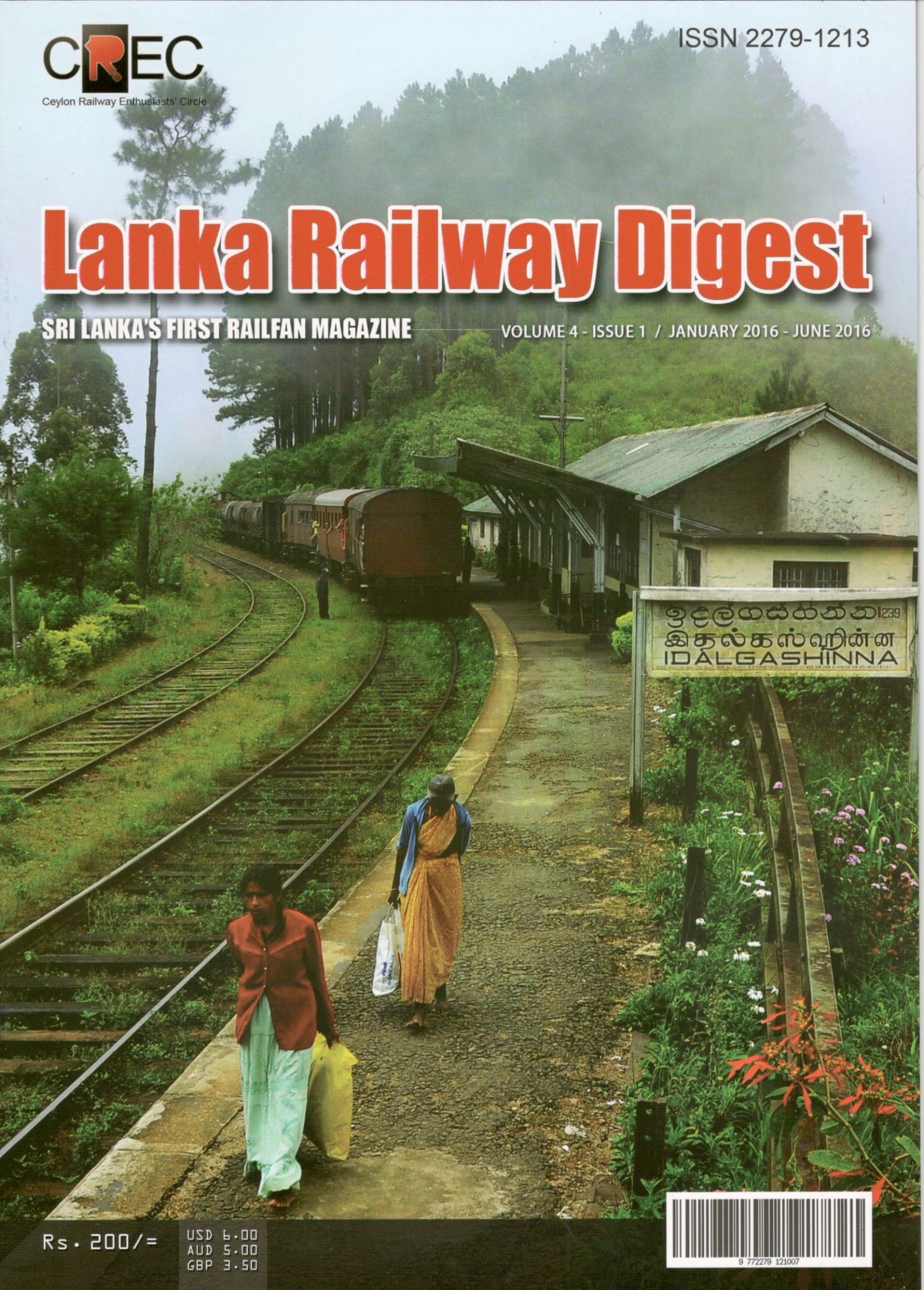


# Lanka Railway Digest

SRI LANKA'S FIRST RAILFAN MAGAZINE

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# MESSAGE FROM THE EDITOR



Volume 4 #1 is our ninth magazine, a significant publication which was planned to coincide with the 150th anniversary of railways in Ceylon. The magazine was held back from the usual issue week to accommodate the opening of the National Railway Museum Stage I, the 150th anniversary events and the opening of the Northern Railway to Kankesanthurai in January 2015.

Hon. Ranjith Madduma Bandara, the Minister of Transport at that time was the chief guest. At this occasion, the ceremonial Cancellation of a Stamp to commemorate 60 years service of M2 locomotive 'Ontario' was held. Due to restricted time and resources, the original museum proposal was segmented to three stages, and Stage One consists of the Kadugannawa Goods Shed being modified to house typical indoor exhibits. A few items of rolling stock and locomotives are displayed outside the original lorry park on the Goods Shed. The museum at the old Colombo Terminus will be retained as a 'satellite museum'.

In October 2014 the Northern line was opened from Pallai to Jaffna. The then President was the chief guest. The train and stations were gaily decorated with traditional northern motifs.

On 2nd January 2015 Kankesanthurai was opened but the occasion was of low patronage.

The Prime Minister of India, Hon. Narendra Modi declared open the Talaimannar Pier Station in April 2015. He flagged off a 'special' to Medawachchiya.

The Beliatta area of the Kataragama Line is still under construction. CREC and LRD will visit Beliatta for a few photographs.

This issue will feature the diesel locomotive saga and hikes in the Ohiya area. Dan Gamber's rare colour photos of the 1970s with operating trains at Opanaika and Ratnapura are included.

In a disturbing trend, a newspaper saw it fit to copy directly some of our articles, which our authors had carefully researched. We hope that more journalistic etiquette is maintained.

Two of our key players designing this magazine, obtained employment during the year, and as new entrants were unable to release themselves off work for quite some time. We have tentatively decided that LRD will be a bi annual magazine.

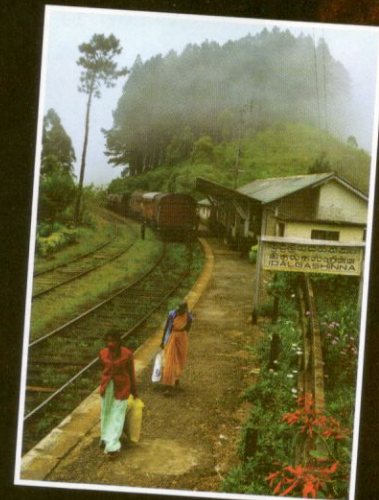
We wish all our readers a Happy New Year!

Thank you.

**Vinodh L.J. Wickremeratne**  
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**Cover Photo**  
Idalgashinna Railway Station  
Pic by Sisira Gintotage

THIS ISSUE OF "LANKA RAILWAY DIGEST" HAS BEEN BROUGHT TO YOU BY

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**පාඨකයින් සහ පළකිරීම් ලබාදෙන අය සැලකිය යුතුය -**

රචකයින්ගේ භාෂා හැසිරවීම හෝ පළකිරීම වල නිරවද්‍යතාව පිළිබඳව ලංකා දුම්රිය ගවේෂකයින්ගේ සංගමය කිසිදු වගකීමක් නොදරයි. තවද, ලංකා දුම්රිය ගවේෂකයින්ගේ සංගමය මෙම ලිපි සහ දැන්වීම් පළකිරීම සිදු කරන්නේ ඒවායින් බුද්ධිමය දේපල හිමිකම් කඩවීමක් සිදු නොවේය යන විශ්වාසය මතය. මෙහි ඇති සියළුම පළකිරීම් වල අයිතිය ලංකා දුම්රිය ගවේෂකයින්ගේ සංගමය හෝ අදාල කතෘවරයා සතුවේ. අනවසරයෙන් උපුටා ගැනීම හෝ කිසිදු මාධ්‍යයකින් නැවත පළකිරීම සපුරා තහනම් වේ.

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# Aspects of Railway Development Thinking in the early 20th Century, its Economics then and some Engineering Feats of the Era

by **Lalith Seneviratne**  
C.Eng., MIET

**A** Railway is a specialised road with easy gradients and comparatively flat curves, constructed with the object of transporting people and goods economically, safely, reliably and within reasonable time.

Prior to the development of the railway, the primary means of transport was public cart roads that were of uneven contour and bad corners. Therefore the railway quickly established itself in the industrialised world and its favoured colonies, driven by commercial requirements and public demand.

Railways in Sri Lanka are constructed to a broad gauge of 5 feet 6 inches with minimum curvatures of 5 chains (110 yards) radius and a ruling gradient of 1 in 44<sup>1</sup>.

Compared with public road transport, railways have three outstanding advantages, namely;

- The large weight and volume that can be hauled at comparatively cheaper cost;
- the low cost of maintenance;
- speed resulting in superior alignment, and which is not interrupted by other forms of traffic, but is only restricted by the limitations imposed by load in relation to available power, as well as by curve and gradient.

Just as much as the people of Sri Lanka always believed, our colonial masters too understood that Ceylon could be nothing if it is not agricultural,

<sup>1</sup> With the exception of the now discontinued Kelani Valley Line and Uda Pussellawa Railway. Broad gauge was chosen because Viceroy Lord Dalhousie had decreed this for India and it was expected that it would become the South Asian norm. Dalhousie chose 5' 6" for military reasons as it allowed two cavalry horses to travel side by side.

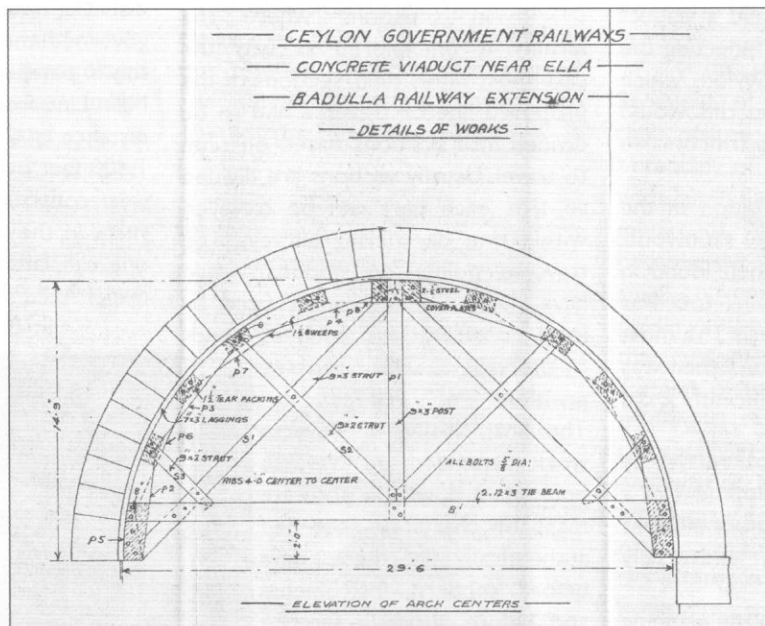
and therefore the requirement of a railway to transport produce was quickly recognised. The produce requiring economical transportation included the commercial crops introduced by them, viz., coffee, tea, and rubber, and indigenous produce like spices, coconut, and rice.

It was the aftermath of the Great War. The Allied Forces led by

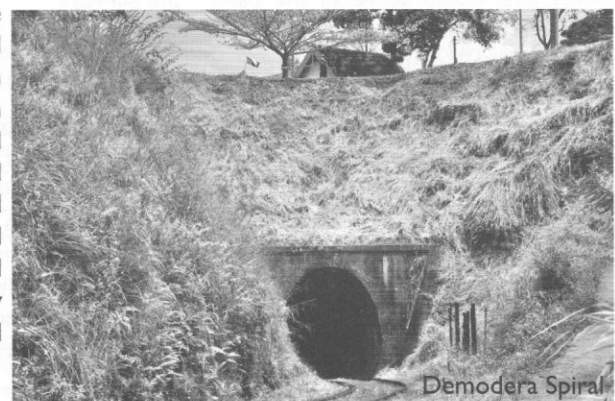
By the 1920s the British Empire held sway over nearly half a billion people, one-fifth of the world's population at the time. The "empire on which the sun never sets" covered more than thirteen million sq. mi., almost a quarter of the Earth's total land area. India, the empire's most valuable possession then, and Ceylon, the fairest of its possessions, though

governed separately from Whitehall, had a symbiotic relationship with Britain, just as much as the histories of the two neighbouring nations, one dwarfing the other in size, were interwoven, and interdependent, from as far back as the time of the Ramayana. Britain took for granted that India and Ceylon forever would be their Jewels in the Crown. From here it would be conjecture that the British would have had a

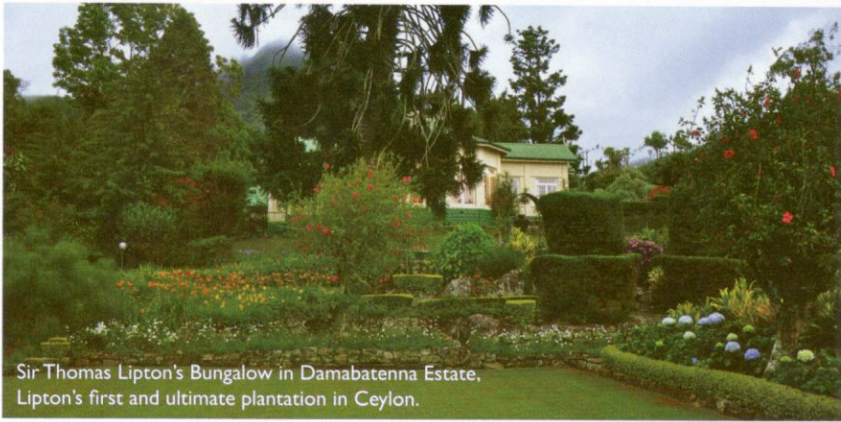
blueprint for the joint exploitation or economic development of the two countries, whichever the term one may use depending on how you look at colonialism. Such conjecture is supported by the fact that they at that time saw the magnificent natural harbour at Trincomalee in the East as



Great Britain had defeated the Central Powers led by Germany. Human beings had gone through unprecedented suffering, death, and destruction on a scale never seen before, due to the introduction of technology to warfare – a trend that has continued and grown ever since. Modern technology had brought on the one hand unprecedented misery through its introduction to warfare, and on the other hand unprecedented convenience and lessening of toil through the railway to give one wonderful example.







Sir Thomas Lipton's Bungalow in Damabatenna Estate, Lipton's first and ultimate plantation in Ceylon.

a hub port for South India that had no large deep-water harbours. The extension of the railway to the East was partly to connect Trincomalee to the rest of the country so that the port could flourish. Plans were afoot, though unrealised, to build a viaduct across Adam's Bridge, connecting the railways of India and Ceylon, which had the same gauge, and this would have made the rail link to Trincomalee invaluable.

Similarly, exploitation of the vast timber resources like satinwood, palu, ebony, milla, etc., then found in the dry zone jungle plains too was in the minds of the British. The most backward part of the island then was the Eastern half and significantly it did not have a railway.

The important part played by the railways in the development of a country through provision of efficient transportation was universally accepted at that time.

The first step in the planning and construction of a new railway line is the preliminary survey of possible different routes and the final survey of the best one for construction purposes. With the aid of the preliminary survey the Engineer would set his party to cut a survey line on a compass bearing previously decided upon for the direction of the railway. This survey line would serve as the base as well as the baseline with reference to which detailed and exhaustive fine surveying will be carried out in order to determine the permanent way. Acquiring of private property along the planned route and compensation for the effects on adjacent lands that would be divided are necessary procedures to be carried out. Unlike today, where there is rampant frenzy of construction activities in general

that necessitates thorough regulations thorough assessments to minimise its environmental impact, such evaluations were not thought relevant in that era of seemingly unlimited space and natural resources.

In situations where the locality is unexplored as was the case most times then, sections of the proposed line or traverse had to be divided into portions based on time to travel. Usually sections are divided so that each part can be travelled within one day during surveys. The traverse points or stations would have their distances apart fixed by local considerations, such as bends of the valleys, ascents, passes, positions of villages, etc. The final closing of traverse work depended on traverse points laid down on accurate maps or charts or recorded authentically. In those days before modern instruments and before survey reference points were established, direct astronomical observations aided by good chronometers were used for longitude measurements. The pedometer, the aneroid altimeter, and the compass were the instruments used in addition to the theodolite in the surveys.

The preparation of designs and working estimates for cuttings, earthwork, station buildings, permanent staff quarters, level crossings, approach roads, tunnels, retaining walls, culverts, bridges, viaducts, and water supplies completed the main pre-construction activities of a railway.

The practice was to engage petty contractors at piecemeal rates

to supply labour and proceed with the earthwork, bridges, culverts, and buildings. When the line ran through the low country jungle, sleepers and timber for the work were obtained comparatively cheaply and where suitable brick-clay was met, bricks were made and fired at the site. In most districts sufficient quartz gravel existed for ballasting purposes and blue gneiss stone for concrete and masonry work. Permanent way materials, structural steelwork, signalling apparatus, and cement were imported from Britain. The labour available and the ability to provide them with basic amenities, and keeping them in good health, in mostly isolated and uninhabited districts, were considerations that governed the progress of work. Put this in perspective of the fact that the Main Line from Colombo to Kandy, a distance of 74 miles with a climb of 1,400 feet over a section of 13 miles, was constructed in just over five years in the mid 19th Century - and one can fathom the herculean effort dispensed!

In Britain, a steam powered

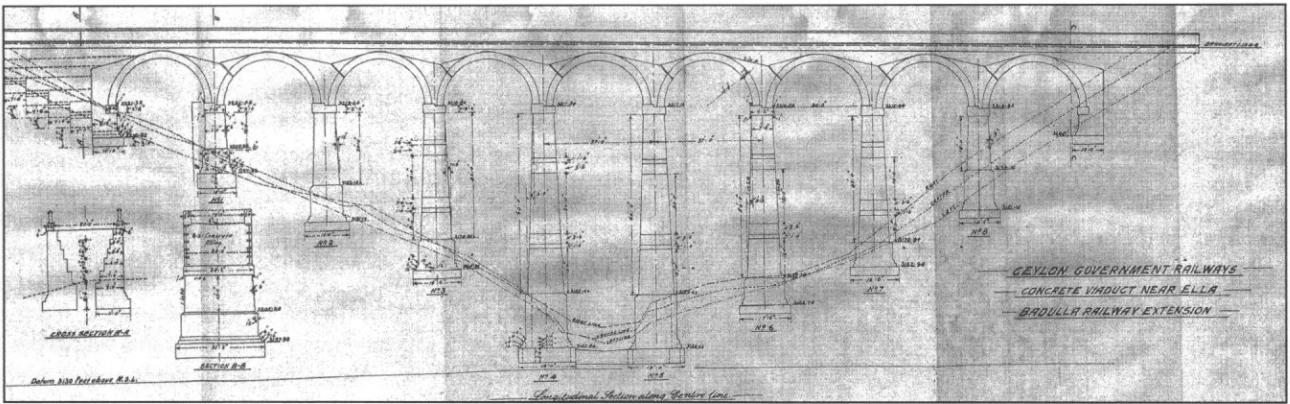


Latest Class S12 Diesel Multiple Unit with an Sifang diesel-electric locomotive each at the front and the rear, electronically synchronised passes over the Nine Arch Viaduct. The viaduct has withstood rail traffic for nearly one hundred years, including the heavyweight of the steam-era, the Beyer Garratt, without settlement.

excavator called the 'Steam Navy' was used for excavating heavy earth work, but it was not proven to be economical in Ceylon, where manual labour, aided by light rails and tip trollies for running off the materials to

Excepting the effort started in 1858, and abandoned in 1862 to construct the line along a route that was found to be too treacherous to be economical. The alternative trace called the 'Dekanda Route' posed more manageable nevertheless extremely challenging construction conditions and therefore became the permanent way.





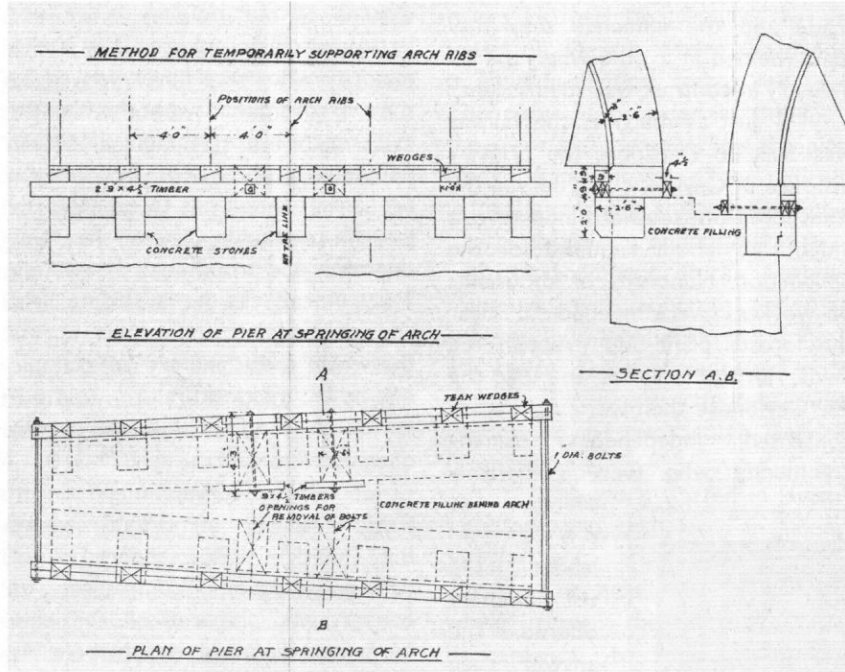
the banks, was satisfactory. An ideal section would be one on which the cuts equal the fills, thus avoiding waste of material in earthwork.

The cost of reinforced bridges was generally cheaper than steel bridges due to the fact that it requires no built-up steel work and when properly done needs no expenditure on maintenance. However, unlike in Britain, the shortage, and cost of

Rush" as it was called in the 1840s resulted in over 250,000 acres of pristine primary forest in central Ceylon surrounding Kandy felled for coffee plantations. But soon after the line was opened to Kandy in 1867 came the lightening coffee blight<sup>2</sup> devastating the plantations and making the planters destitute. Undeterred, and stirred by James Taylor who started the first tea plantation in

tea drinkers from scratch, and making Ceylon the leading exporter of tea, as well as making Ceylon Tea the premium of all teas. As the plantations spread out, so did the extension of the Main Line beyond Kandy to reach Badulla in the Eastern slopes in 1924, in stages.

In 1890, Thomas Lipton, a Scotsman of Irish origin, wealthy by then, visited Ceylon and seeing the potential of tea, started business with James Taylor. He by then had an empire of 300 stores in Britain and became the first to package tea in small, convenient tins to keep it fresh, preserve the flavour and guarantee that customers received the correct amount of tea. He started bypassing traditional trading in order to make tea universally accessible with guaranteed quality at acceptable prices. So that he could provide teas directly from the tea estate to the teapot, he bought tea estates in Ceylon and in doing so established the Lipton tea brand, still the world's leading tea brand. Ceylon Tea then owes its phenomenal success to both Taylor and Lipton.



satisfactory supervision in Ceylon, and the difficulty of getting well-seasoned timber, economically and in sufficient quantity, for shuttering, explains the prevalence of steel bridges in our railway network.

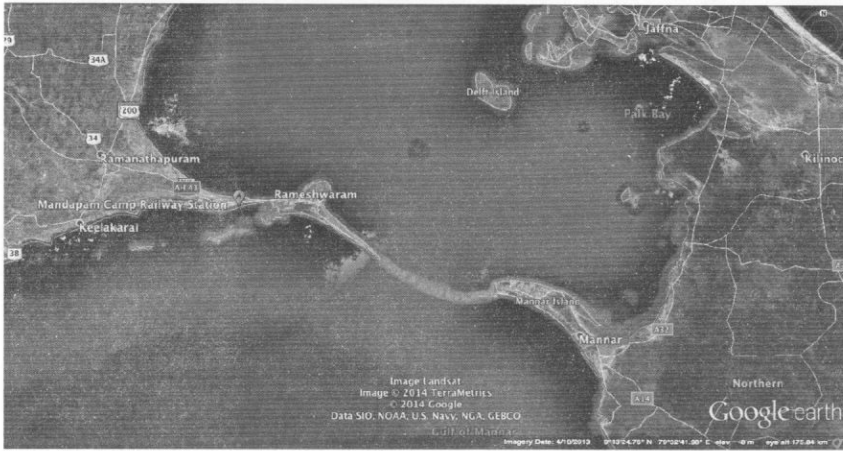
The 1850s were the golden era of coffee in Ceylon. The great influence yielded by the planters who made their fortunes with coffee and the taxation revenue coffee provided to the coffers would have been the incentive to complete the Main Line to Kandy in record time. The "Coffee

Loolecondera estate in Kandy in the same year the line reached Kandy, the remaining brave took to tea<sup>3</sup>. Over the next three decades tea plantations dramatically increased to reach 400,000 acres under cultivation, in the process converting the whole of the population of Ceylon to prolific

2 Hemileia vastatrix fungus  
 3 Sir Arthur Conan Doyle, the creator of Sherlock Holmes remarked, "Not often is it that men have the heart, when their one great industry is ruined, to rear up in a few years another as rich to take its place: and the tea fields of Ceylon are as true a monument to courage as is the lion of Waterloo."

It is interesting to speculate on the financial value of the tea industry then. Unlike today, where the tea fields are mainly composed of high yielding VP<sup>4</sup> tea, the fields then were composed of more robust but less productive seedlings. Assuming an average yield of 1,800 lbs. of green leaf per acre per annum from seedling tea, the annual green leaf harvest would have been around 720 million lbs. This would have led to the production of about 160 million lbs. of black tea per annum. Ceylon Tea fetched a record price of £36.15 per lb. at the London Tea Auctions of 1893.

4 Vegetative Propagation, an early form of cloning where plants are propagated from cuttings from a mother bush.



In today's purchasing power value this amounts to a staggering £3,500 per lb. equivalent. Even if we assume that the average auction price was one-tenth the record price, then the market value of the tea industry would have been around £580 million per annum. In today's purchasing power equivalent this amounts to an incomprehensible market value of £56 billion per annum. It takes only this little math to figure out what value the possession of Ceylon with its tea would have been to the British.

The production of tea may be in the hands of Sri Lankans today but ironically though we make only £0.5 billion per annum, or one hundredth the equivalent value of the industry in 1893, from the export of thrice the amount of Ceylon Tea compared to then, while employing a million people. Notwithstanding that tea is today produced by many more countries other than India and Ceylon as was the case then, for example Kenya,

come home, from Mincing Lane<sup>1</sup> to Colombo.

The tea industry then was akin to the oil industry of today. Just like the oil giants like Exxon, Shell, etc. of today who control the entire chain of the industry, tea industry giants then like Lipton owned the whole value chain from the plantations, to processing, to retail. One can imagine the fortunes that would have been made and the influence they may have wielded at a time when the oil industry in contrast was still nascent.

Just as much as the railway was built to transport the primary produce of Ceylon, it also served the transport from southern India of vast indentured labour required for the production. Hundreds of thousands of workers were needed to clear the forests, plant and maintain the fields, run the factories, and load the tea. Ceylonese then were a generally contented, independent, farming community who were completely



Vietnam, Indonesia, etc., one cannot deny the fact that we as a producer earn so little because the value addition is almost entirely outside. Not that different to what it was 150 years ago although the auctions have

averse to physical labour the tea industry offered. The answer then lay in South India with its impoverished population, for who travel to Ceylon and a proper meal was perhaps the promise needed. The mass exodus of South Indian labour to Ceylon prompted by the British and their agents began. From all across South India, they travelled

<sup>1</sup> The street in London, which was the centre of the global tea trade.

in the Indian Railway to two camps established by the British. Mandapam Camp, near Rameswaram, in the tip of the Indian peninsula, was the main camp. It was literally a vast screening ground to select the able-bodied and their families, and to reject the sick and infirm<sup>2</sup>. From there they were taken by ferry over a distance of thirty miles, to Mannar, in the north western tip of Ceylon, and thereafter by foot at the beginning and rail later, to the hill country of Ceylon. What dreams and aspirations these people would have had, what sparkle their children may have had in their eyes, very little records if at all any, remain. One can wonder in awe at the vast, perfectly contoured, and stone terraced tea fields of Ceylon, and the railroads, which were carved out of the mountain slopes, with their labour, and solemnly appreciate the immense sacrifices made by these labourers. Their descendants today are proud citizens of our country while not jettisoning their culture. They are a minority who were never swayed by the extremism that swept the country in its recent history and engulfed their northern brethren. For this, we the Sri Lankan nation has to be eternally grateful to the Up Country Tamils as they aptly and proudly call themselves. They indeed can be a shining light and guidance to minorities across the world today, and are an example of how multiculturalism without extremism can flourish to the benefit of an entire nation.

The Railway Engineer in Ceylon, unlike in Britain where the work was tendered out to construction companies or consortiums, prepared all the data for a new line and was responsible for its economical construction and successful completion. Therefore the Engineers were experienced and well qualified in both the theory and practice of structural work and the cheapest method of carrying it out. The survival of the railway network

<sup>2</sup> A twist of fate decreed that the same camp be used for human traffic in the opposite direction, over a century later. At the height of the recent ethnic conflict in Sri Lanka, which involved the nation combatting a terrible insurgency by a segment of the northern Tamils agitating for a separate state, many northern Tamils seeking refuge left Sri Lanka by boat from Mannar and arrived in Mandapam.



for 150 years with hardly any structural deterioration bears testimony to the competence and devotion of the Engineers of that era.

Although it was true that the Engineer of the railway must make the best of the capital supplied to him for the work, yet his recommendations largely controlled the efforts to secure capital. The Engineers then were entrusted with the task to recommend how much capital may be profitably spent to secure the greatest rate of net return on the capital invested, and therefore to a great extent took ownership for the success of a railway venture. Today the situation is less straightforward with multiple decision makers representing different interests.

The section of the Main Line from Nawalapitiya to Badulla with its stunning views is a masterpiece of surveying and construction. The "Summit Point" at Pattipola being 6,226 ft. above mean sea level, is the highest point reached by a broad gauge main line in the world, and the construction of the Nine Arch Viaduct at Ella and the Demodera Spiral are crowning achievements of its engineering ingenuity. The 1:44 gradient is the ruling gradient for 88 of the 95 miles between Nawalapitiya and Badulla and curves of the minimum 5-chain radius follow one another.

The Main Line reached Bandarawela in 1894. Its extension from there starts at an elevation of 4,100 feet above sea level and descends through mountainous country for a distance of 20 miles and ends up in Badulla at an elevation of 2,000 feet. Six tunnels of 300 ft. or so in length as well as numerous viaducts, bridges, and culverts had to be constructed.

The Nine Arch Viaduct is the largest of such viaducts and is situated 1 mi. distant from Ella, in Gotuwela. At the time it was constructed, it was the longest such viaduct in Asia. The railway is on a nine-degree curve (6.37 chains or 140 yards radius) at the site and the gradient is the maximum 1 in 44. The sharp curve and the nature of the foundation made it desirable to adopt nine spans of 30 feet; and semi-circular arches of 15 feet radius left the least room for failure. The greatest height from rail level to bed of stream is 100 ft. 6 inches and the length of the

viaduct is 400 ft.

The considerations which governed the design of the structure were threefold, namely, the curve, the gradient and the foundation. The need for exact working drawings was emphasised, as without them and constant checking of dimensions and levels at the site, the necessary accuracy could not have been obtained to provide the correct spans at the top of the piers for the arches to be turned.

The foundation material consists of cabook and foundations extend well into the slopes of the ravine and spread the weight as far as possible. The maximum live weight on the foundation is 3.3 tons per square foot. The arches are made with concrete blocks of three different sizes. Each arch was formed of two rings of these. The arches are semi-circular so that the tendency for the piers or pillars to overturn during construction is less. However, for viaducts that are lower in height where headroom is limited, elliptical arches are used. The curve is provided in the piers, the spans being parallel and the piers wedge shape. In view of the difficulty in finding seasoned and suitable timber for the shuttering, concrete was faced with sand cement blocks. Spandrel filling was with concrete, and mass concrete and face work was done in 2 ft. layers. The only plant used in the construction was a concrete mixer, one crane, and two Scotch Derricks (simple crane).

The work started in January 1917 and was completed in January 1919.

The next major engineering work along the section from Bandarawela to Badulla is the Demodera Spiral or Helix, a few miles past the Nine Arch Viaduct. Demodera means the meeting point of two rivers, the Badulu Oya and the Gowrawela Oya. Here the engineers ran into a major problem. The line had to be taken across a yawning valley through which the Gowrawela Oya flowed to the ridge beyond while maintaining the prevailing gradient of 1 in 44.

The solution was to take the track beyond the Demodera station round the hill descending all the way at the prevailing gradient and take it through a tunnel under the station to

the other side across a bridge thrown over the Gowrawela valley to the ridge beyond. It is considered the only spiral in the world with a railway station situated exactly over a tunnel along the spiral. Therefore the tunnel had to be designed so that it could take the weight of a loaded train halted at the station.

From the Demodera station the descending track circumscribed the hill for a distance of 990 yards and by the time it reached the tunnel it had descended 100 feet. It then proceeded through a 220 feet long tunnel under the station, got across the Gowrawela Oya valley over an iron bridge, reached the ridge on the other side and wended its way down to Hali-Ela and Badulla.

The Demodera Spiral was undoubtedly a masterpiece of engineering ingenuity. When Governor Sir William Manning travelled on the first train to Badulla in 1924 he expressed his admiration in no uncertain terms for this ingenious piece of engineering.

**The design and supervising engineer for the Bandarawela to Badulla extension of the railway was Mr. Harold Cuthbert Marwood, M.Inst.C.E., Executive Engineer of the Railway Construction Department, C.G.R., instructed by Mr. M. Cole Bowen, B.A.I., M.Inst.C.E., Chief Construction Engineer, Railway Extensions. The Nine Arch Bridge, and the Demodera Spiral have withstood the wear and tear of railway traffic without settlement for nearly one hundred years. They stand as lasting testaments to the expertise, skill, and excellence of these two great British-Ceylonese railway engineers of the era, and their workmen for whom toil and sacrifice came naturally because of the pride they had in what they did.**

*"Excellence is an art won by training and habitation. We do not act rightly because we have virtue or excellence, but rather we have those because we have acted rightly. We are what we repeatedly do. Excellence, then is not an act but a habit." - Aristotle*

(Valuable facts presented in two papers by Mr Marwood, published in the Transactions for 1923 of the Engineering Association of Ceylon, article titled Looping, the loop at Demodera by Mr Walter Rupesinghe published in The Island newspaper, and information gathered from other published sources, used in extracted form in the preparation of this paper, are gratefully acknowledged by the author.)