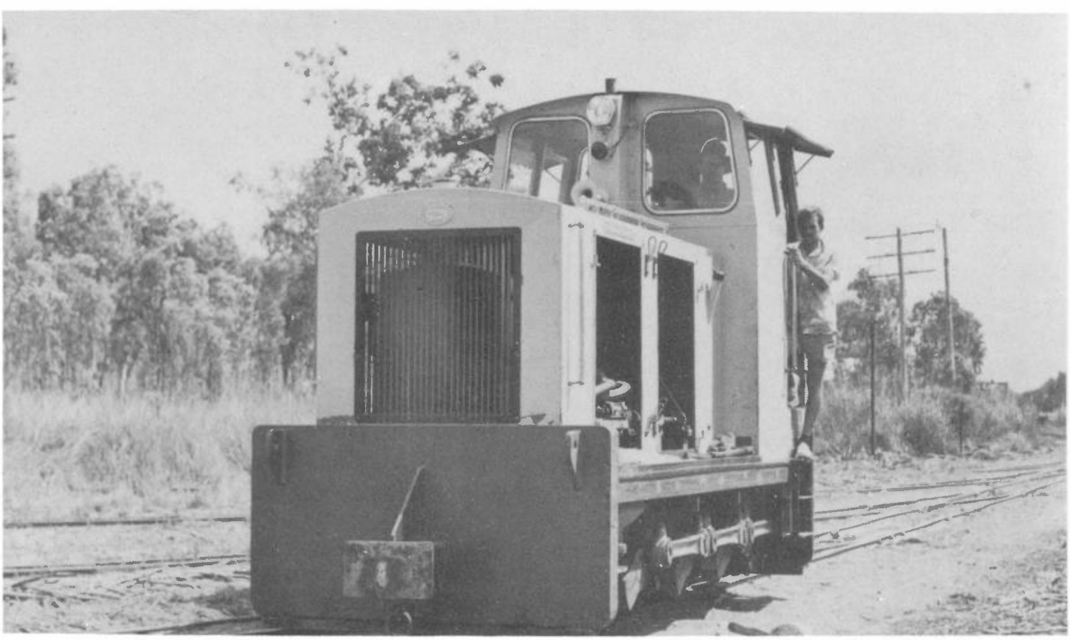
This company constructed its first locomotive, a 5 ton 45 hp four-wheel diesel-hydraulic built under licence from "Bulldog" of South Africa, in 1962, for South Johnstone Mill, near Innisfail. Unfortunately, this machine has now been scrapped. Since then, a wide range of designs has been developed for a variety of industrial service and this firm is now the major locomotive supplier to Queensland sugar mills. Examples in cane tramway use range from a 3 ton four-wheel diesel-mechanical to a 32 tonne B-B diesel-hydraulic of 475hp. From the early days, the firm was prepared to offer a wide range of types tailormade to customer requirements, and this policy gained some success in establishing a foothold in the industry. A notable step took place in 1965, when the first order was received from CSR Ltd, the industry giant which owns seven sugar mills in Queensland.

The success of this small firm was assured after successfully introducing the B-B diesel-hydraulic in 1972. Since then, another 34 examples of this type have been built for Queensland and two for Fiji, and more are on order for the 1981 season. The traditional suppliers of the 1950s and 1960s, Clyde and Com-Eng have been superseded by E.M. Baldwin, which have supplied the following main types to Queensland sugar mills:

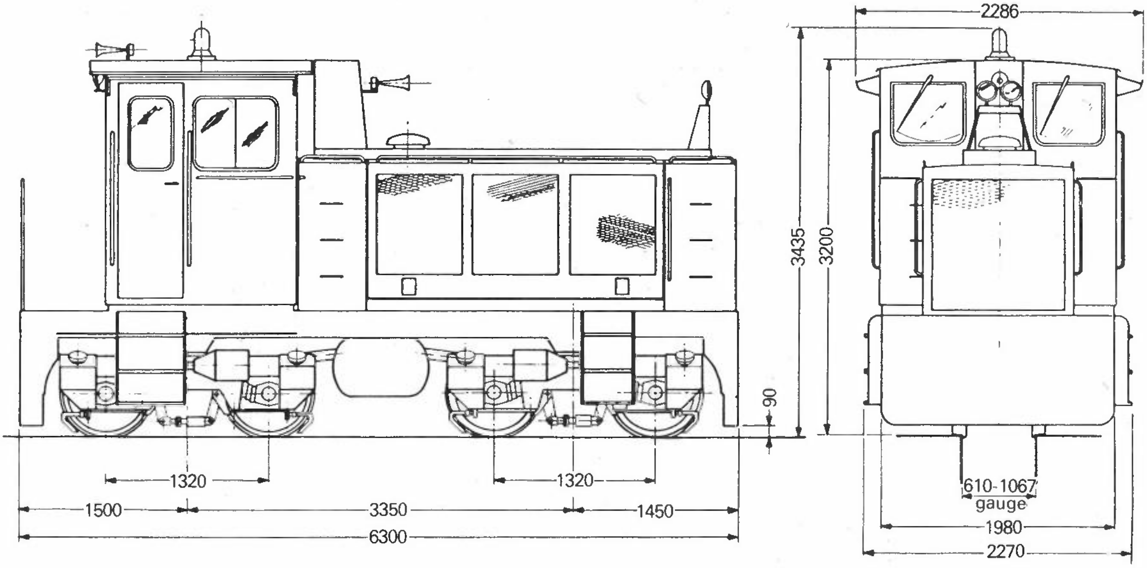
Type	*Weight*	*Engine rating*	*Number supplied*
4wDH	5-12 tonnes	57hp-121hp	4
0-4-0DH	5-10 tonnes	107hp-121hp	7
0-6-0DH	15-20 tonnes	205hp-365hp	9
B-B DH	15-32 tonnes	170hp-475hp	35

The company has also rebuilt a number of locomotives including two 3ft gauge, 100hp Ruston & Hornsby 0-6-0DM formerly used by the contractor involved in the Snowy Mountains scheme. These emerged from Baldwin's works as 2ft gauge 0-6-0DHs. Including these 62 Baldwin's are used by sugar mills, four of which were purchased from tunnelling contractors and rebuilt by the mills. There are another eleven at work in Fiji. A wide range of engine types is available, the most common being by Caterpillar and GM. E.M. Baldwin pioneered the use of soundproofed cabs on canefield deisels and have fitted a number to older Clyde and Com-Eng diesels. It is believed that a 48 tonne C-C diesel-hydraulic is currently on the drawing board, but one suspects that its hauling power might be too much for the drawgear and running characteristics of the four-wheel cane "bins" currently in use in the industry.

In conclusion, I would like to thank my friends David Mews, George Bond and Keith McDonald, for providing information incorporated in this article. The drawing of the Commonwealth Engineering model A locomotive is reproduced from *Merioneth Mercury* No.19 by kind permission of Stuart Baker.



E.M. Baldwin built this 15 tonne 0-6-0DH on the frame of a Ruston Hornsby 3ft gauge 100 h.p. locomotive used by a contractor on the Snowy Mountains Hydro-electric scheme. In September 1968 it was photographed at Plane Tree Mill, their No.9. *(John Armstrong)*



The 15-32 tonne B-B diesel-hydraulic locomotive built by E.M. Baldwin & Sons Pty Ltd.

Appendix 1: LOCOMOTIVES SUPPLIED BY PERRY ENGINEERING

3ft 6ins gauge

Number	*Date*	*Type*	*Owner*	***Number/Name***
265	1925	0-4-0T	State Rivers & Water Supply Commission of Victoria, Hume Weir	
			Lovig Brothers (dealers), Melbourne, Victoria, 1939	
			*Mount Morgan Mines Ltd. 1940	4
		0-4-2T	Pioneer Sugar Mills Ltd. Pioneer Mill, c1950	KILRIE
			Australian Narrow Gauge Railway Museum Society, Brisbane, 1980	KILRIE
			Queensland Pioneer Steam Railway Co-operative Ltd, Swanbank, 1980 (on loan)	KILRIE
269	1927	0-4-0T	State Rivers & Water Supply Commission of Victoria, Hume Weir	
			Lovig Brothers (dealers), Melbourne, Victoria, 1939	
			*Mount Morgan Mines Ltd. 1940	1
		0-4-2T	Pioneer Sugar Mills Ltd. Pioneer Mill, c1950	TAIPAN
			Scrapped c1966	
271	1927	0-4-0T	State Rivers & Water Supply Commission of Victoria, Hume Weir	
			Lovig Brothers (dealers), Melbourne, Victoria, 1939	
		0-4-2T	Pioneer Sugar Mills Ltd, Pioneer Mill, 1940	KLONDYKE
			Geelong Steam Preservation Society, Belmont, Victoria, 1971	

*There is some doubt as to whether Perry 271 rather than 265 worked at Mount Morgan Mines.

2ft gauge

9351	1934	0-6-2T	The Australian Estates Co Ltd, Kalamia Mill.	IVANHOE
			Pioneer Sugar Mills Ltd, Inkerman Mill, Home Hill, 1961	CARSTAIRS
			Lower Burdekin Historical Society Museum, Home Hill, 1972	CARSTAIRS

6776	1938	0-6-2T	The Australian Estates Co Ltd, Kalamia Mill Rotary Park, East Ayr, after 1960 Peter Neve, Sydney, N.S.W. 1975	CHIVERTON
8403	1939	0-6-2T	Proserpine Co-operative Sugar Milling Association Graham Harding, Melbourne, Victoria, c1974	1
8967	1939	0-4-2T	Pioneer Sugar Mills Ltd., Inkerman Mill, Home Hill Dwyer's Pipe Works, Home Hill, 1965 Home Hill Caravan Park Arch Dunn Rotary Memorial Park, Home Hill	ADELAIDE ADELAIDE ADELAIDE ADELAIDE
2382	1941	0-6-2T	North Eton Co-operative Sugar Milling Association Megalong Valley Tourist Railway, Blackheath, N.S.W. 1971	No 6
9737.45.1	1945	0-4-2T	South Johnstone Co-operative Sugar Milling Association Ltd. Millaquin Sugar Co Pty Ltd, Millaquin Mill, Bundaberg, 1967 Essendon Steam & Oil Engines Preservation Society, Victoria. 1981	6 9
1850.46.1	1946	0-6-2T	Millaquin Sugar Co Pty Ltd, Millaquin Mill, Bundaberg Millaquin Sugar Co Pty Ltd, Qunaba Mill, 1966 Mile End Railway Museum (S.A.) Inc, Adelaide, S.A. 1981	3 3, 2 SKIPPER
6160.48.1	1948	0-6-2T	Proserpine Co-operative Sugar Milling Association Fairymead Sugar Co Ltd, 1964 Millaquin Sugar Co Pty Ltd, Qunaba Mill, 1970 The Queensland Museum, Brisbane, 1981	7, 5 21 4, 3 FLASH
7650.49.1	1949	0-4-2T	Douglas Shire Council Tramway, Mossman Mossman Central Mill Co Ltd, 1959 Mill Street Playground, Mossman, 1967 Australian Narrow Gauge Railway Museum Society, Brisbane, 1976 A.N.G.R.M.S., Durundur Railway, Woodford, 1979	R.D. REX R.D. REX R.D. REX
7650.49.2	1949	0-4-2T	South Johnstone Co-operative Sugar Milling Association Ltd.Scrapped 1970	7
7650.50.3	1950	0-4-2T	South Johnstone Co-operative Sugar Milling Association Ltd.Scrapped 1970	8
7967.49.1	1949	0-6-2T	Tully Co-operative Sugar Milling Association El Arish Golf Club, 1963 Illawarra Light Railway Museum Society, Albion Park, N.S.W. 1973	No 6
7967.50.2	1950	0-6-2T	Tully Co-operative Sugar Milling Association Scrapped c1972	No 7
7967.50.3	1950	0-6-2T	Babinda Co-operative Central Mill Society Ltd Sandhurst Town, Bendigo, Victoria, 1974	7
7967.50.4	1950	0-6-2T	The Australian Estates Co Ltd, Kalamia Mill Fairymead Sugar Co Ltd, 1963 Millaquin Sugar Co Pty Ltd, Qunaba Mill, 1970 Puffing Billy Preservation Society, Menzies Creek Museum, Victoria, 1981	DELTA 20 1 DELTA
2601.51.1	1951	0-6-2T	Marian Mill Co-operative Society Ltd	
2714.51.1	1951	0-4-2T	Mourilyan Sugar Co Pty Ltd (later Howard Smith Industries Pty Ltd) Bruce Belbin, St. Ives, Sydney, N.S.W. 1973	No 7

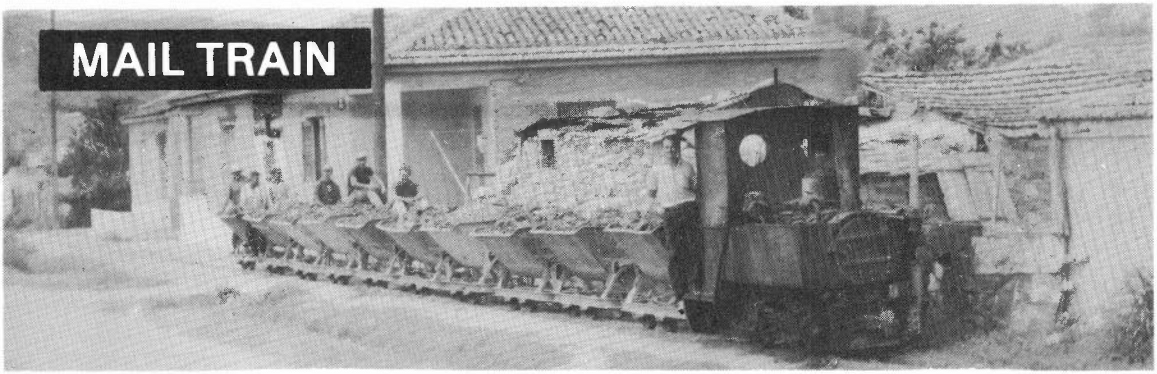
5643.51.1	1951	0-6-2T	Gibson & Howes Pty Ltd, Bingera Mill	PERRY
			Bruce McDonald, Goulburn Steam Museum, N.S.W. 1974	PERRY
			Privately preserved, Sydney, N.S.W. 1977	PERRY
6634.52.1	1952	0-6-2T	North Eton Co-operative Sugar Milling Association	No 7
			Megalong Valley Tourist Railway, Blackheath, N.S.W. 1971	

Appendix 2: LOCOMOTIVES SUPPLIED BY BUNDABERG FOUNDRY (2ft gauge)

Ref.	*Date*	*Type*	*Owner*	*Number/name*
1	1952	0-6-2T	Mulgrave Central Mill Co Ltd, Gordonvale	10 RIVERSTONE
			Millaquin Sugar Co Pty Ltd, Millaquin Mill, Bundaberg, 1955	1
			Millaquin Sugar Co Pty Ltd, Qunaba Mill, 1975	4 JUMBO
			Millaquin Sugar Co Pty Ltd, Millaquin Mill, Bundaberg, 1979 (retained for preservation, 1981)	4 JUMBO
2	1952	0-6-2T	Mossman Central Mill Co Ltd	5 BUNDY
			Alan Robert, Wantirna, Victoria, 1971	
			Alan Robert, Bundaberg, 1977	
3	1952	0-4-2T	Mourilyan Sugar Co Pty Ltd (later Howard Smith Industries Pty Ltd)	No 8
			Millaquin Sugar Co Pty Ltd, Millaquin Mill, Bundaberg, 1966	8
			Millaquin Sugar Co Pty Ltd, Qunaba Mill, 1978	
			Bundaberg & District Tourist Tramway & Preservation Society, Bundaberg, 1981	
4	1952	0-6-2T	Gibson & Howes Pty Ltd, Bingera Mill	RALF
			Bruce McDonald, Goulburn Steam Museum, N.S.W. 1973	
			Lachlan Vintage Village, Forbes, N.S.W. 1974	2
5	1952	0-6-2T	Amalgamated Sugar Mills Pty Ltd, Pleystowe Mill	5
			Australian Narrow Gauge Railway Museum Society, Brisbane, 1973	
			A.N.G.R.M.S., Durundur Railway, Woodford, 1979	
6	1952	0-6-2T	Millaquin Sugar Co Pty Ltd, Millaquin Mill, Bundaberg	6
			Millaquin Sugar Co Pty Ltd, Qunaba Mill, 1978	5 DOBBIN
			Mossman Central Mill Co Ltd, 1981 (for preservation)	
7	1953	0-6-2T	Gibson & Howes Pty Ltd, Bingera Mill	KOLAN
			Boyd's Antiquatorium, Bundaberg, 1975	KOLAN
8	1953	0-6-2T	Proserpine Co-operative Sugar Milling Association	8, 6
			Joe Hawkes, Airle Beach, 1978 (on loan)	
			Proserpine Co-operative Sugar Milling Association, 1980	
10	1953	6wDM	North Eton Co-operative Sugar Milling Association	D1
11	1953	4wDM	Haughton Sugar Co, Invicta Mill, Giru	
			Sold for scrap, 1973	
13	1954	6wDM	North Eton Co-operative Sugar Milling Association	

All locations shown are in Queensland unless otherwise stated.

MAIL TRAIN



RAILWAY PRESERVATION IN GOTLAND

This article in NG85 mentioned the Visby - Västerhedje line, and reminded me of an article in *Railway Magazine* for January 1939. In the Overseas Railways feature, C. Hamilton Ellis had most of a page devoted to "Baltic Island Railways", and—a regular feature at the time—one of his sketches of a fascinating and very quaint railcar of this line. The railcar had open end platforms, with a short roof over the driver. A vertical boiler inside the body supplied steam to a pair of outside cylinders, driving forwards onto a single axle at one end. The other end was supported by a four-wheel bogie. A lovely clerestory roof surmounts the body. The article mentions that a 2-4-2T and four-wheel coaches formed the train when traffic was heavy. Can any member provide more information on this little line?

SELBY, NORTH YORKS. KEN HARTLEY

DRUSILLA'S TEA COTTAGE

Before my letter on 9in gauge miniature railways appeared in NG91 I received some photographs on loan from Mr. Michael Ann, a Director of Drusilla's. These show two locomotives: one is that which appears in NG92 with David H. Smith's letter, (but not the same picture). The other was of a scale model steam locomotive painted and lettered SOUTHERN B286. The wheels are not visible in the photograph, but since B286 (later 2286) was an 0-4-2T it is reasonable to assume that the model had the same wheel arrangement. This engine is not the one whose origin I am trying to trace, and I shall be interested to hear of any other 9in or 9½in gauge lines or locomotives, especially those operating before 1956.

MAIDSTONE, KENT ARTHUR G. WELLS

In NG92 David H. Smith raised some queries about this railway. It was 9½in gauge with a circuit of over ¼ mile and gradients on 1 in 40 and 1 in 50. The petrol locomotive, SOUTHERN 6, was built by Morse at Brighton, had a 8 h.p. Citroen engine and was known to travel at speed. Morse also built a small steam locomotive based on the LBSC Stroudley D class 0-4-2T which was the only other engine used on the line. The rolling stock was well suited to the petrol locomotive but was almost certainly far too heavy for the steam locomotive when loaded with passengers.

The 0-4-2T, now named RANMORE, is one of the classic 9½in gauge engines and later spent many years at the Downs School. It has recently been completely restored by Coleby-Simkins.

NEWBURY, BERKS. J.F. HALL-CRAGGS

SYNOLDA

In NG92 Mr Bowtell quotes H.R. Dunn's suggestion that SYNOLDA went to Belle Vue around 1944-45. If the engine illustrated on p.3 is indeed the original SYNOLDA it was certainly at Belle Vue on 15th April 1944, but running without a name. The photograph I took then was published in NG39 (September 1965). Remarks on following pages of this same issue cast some doubt as to whether the engine was really SYNOLDA, and one correspondent suggested that there were more than three Bassett-Lowke class 30 Altantics which, if correct, further complicates the issue.

MAIDSTONE, KENT. ARTHUR G. WELLS

NARROW GAUGE AT WHITEHILL

I can add some information on the locomotives mentioned in NG92. MARS and VENUS were from a class of four built for the Royal Arsenal, Woolwich in 1883/85. The other two, VULCAN and MERCURY were soon transferred to Chatham for construction of the forts around Chatham Naval Dockyard, but were recalled to Woolwich for shipment to the Sudan with General Graham's force constructing the Suakin-Berber railway. When this failed in 1885, they were abandoned at Suakin. MARS and VENUS probably worked at Woolwich before being sent to Chatham, and left there for Longmoor in 1905. VENUS was probably scrapped around 1907, but MARS survived as a stationary boiler until 1924, when its boiler was sectioned for instructional purposes. This still survives at the Army Transport Museum, Leconfield, N. Humberside.

FLAMINGO was one of a class of seven locos built by Fowler in 1885, and worked at Longmoor until withdrawn for scrapping in April 1919. The remaining six engines at Woolwich were scrapped or sold on 15th November 1919, when they carried numbers MED43-47; MED59.

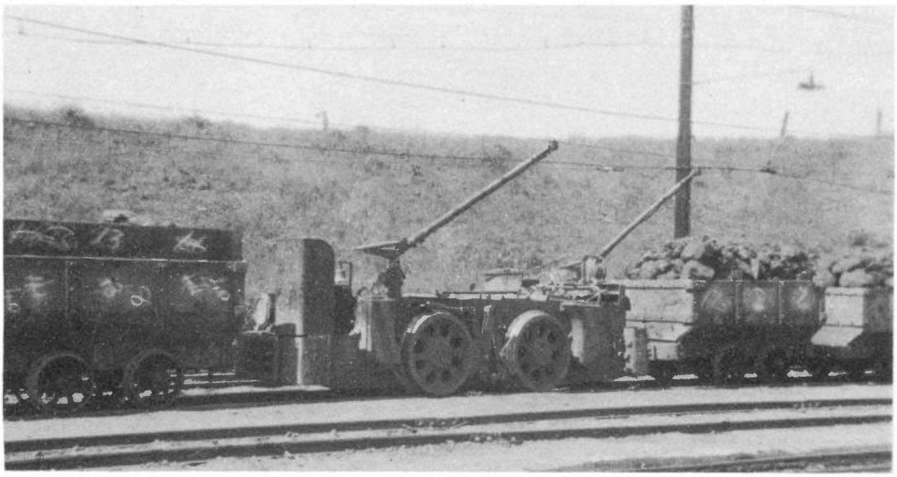
I am researching the history of all the 18in gauge lines mentioned, and would be pleased to receive any information on them, at 22 Clifton Road, Seaburn, Sunderland.

SUNDERLAND, TYNE & WEAR. CHRISTOPHER C. VEITCH

Mr. Lumb's note in NG92 reminded me of a postcard in my collection of almost exactly the same scene, but clearly showing a standard gauge track on the site of the 18in gauge, but a little closer to the road. This card was posted in December 1909, so the narrow gauge had clearly gone by then.

EDGWARE, MIDDX. E.D. CHAMBERS

UNDERGROUND ELECTRIFICATION

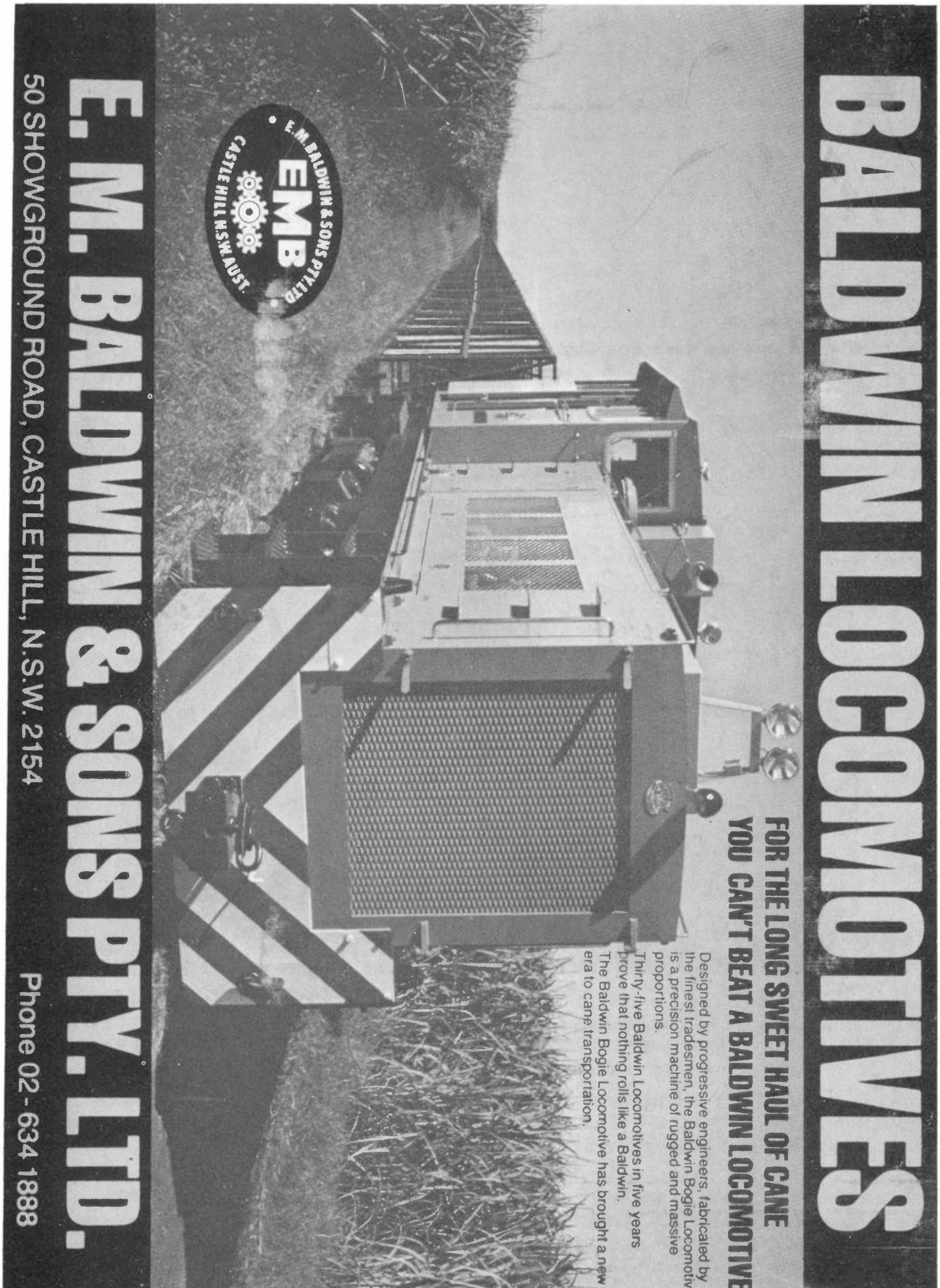


A letter in NG92 referred to the system at Irthlingbrough, and I enclose a photograph taken in June 1962 of one of their trolley locomotives. The caption states it is No.2, and a Greenwood & Batley loco, but 1 and 2 were the two BTH locos and 3-6 built by GB so it is obviously incorrect. Can any reader confirm the builder from this picture? The right hand trolley pole is on another loco parked on an adjacent track.

Mention is also made of the Wingrove & Rogers and GB battery locomotives used at Irthlingborough. The former were 78, 79 and 156/1919; 157, 252-255/1920; 374-379/1922, all class No.1 four-wheel machines weighing 2 tons. Adrian J. Booth gave details of the GB locos in NG93.

So far as is known, all the locos were scrapped following closure of the mine, but I am not sure if this was the case. Some years ago an internal 3ft gauge, worked by a pair of GB battery locos, was discovered at B.S.C. Dale Plant Foundry, Ilkeston. I have seen these locos but have never found any identification on them. I have also checked the GB list but there is no entry which could refer to them. My own thoughts are that these locos may have been transferred from Irthlingborough. Can anyone comment on this suggestion?

RUGBY, WARWICKS. R.D. DARVILL



The other Baldwin locomotives, described in this issue by John Browning. This advertisement shows one of the 26 tonne B-B DH locomotives built for the 2ft gauge system at Bingera Mill in 1975.