LYNTON: just beyond suburban Mitcham in Adelaide. It is the start of the climb to Mount Lofty that would require the fireman's full attention. This is the start of the 1 in 45 gradient. Note the track which was the interstate mainline to Melbourne. They were still using rails joined by bolted fish-plates and were yet to learn the advantages of concrete sleepers. The train was the afternoon service to Tailem Bend. The weight of carriages and van would have been less than the weight of the locomotive. **JLW, 6 December 1965.**

CHAPTER 1

THE TRACK TO THE CENTRE OF THE EARTH

We can't deal with gauges until we have dealt with track.

The modern railway works on the principle that the train and the track are in a state of conflict. Each has the potential to damage the other. It is the role of the railway administrator and the engineers to ensure that the system is safe. We need to understand this before we move on and consider the implications of gauge. That conflict can extend to the railway engineers. The civil engineer may accuse the locomotive engineer that his engines are destroying the track, whilst the locomotive engineer may complain that the track is wrecking his rolling stock. Such a situation developed in South Australia in the 1880s.

> It is not true that the feud between Patterson and Thow is so bitter that two special trains are required to take them to the same stations on the same day. They obviate the unpleasantness of travelling in the same train by going on different days. ***Port Augusta Dispatch and Flinders Advertiser*, 19 September 1884.**

Robert Patterson was the Deputy Engineer-in-Chief. William Thow was the Locomotive Superintendent. The problem was that both of these officials reported to the Commissioner of Public Works who was a member of Parliament and appointed by the prevailing government. It was a position that did not call for any depth of knowledge about railways. The tenure of the position was quite short as there was considerable instability of the administrations forming government.

The Parliament could be excused with the reasoning that their practices and procedures were based on the Westminster tradition, and in England the railways were run by companies.

The involvement of Australian colonial governments in the owning and operation of railways occurred in the mid-1850s and, out of necessity, when the private companies collapsed. The longer distances and sparsely settled population in the colonies would not work with the English model. In the colonies the railways took on a much different function. They filled the much-needed role of opening up the lands of the interior for closer settlement. But cost was always the main consideration.

The situation that caused the rift in South Australia in the mid-1880s drew attention to the need to have a railway expert, or Railways Commissioner, having the responsibility for all aspects of the railway operation. The South Australian Government achieved that in 1888.

The experience in Victoria had some similarities to South Australia's woes. In both colonies there was resentment within the respective parliaments that these railway commissioners were too highly paid.

There was also resentment that the Commissioners had too much power. So the governments clawed back their control. New South Wales had a happier experience.

Rails and the sleepers are the obvious parts of the track. What we don't see along a modern track are the cables under the ground that have replaced the wires that were strung between the poles. Track is no good without communications. There are the earthworks, the embankments and cuttings, and the drainage and channels to divert the storm-water.

Infrastructure includes bridges and culverts, and there are the line-side structures like signals and stanchions that must be placed outside the structure gauge.

And right at the bottom, and often overlooked, is the 'right-of-way'.

But whilst the train and the track are locked into a perpetual battle to wreck each other, the modern railway survives because the track engineer, the rolling stock engineer and the administrator of the system make sure that it doesn't happen.

RAILS

The rails need to be strong enough to support the weight of the train and require some flexibility to allow them to be worked into curves. They need to be manufactured to a high level of quality control as they will need to be hard wearing steel and not prone to fracture. In the past, rails were joined with fish-plates that were bolted. The rail joints gave the lilting 'clickety clack' song of the railway track. But those rail joints were a source of wear to both the rails and the rolling stock.

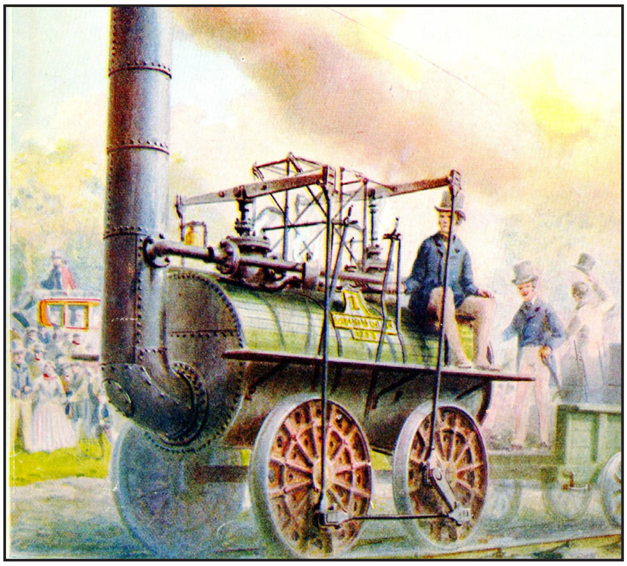
The rails support the load of the locomotive and rolling stock and guide the train along straights and at curves. They provide a running surface with low friction yet must provide enough friction to allow the locomotive to achieve traction.

Modern rails are of a cross-section known as flat bottom rails or Vignoles*, and are manufactured in Australia in the following weights. 47 kg/m, 53 kg/m, 60 kg/m and 68 kg/m. Historically the following were used extensively. 41 lb, 60 lb, 80 lb, and 94 lb. (that is pound weight per lineal yard). The greater weight of rail allowed greater loading as measured by axle loading. Heavier rail is used where higher train speeds are required and for tracks with frequent services.

Historically, the first rails were wrought iron plates, hence the term 'plate-laying' when referring to installing the railway. Richard Trevithick deserves to be honoured as the inventor of the railway locomotive but the failing of Trevithick's locomotive was that the track it ran on was built with cast iron plates that fractured under the load of the locomotive. He did not persist with the invention.

George Stephenson took the title of the inventor of the modern railway because he had the advantage of being 20 years after Trevithick and he was able to source wrought-iron plates which did not fracture. His *Locomotion* was in service on the Stockton to Darlington Railway in 1825.

*Charles Vignoles was a railway engineer who was an advocate for wider gauges (see chapter 5).

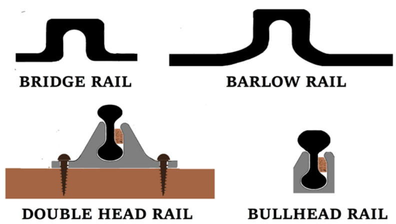


GEORGE STEPHENSON'S *LOCOMOTION.* Built in 1825 for the world's first public railway, the Stockton to Darlington Railway. Its success was largely due to the wrought iron rails that did not crack under the weight of the engine. **IMAGE FROM THE AUTHOR'S COLLECTION.**

Subsequent types of rail have included bridge rail, Barlow rail, bullhead rail, and double headed rail. The latter two sat in 'chairs' that were fixed with wooden wedges. They were demanding of considerable maintenance. The idea behind double-headed rail was that when one side became worn it could be turned over and have a second life. But where the bottom section had been fixed into the chairs, there was some irregularity at the weight-bearing surface which, when turned over, caused vibration of the engine and rolling stock. Bullhead rail had a larger head than the bottom and was not designed for being turned over.

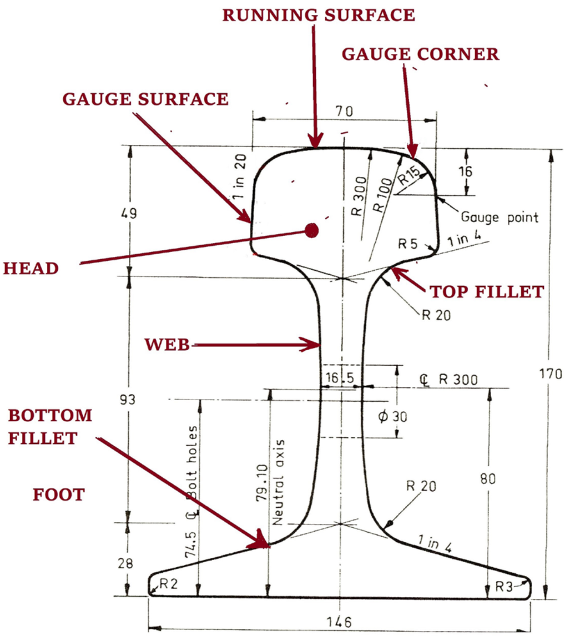
Old rails never die, or so it seems. For some rails that have been of recent manufacture, the sections have been recycled by having the ends with the bolt holes trimmed and welded into long sections that are used for crossing loops. Some of these welded sections have been used on mainlines.

Just when it seemed that old rails had reached the end, they are recycled into new applications. All of the rails from the old narrow-gauge Alice Springs railway went to Queensland to be used for the sugar cane tramways. A look around some of the older suburbs or country towns will turn up lengths of old bullhead or double head rail that have been used as fence posts or upright stays against the walls of old stone buildings.



PRIME MINISTER MALCOLM FRASER putting the challenge to Des Smith (back to camera) while Keith Smith (Commonwealth Railways Commissioner) ponders the matter and rubs his chin. The question to Des "Can you get the track to Alice Springs a year ahead of schedule?" Des replied that it was a deal. It would be his 50th birthday. And Des delivered on time. He had the benefit of concrete sleepers and a small gang of hard-working and loyal track workers. **PHOTOGRAPH FROM THE DES SMITH COLLECTION.**

BELOW. Profile of 60 kg rail according to the Australian Standard AS 1085 with the various parts of the rail described. The illustration at the bottom of the page shows the application of rail cant and the perfectly vertical gauge surface.

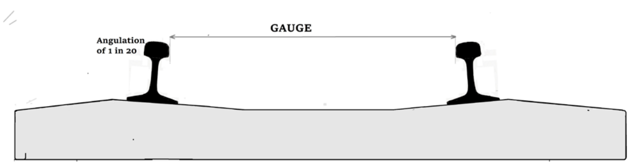


When timber sleepers were used the cant of the rail was achieved first by machine adzing of the sleepers, and later, with baseplates which had a 1 in 20 angulation. That was at a time when rails were manufactured with parallel sides of the rail, otherwise known as the 'gauge surface'. Since 1981, heavy rail has been manufactured with a 1 in 20 angulation of the gauge surface. Concrete sleepers have been manufactured with that angulation. The measurement of gauge is, by definition, 16 mm from the running surface of the rail. This combination delivers a gauge surface that is perfectly vertical. There are problems when using old (pre 1981) rails on new concrete sleepers. This is compounded by wear of the old rails. The gauge surface is not perfectly vertical. Des Smith says that old rails on sleepers with a 1 in 20 surface can affect the measurement of gauge by as much as a quarter of an inch. (6 mm).

Our modern rails have their heads inclined at 1 in 20 on both sides so the faces are vertical on canted rails. Our old rails have a radius of 11 or 12mm on their top corners. Gauge is measured at 15 mm below the top of the rail. It was the tilt of the whole rail that changed the gauge, by a quarter of an inch (1 in 20) on a rail about 5 inches (125 mm) high). So back in the timber sleeper days the spike holes had to be bored half an inch further apart if our old rails were to be canted.

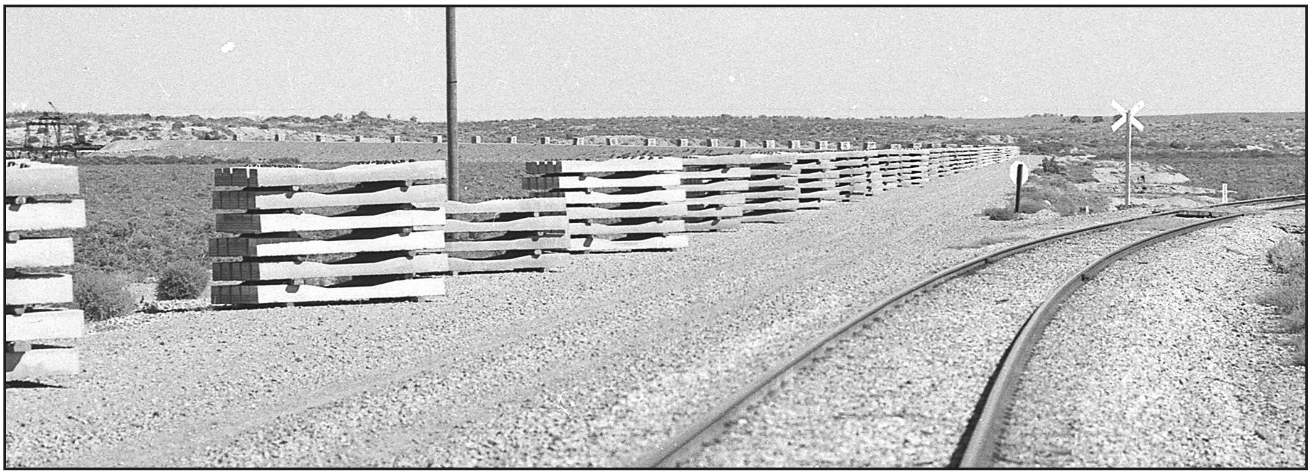
RAIL CANT

Curves are an important consideration and the next chapter is given to that topic. Cant on curves is explained in some detail in that chapter. Rail cant is independent of curves. It is appropriate to deal with it here as it has a bearing on the measurement of gauge. The purpose of rail cant is to minimize the running surface of the rail to a small ribbon of contact. In earlier times the wheel occupied a large part of the running surface of the rail. By minimizing the contact surface the useful life of the rail is extended. The application of rail cant dates from about the 1930s.



SLEEPERS

Track needs sleepers. Sleepers provide an even base for the rails, hold the rails in the correct gauge, and by virtue of their weight provide stability. They must also provide a bearing surface for the rail. Railway track can be regarded as a length of panel, where the rails and sleepers are rigidly fixed.



CONCRETE SLEEPERS all ready for the Whyalla line. 30 January 1972. This is at the Spencer Junction. The mainline to Western Australia veers to the right. **JLW.**

Over the last 50 years concrete sleepers have become the standard for mainlines. Welded rails, securely fixed to concrete sleepers, are designed not to buckle because the weight of the track with the concrete sleepers stabilises the track.

The combination of concrete sleepers and continuously welded rails has resulted in railway track that is very durable and has a low demand of maintenance. It was once a feature of the Trans-Australian Railway to have communities along the line for the purpose of track maintenance. Those communities were serviced by the legendary *Tea and Sugar* train. With the advent of concrete sleepers and continuously-welded rails, the maintenance task became much lighter. The communities are gone and the *Tea and Sugar* made its last run in 1996.

TWO MORE FROM THE DES SMITH COLLECTION. Top: Prime Minister Malcolm Fraser. Bottom: Des Smith's 50th birthday and he is congratulated by AN Chief, Keith Smith, for completing the railway to Alice Springs a year ahead of schedule.

Commonwealth Railways championed the use of concrete sleepers in Australia and installed trial sections along the Trans-Australian Railway in the 1950s. Then they used only concrete sleepers for the new railway construction from Port Augusta to Whyalla. When the Whyalla line was built the costings were done on the basis of those concrete sleepers having a pay back period of 50 years.

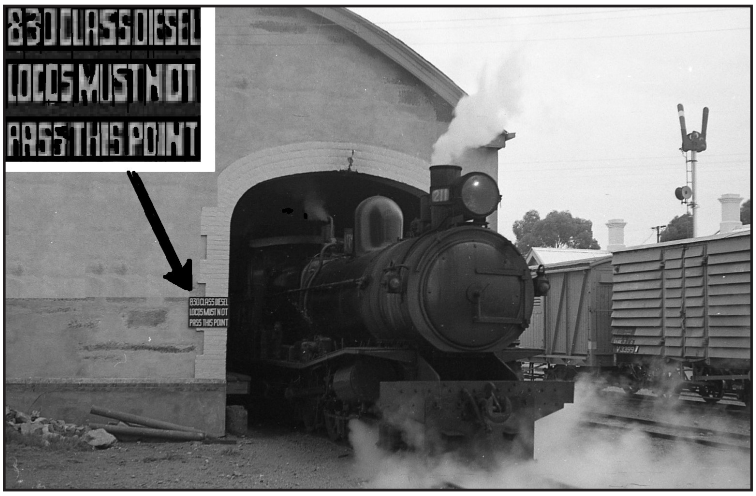
Those 50 years were up in 2022, and the concrete sleepers on the Whyalla line are still in excellent condition. There are also steel sleepers that featured in an attempt 30 or 40 years ago to gain acceptance. They were generally lighter than concrete sleepers, although there were some heavyweight steel sleepers, but they had the disadvantage of cost.

It was fairly obvious soon after the Whyalla line was opened that concrete sleepers were the choice for new railways to Alice Springs and Darwin but the hardwood and steel industries were not going to let go without a fight. There was a period about 1970 - 1983 which resulted in what Des Smith called the 'sleeper wars'.

The natural tendency is that an approaching train, with its downward thrust some distance away puts an upward thrust and if that results in elevation of the rail some distance ahead. Once the sleepers have been freed from the restraining influence of the ballast the modelling showed that the track would buckle upwards, and once free from the stabilising effect of the ballast the rails would buckle horizontally.

A concrete sleeper weighs about 275 kg. Unlike timber sleepers they actually gain strength with time. They have consistency of shape and weight, a longer life, and are heavier. The costing exercise did not go beyond 50 years as the depreciation calculations made little impact with increasing years.

The clip fasteners hold tight, unlike the dog spikes of timber sleepers which become loose with time.



OOPS!

Orroroo is the first major centre encountered on the narrow-gauge railway from Peterborough to Quorn. The first 830 class diesel entered service on the Peterborough Division in 1963. These 830 class diesels were initially put to work on the line from Cockburn to Port Pirie. Eventually it was decided to send one up to Quorn. Of course all the appropriate approvals were obtained. Note the sign on the goods shed and the damage to the brick arch. They tell the rest of the story. **JLW, 29 DECEMBER 1965.**

The timber, concrete and steel industries were fiercely competing and some reputable companies were making unfounded claims. Des recalls that the timber industry backed off early, but the steel industry tenaciously hung in well beyond the construction of the Alice Springs line, for which concrete sleepers were the standard.

The perfect railway is straight and flat. The reality is that the perfect railway is a rarity and some curves and gradients are inevitable. There is the long straight on the Trans-Australian Railway but any economy of operation is negated by the 170 (or thereabouts) curves through the Barton sand-hills east of the long straight.

EXPANSION OF THE RAILS

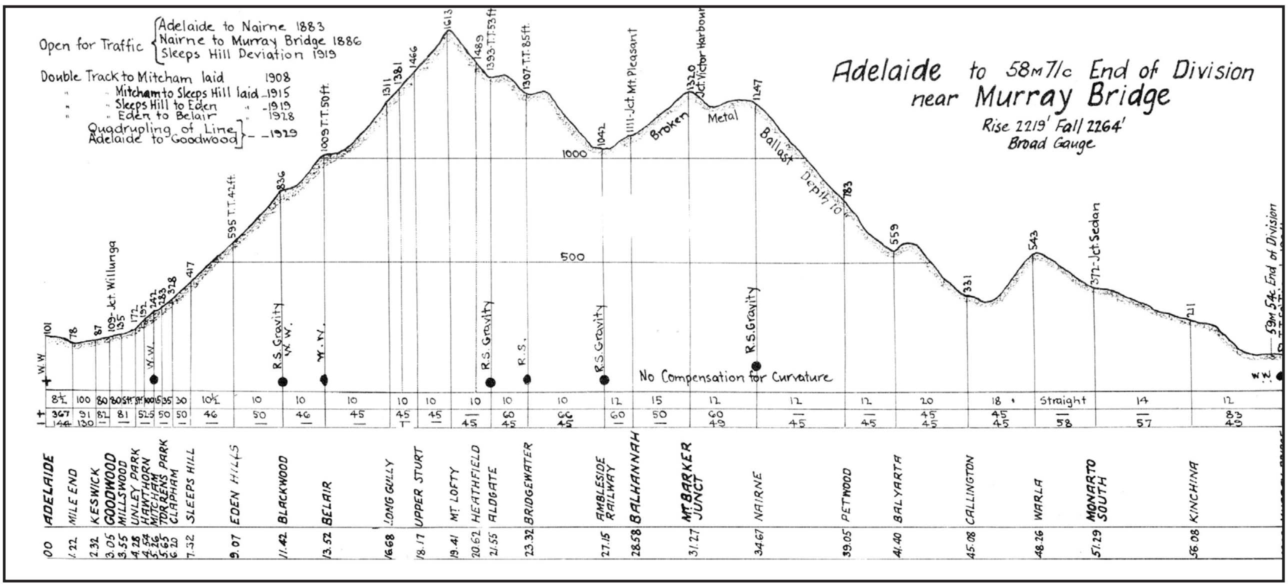
Concrete sleepers work best with continuously welded rails. Rails arrive from the steel mill in standard lengths. The rails are then welded on-site into lengths of some kilometres. We were once taught that the rail joints were bolted with fish-plates to provide expansion gaps. I recall that my high school physics text book had an example of the co-efficient of linear expansion of rails requiring about a mile of expansion gaps on the Trans-Australian Railway.

When the rails get hot, really hot, they expand in all directions. In 1983 AN (Australian National) did its calculations on the basis of an unstressed temperature of 40°C. The combination of rails, concrete sleepers and ballast would hold the track, but there would be some uncertainty at higher temperatures. When the rails get hot their natural tendency is to expand in length and if the components of the track have been assembled properly their lengthwise expansion is thwarted and the expansion is of the cross section. Continuously welded track, no matter how long, expands lengthwise only in the last 100 metres at each end.

GRADIENTS

Both curves and gradients result in slowing the train, creating inefficiency of traction and a source of wear of rails and rolling stock. But for any indication as to which of the two is the greater evil, it is mention of curves that generates the greater expression of anguish on the face of the railway engineer.

The illustration below is the gradient profile of one of the most challenging sections of mainline railway in Australia, being from Adelaide to Murray Bridge. Some explanation is here given of the information provided.



There is data on the x-axis of the diagram that identifies the minimum curve for that section. The tightest curves on that section are 10-chain radius. The diagram advises that the gradients are not compensated. A compensated gradient is one where the gradient is eased at a curve.

The advantage is that the engine can maintain a steady pull. The effect of the uncompensated gradient is that a section that is listed as a 1 in 45 gradient is actually less. Even 1 in 37 has been quoted.

The engine generates tractive effort that is effectively the pull on the draw-bar. The engine must consume a large part of the pull getting itself to the top of the gradient. Then there are the carriages and brake-vans that must be provided for the safety and comfort of the passengers. They earn no revenue and are called ' dead weight'.

THE RIGHT-OF-WAY

This is the title or ownership of the strip of land with its legislative entitlements and encumbrances. This raises many issues. In rural areas there are corridors of land from dismantled railways that cannot be sold or put to production because of years of arsenic weed spray, and must remain crown land.

Des Smith has advised that on the Trans-Australian Railway, the Commissioner owned the land 10 chains (201 metres) either side of the centre line of the track.

THE COST OF TRACK

I asked Des Smith for some indication of the relative costs of the components of track. This does not include the cost of land acquisition or engineering works related to terrain, such as bridges and tunnels. He gave the following as an approximation.
Rails 30%
Sleepers 25%
Ballast 15%
Track laying 20%
Signalling, cables and communications, up to 10%

He added that the ownership of the land extended below the surface 'unlimited as to depth'. His interpretation of that is that the railway corridor extends to the centre of the earth.

It is no seceret that the railways were a law unto themselves regarding what they dumped on their own land. There is a long reverse curve near Gumbowie on the former Terowie to Peterborough line, that was known to most as 'the rubbish dump'. This is where they used to dump the locomotive ash from the Peterborough depot. It is a fair bet that there was some asbestos in it.

ABOVE:

GLADSTONE. Here they have developed the concept of 'third rail' and turned it into 'fourth rail'.

PHOTOGRAPH BY PAUL DWYER.

RIGHT

COMMONWEATH RAILWAYS diesel depot at Port Pirie, showing contamination of the soil.

JLW PHOTOGRAPH.

But the matter of air-rights is rather vague. So for the interim, the new wave of railway photographers can 'trespass' above the railway with their drones.

Des commented that the 'right of way' of the Central Australia Railway north of Oodnadatta was never formally ceded.

The 'right-of -way' also extends to allow the Commissioner to sell liquor and operate pokies.

The line from Port Augusta to Kalgoorlie has no tunnels or low overpass bridges. This allows the double stacking of containers, but when a train from the west arrives at the freight terminal in Adelaide, and containers are consigned to the eastern states, the upper containers have to be removed before the train can negotiate the many tunnels further east.

The formation or road bed includes consideration of drainage, cuttings, embankments, bridges and culverts, Washaways and mudholes are problems that have been a source of considerable grief in recent times particularly on the standard-gauge line from Melbourne to Albury.

BROKEN HILL 1972. It is not the locomotives that demand attention here, but look at the five open wagons behind them, and the contents thereof. They have mineral concentrates, either zinc concentrate or lead concentrate, both on their way to Port Pirie. The zinc concentrate will be shipped to Hobart's electrolytic refinery. The lead concentrate will be processed at Port Pirie. The concentrate contains small amounts of gold, silver and other heavy metals. Some of these are less desirable, such as mercury and arsenic. A recurring question has been 'how much of this load would blow off on the way from Broken Hill and what is the consequence for the soil of the railway corridor and the people who live in the towns along the route?'.**JLW.**

THE LOADING GAUGE AND THE STRUCTURE GAUGE

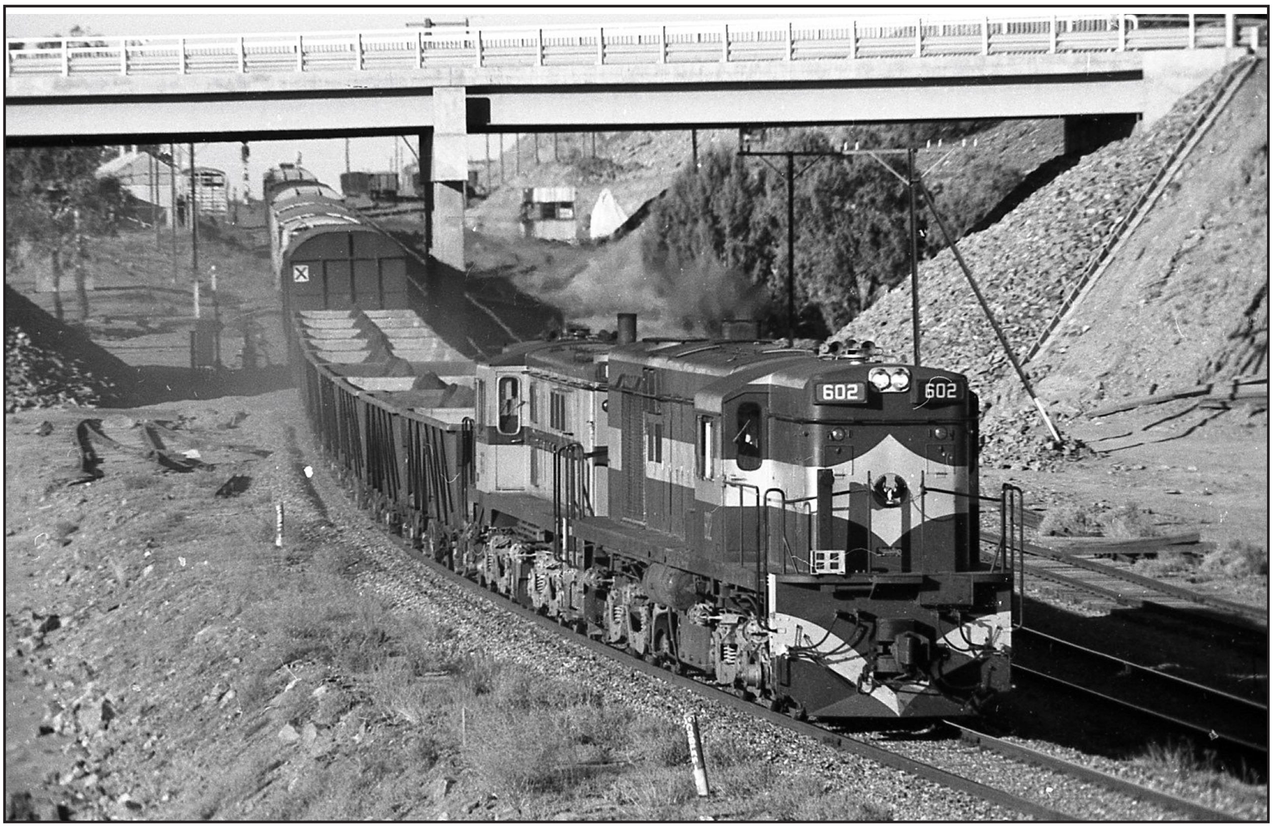
They set out to do the same thing but they do it differently. The structure gauge is to define how close platforms, signals and other structures can be built. Tunnels are another. The loading gauge is an outline of the maximum dimension of a carriage. It is also relevant to semi-trailers and agricultural equipment, for example, loaded onto a flat car. The structure gauge is wider and higher than the loading gauge.

There is a diagram of loading gauge and structure gauge in Chapter 5. The dimensions of loading gauge and structure gauge are smaller for narrow-gauge networks. This is a matter that has a bearing on any consideration of converting railways in Queensland to standard gauge.

BALLAST

Ballast has traditionally been provided to stabilise the track. When timber sleepers were used there was the need for regular repacking, hence the track worker was known as a 'Packer', with the task carried out manually with a type of pick. There are track tamping machines that now do the task. There are very specific requirements for railway ballast, and this may involve transport over considerable distances.

Des Smith commented that Keith (K A) Smith, when Commissioner of Commonwealth Railways, often lamented, back in the days of hardwood sleepers, that it took time and effort to get the ballast settled down. Then it was time to replace the sleeper, and the ballast would be disturbed and would require more time and effort. The elimination of this cyclical process was one of the benefits of the change to concrete sleepers.



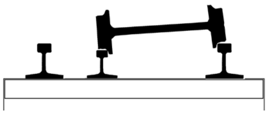
GUMBOWIE. The mid-way station between Peterborough and Terowie. Elevation was 1976 feet (602 m) above sea level, and was exceeded in elevation on the South Australian Railways only by Belalie North (2024 feet /617 m) which was on the narrow-gauge railway west of Peterborough. Belalie North was by-passed when the standard gauge line was opened in 1970. Railcar 104 on the mixed-gauge track.

PHOTOGRAPH BY JLW 4 June 1969.

THIRD RAIL AND GAUNTLET TRACK.

Third rail is a common solution to manage multiple gauge situations but it has its limitations.

It has been used extensively in South Australia for its gauge conversion projects. In those situations the third rail is the one in the middle of the track that is of temporary purpose. It allows rail services to continue virtually up to the day of change-over. That rail is usually of a lighter weight and height, with the result that the narrow-gauge train has as slight tilt.



It is a costly process in that the workforce that has installed track has to come back and remove the rail. It is quite a cost involvded in station yards where it complicates points and crossings. It became a sort of tourist attraction in the past, for railway enthusiasts to stop by at Gladstone and take a photograph of the triple-gauge trackwork. That was quite appropriate because there is nothing like it anywhere else in the world.

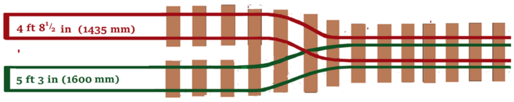
Engineers don't like third rail. One cause of their anxiety is the mixed-gauge track of broad and standard gauge, which leaves a very narrow gap between the rails. The problem here is that it is easy for a brake block or ballast stone to lodge in the gap between the two rails. This can cause a derailment.

IS IT ART? IS IT AN AID TO EDUCATION OR IS IT A RAIL ENGINEER'S FOLLY? Belair Station. It dates from the time of the standardisation of the Adelaide to Melbourne route.

Where mixed standard-gauge and broad-gauge third rail are provided as a permanent arrangement, severe speed restrictions are in place. This is a problem with the entry of the standard gauge into Southern Cross.

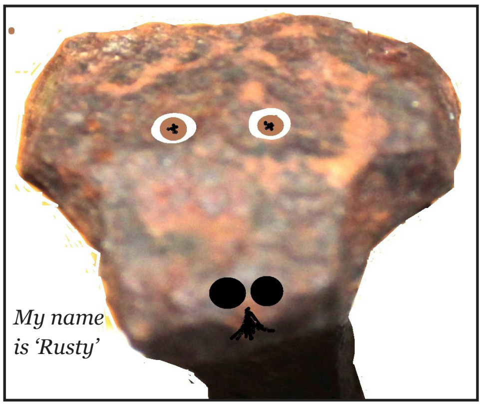
Gauntlet track has application where separate tracks of different gauges may encounter a bridge or tunnel. It requires sophisticated signalling.

GAUNTLET TRACK



ABOVE: On the platform of the Port Augusta station.

LOWER: I confess that it was something that I had never previously considered - the origin of the expression 'dog spike'. There are many items related to railway track that take their names from animals. Des and I were discussing some of these on one of our recent train trips. There is the 'pig's trotter' (for removing dog spikes) and the 'Jim Crow' (a rail bender) which required a 'crow bar'. And there are 'fish-plates'. Des explained that the early dog spikes had a 'T' configuration of the head that resembled a dog's face, and even more so when it was rusted.



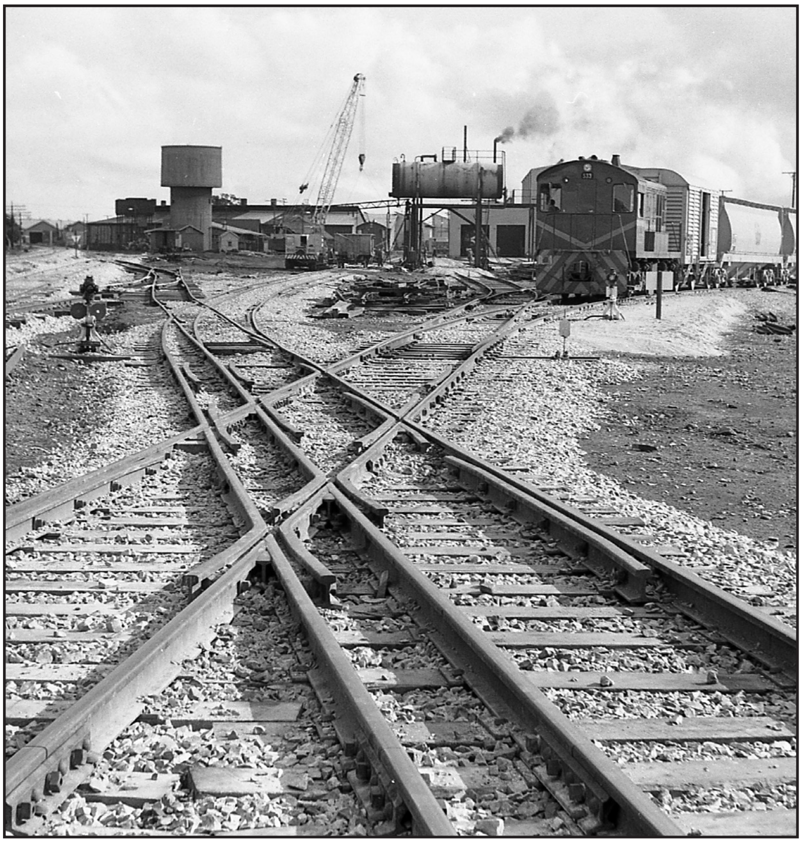
THE TRIPLE-GAUGE TRACKWORK AT GLADSTONE

It is commonly described as a 'triple-gauge turnout' but Des Smith says that is not strictly correct. There are only two gauges that turn out. The broad gauge and the narrow gauge.The standard gauge is a through line.

This piece of trackwork is unique. There is nothing like it anywhere else in the world. It is no longer at Gladstone in consequence of the broad-gauge and narrow-gauge connections being closed. It has been re-assembled at the National Railway Museum at Port Adelaide.

This piece of construction was neccessary because of the limited space in the Gladstone yard. Ron Fitch, the former South Australian Railways Commissioner was quite certain that for less than the cost of all the engineering of the Gladstone yard that the entire Wilmington line could have been converted from 3 ft 6 in to 4 ft 8½ in. A large part of that cost was the signalling. **PHOTOGRAPH BY ADRIAN JONES.**

BELOW. THE SCENE AT PETERBOROUGH. 2 December1969. With only a few weeks left before the commencement of standard-gauge operations on the Broken Hill line. **JLW.**



THREATS TO THE INTEGRITY OF THE TRACK

The elements will eventually destroy the track unless there is ongoing proper maintenance. Water, termites, the tendency for timber to naturally decay, extremes of hot and cold, bushfires, grass and trees, rabbits, wind and sand. And so the list could go on.

And we can add humans to that list. By way of illustration I quote the incident near Saddleworth about 1943 when a boy put a rock on the line and turned the Broken Hill Express into a train wreck. Terrorism? It was a word that had not been invented in 1915, when two zealots attacked a picnic train at Broken Hill on New Years' Day.

Members of Parliament are a special category of humans that deserve mention. These days they act collectively and thus can sleep well in the comfort of the knowledge that as individuals they have not brought about the collapse of the system. The indecision and inaction over the Mt. Gambier line is an example.

NEAR RUMBALARA ON THE OLD CENTRAL AUSTRALIA RAILWAY - 1974. Jeremy Browne has used a long lens. Or was this section of the old Central Australia Railway accurately recorded by his camera? The conical peak in the distance is Colson's Pinnacle.

NARROWER AND NARROWER, BUT THERE COMES A POINT...

My tutorials with Des Smith usually drifted into informal discussion.

There had been some discussion about the 3 ft 6 in gauge, and whether the line from Tarcoola to Alice Springs to Darwin would have worked if it had been built to narrow gauge and constructed with concrete sleepers and continously welded heavy rails. After all, the railway networks of South Africa and Japan seem to function well with 3 ft 6 in.

But it was also of note that the Japanese had gone to the 4 ft 8½ in for their 'Shinkansen' bullet train.

In Australia, Queensland is operating a fairly smart rural passenger service with its tilt train. And in Brisbane and Perth the metro services are 3 ft 6 in gauge and seem to be fast and efficient and largely electric.

Des thought about this for a short while and then commented that on the old Central Australia Railway, between Marree and Alice Springs, they had to operate a 3 ft 6 in gauge line and had loaded semi-trailers up on flat cars. The track was not in good condition although it may have been in better shape than suggested by some of the telephoto images we have been used to seeing.

In the end, Des was of the opinion that they wouldn't be able to go as fast, but he didn't say by how much. He didn't think they would be able to run double stacked containers.

Regarding the double stacking of containers, Des commented that it was a rare event, but still happened that a loaded container was stacked on top of an empty.

This would result in an elevated centre of gravity which probably wouldn't topple, but when other forces were acting could conspire to have the centre of gravity fall outside of the base. And that base, he was quick to explain, was wider than the nominated gauge. It was the measurement of the mid point of the rail heads. So, for a track with a gauge of 3 ft 6 in or 1067 mm it was a little wider than 1100 mm.

What are those other forces that could conspire to topple the train? There are side winds and mud holes. There is also the angulation of the cant in the event of the train coming to a stop on a curve. There is also the risk that the load may shift to one side. Imagine a couple of bull elephants in a contest.

I confess that I was a hard task master and put to Des why, if 3 ft 6 in would work, whether we could do it with 2 ft 6 in gauge?

Intuitively I knew that somewhere between 3 ft 6 in and 2 ft 6 in, the point had been passed. The question was not so much as defining that critical point, as identifying those factors that were operating.

Again his response was considered. One of the joys of my sessions with Des has been that he is a great lateral thinker and his responses are somewhat wider of the mark than we would expect of the archetypal engineer who pulls the slide rule from a pocket and delivers a mathematically precise answer. He put to me, but not in the exact words, that I was the student and he was the teacher. His tutorials had given me the tools to answer my question.

My carefully considered verdict was that the '2 ft 6' would give us a much narrower base so it was imperative that the track was solid and stable. I would build it with concrete sleepers of the same weight as the standard gauge. Heavy rail, continously welded. Curves would be kept to a minimum number which would not be difficult to achieve between Tarcoola and Alice Springs, but there would probably need to be a new alignment for sundry curves between Katherine and Darwin.

Curves, where we had them, would need to be 1 km radius and with minimal or no cant. That may require speed restrictions on some curves. The need to keep the track in excellent condition throughout the year would require increased maintenance. Whereas there have been some uncertainty about double stacking of containers on a railway of 3 ft 6 in, it would definitely not happen on a railway of 2 ft 6 in. I opined that a railway of 2 ft 6 in would have a much reduced load carrying capacity, and it would be slower. The bean counters would probably find it was uneconomical, but just in case they were yet to give a final verdict, I declared that the bull elephants would derail the plan.