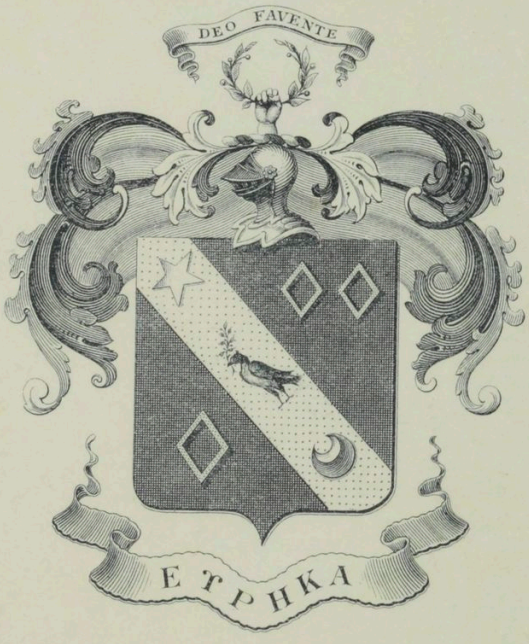

David Scott Mitchell.

Fifty Years of Railway Making

A Historical Essay on the New South Wales Railways from their inception . . .

Prize Essay

By George A. Gilder

("Felicitas")

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1905.

The New South Wales Railway Jubilee Celebrations 1855—1905.

IN connection with the Exhibition of Railway Appliances, organised by the Council of the Railway Institute, and held in Sydney on the 26th, 27th and 28th September, 1905, this Essay, written in open competition for a prize of Twenty Guineas, was adjudged the best, and is now printed to mark the event, and as a . . .

RECORD OF THE INCEPTION, GROWTH AND PROGRESS OF THE RAILWAYS OF THIS STATE

PRESENT REDFERN RAILWAY STATION.

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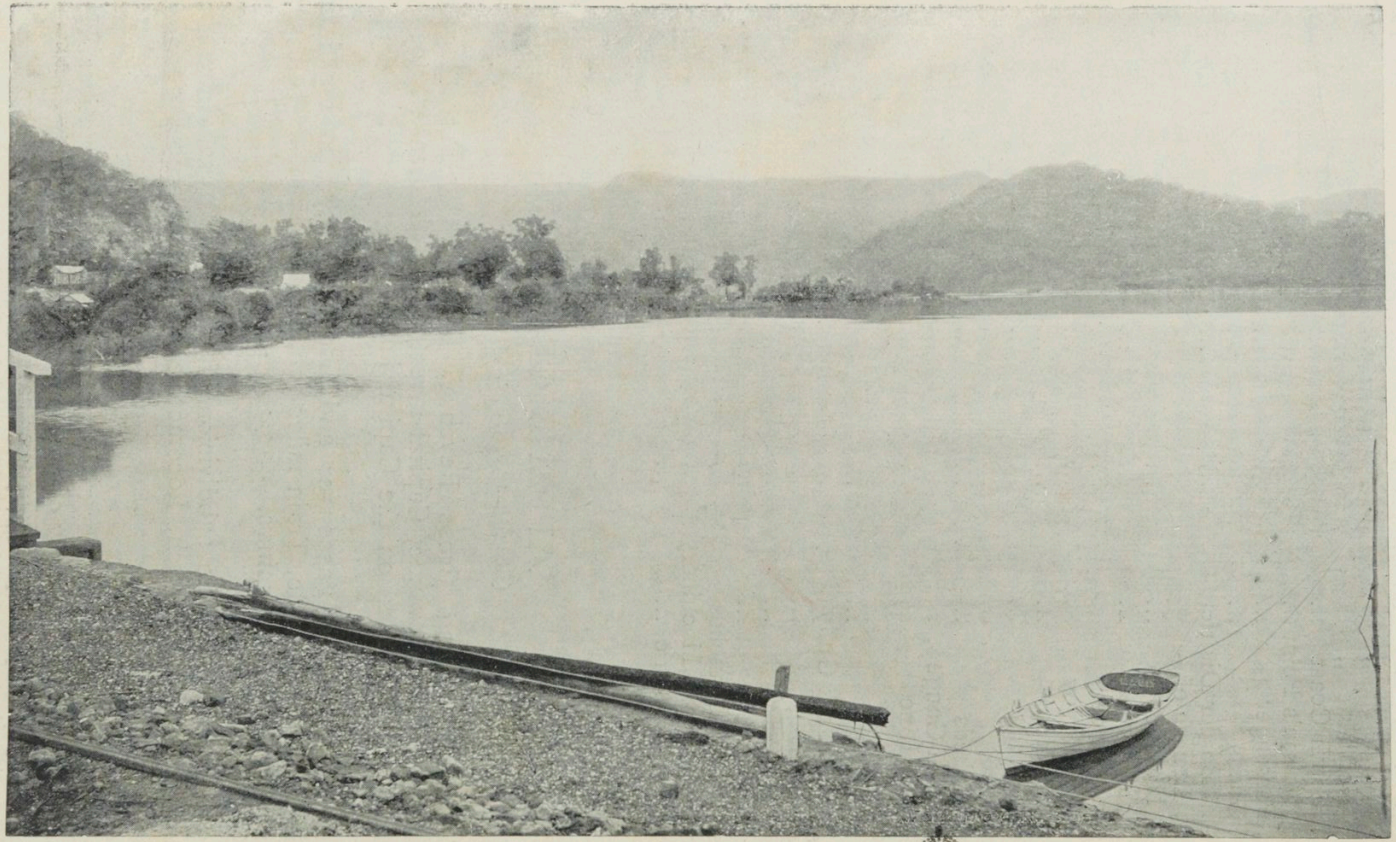

NEPEAN RIVER AT PENRITH.

Fifty Years of Railway Making.

ORIGIN AND LAUNCH OF THE SYSTEM.

The history of the New South Wales railways affords a remarkable example of how great results may follow small beginnings. From the primitive iron shed, with its two pairs of rails, to the massive stone and brick structure with its eleven platforms, each 660 feet long, now approaching completion, is indeed a long step. From the hollow iron "Barlow" rail to the solid 100 lb. "T" headed steel rail; from the simple four-wheel carriage to the luxurious corridor vestibule car; from the 50 to the 100-ton locomotive; from the oil lamp to the electric light; from the importation of railway tickets to the local construction of huge locomotives, are all instances of remarkable transition when viewed in conjunction with the fact that a period of but 50 years has sufficed to bridge the gaps.

To those of us who have no personal knowledge or recollection of the occurrences of 50 or 60 years ago it is pleasant to pass awhile into the realm of imagination, and wonder, say, amongst other things, whether the group of people gathered together in the City of Sydney on the 29th January, 1846, "for the purpose of considering the expediency and practicability of establishing railways in this Colony," had in their mind's eye any such wonderful development as the intervening years have brought forth! Or, to take a step forward, had the people assembled on the Cleveland paddocks on the 3rd July, 1850, to witness the turning of the first turf, a passing thought that the next 55 years would see the site of the "Paddocks" transmogrified almost out of recognition, and the adjoining "God's Acre"—denuded of its dead—covered by a colossal structure, a railway station second to none in the World? Or, later still, did it flash through the minds of the spectators who, on the 26th September, 1855, stood around the unsightly batch of sheds and on the wooden platform at Redfern Station witnessing admiringly the departure of the first train outwards to Parramatta, that in half a century scores of trains would arrive and depart daily, with magnificent and costly engines, over 100 tons in weight, drawing carriages of 20 to 40 tons, and 46 to 70 feet long, some of them of the most elegant appearance and luxurious finish? Such changes, and many others equally astonishing, have the 50 years produced.

But when it is stated that the Provisional Committee chosen at the meeting of the 29th January, 1846, embraced such men as Chas. Cowper, William Pitman, Daniel Cooper, Robert Lowe, Thos. Rankin, John Lamb, George Macleay, Thos. Holt, William Lithgow, T. S. Mort, and others, it would be a matter of surprise if the venture undertaken had failed to effect its purpose. These public-spirited and enterprising pioneers wrought amidst a field of difficulties and opposition at times apparently insurmountable. Railways were regarded askance by the populace,—in fact, savored of the unearthly. By dint of indomitable pluck and perseverance on the part of the promoters, and a judicious succor by the Government, the hostile and other obstructions were eventually removed,

and the foundation laid of what must for all time be a monument to the memory of those worthy citizens.

The Provisional Committee reported in August of the same year. A tender for the survey of a line from Goulburn to Sydney was accepted forthwith (the money for the purpose being raised partly by private subscription and partly by Government aid), and on the 27th July, 1848, the completion of the survey was announced. The report then presented by the Committee was favourable, a petition was presented to Parliament, and a Select Committee appointed. Mr. Charles Cowper fathered the movement, with the result that Parliament cordially supported it, and eventually approved of grants of land along the proposed line, a guarantee of 6 per cent. per annum on the first £100,000 subscribed, and the investment of £30,000 Government money in the concern. This must have been encouraging to a degree.

Matters were not allowed to flag, for in September following the Gas Company's Office was the scene of a meeting to appoint a Provisional Committee to make arrangements for establishing the Company, and in November, 1848, the prospectus of the "Sydney Tramroad and Railway Co." was published, capital £100,000.

A year elapses, and we find that on the 13th November, 1849, the shareholders of the Company elected the following directors:—Messrs. Chas. Cowper (President and Manager), C. Kemp, C. Nicholson, John Lamb, W. Bradley, and Daniel Cooper, junr.

Under the Company's Act of Incorporation, a sum of £10,000 was required to be paid into the Treasury before the actual work of constructing the line could be commenced. This condition was duly complied with, and so far was successfully completed the first practical effort at railway making in Australia.

The 3rd July, 1850, was chosen for the initial ceremony. Business was entirely suspended, the day being observed as a general public holiday. The elements, however, proved unpropitious, rain falling almost without cessation. On an open space called the "Cleveland Paddocks," bordering the Western edge of the plateau of Surry Hills, a gay and representative gathering of 10,000 persons, garbed in the fashion peculiar to the period, was assembled. The turf was turned by the Hon. Mrs. Keith Stewart (daughter of the Governor) and wheeled away by Sir (then Mr.) Charles Cowper. The spade used on the occasion was of satinwood, and suitably inscribed, while the barrow was of polished cedar. The function took place in the presence of His Excellency the Governor, Sir Charles Augustus Fitz Roy, amid a scene of joyousness, rendered brilliant by the appearance of naval and military officers in full uniform, Oddfellows and Foresters in bright regalia, and a Band and Guard of Honor from Her Majesty's 11th Regiment. The occasion was intensified in importance by the attendance of all the notable citizens of Sydney. A banquet was subsequently held in an adjoining tent, and the turning of the turf fittingly celebrated.

From this time until 1855 the career of the Company was a chequered one. In changes of the Directorate we note such names as T. W. Smart and Thomas Barker. Owing to delay of the Home Government in giving certain decisions affecting the project, matters became so bad that reductions in salaries and resignations in consequence thereof ensued.

The first tender for the construction of a line "4½ miles from Haslem's Creek towards Sydney" (known as the Concord contract) was accepted on the 12th March, 1851, Mr. Wallis being the contractor, at

£10,000. During the currency of the work, however, gold was discovered in the Bathurst district, and this practically sealed the fate of the contractor and the company also. Wages rose to ridiculous heights, and labor became almost unobtainable. Mr. Wallis failed—although the Directors had granted him a 30 per cent. increase on his price—and this opened the way for letting another contract—that "between the Cleveland Paddocks and the village of Ashfield"—to Mr. Randle. Such an effect, however, had the gold rush upon labor that it became necessary, in 1853, for the Government to import 500 railway laborers from England. Upon their arrival the construction of the whole line, Sydney to Parramatta, was placed conditionally in the hands of Mr. Randle.

In the same year the Directors made an advance to the Government to take an interest in the concern, which the Government did by investing £150,000, and taking over portion of the control. In 1854 we find the management consisting of a Board partly elected by the shareholders and partly nominated by the Government. Shortly afterwards it was decided to increase the capital by £100,000, and further Government aid was sought and granted. This though was only the final struggle of the Company, for, owing to the continued fever of disturbance in the labor market, the estimated cost of construction kept on increasing. As a matter of fact, the Sydney to Parramatta line, estimated in 1853 to cost £218,420, was estimated in 1855 at £431,000. It was thus made evident that the Company could not profitably continue, and terms were come to with the Government to take over the assets and liabilities.

Contemporaneously with, and undeterred by the struggles of the metropolitan Company, the residents of the Newcastle district had formed a Corporation called "The Hunter River Railway Co." In this the name of W. C. Wentworth figures prominently. After an existence of a little more than a year this body, like its prototype, the Sydney Railway Co., had to yield to the pressure of the times and be swallowed up by the Government.

Under Act Vic. 18, No. 40, the railways were taken over by the Government and vested in three Commissioners; the capital value of the systems being Sydney £520,872 and Hunter River £307,054; total, £827,926.

We now arrive at the important period marking the commencement of actual railway working, a period most conspicuous in the history of New South Wales, as being that in which responsible Government was established. The line from Sydney to Parramatta — 14 miles—was opened for traffic on the 26th September, 1855, almost 25 years to the day after the first railway in England (Manchester to Liverpool) was opened.

The day was a general holiday. The morning broke wet and gloomy. Never before had such a number of people assembled in New South Wales. Every elevated spot from which a view could be obtained was covered with human masses, and on the sloping ground in the immediate vicinity of the engine-shed thousands of anxious spectators were gathered together.

The official train consisted of two 1st class, four 2nd class, and five 3rd class four-wheel carriages, the total weight of the rolling stock, including the locomotive, being about 120 tons. The Governor-General, Sir William Denison, travelled in the first car, and a wild rush ensued for the remaining seats in the train, the passengers scrambling in through doors or windows. The fare to Parramatta was: 1st class 4s., 2nd class 3s., and 3rd class 2s. The train left Sydney at 11.20 a.m., and reached

Parramatta about 45 minutes later in a torrent of rain. The takings at Sydney were £265, and at Parramatta £220.

At a semi-private luncheon held in Williams' family hotel, Parramatta, the Governor-General laid stress on the necessity for extending the railways. He said: "The Colony must have a network of railroads by which every part of the country will be connected one with another." The "Sydney Morning Herald" of the next day, commenting on the opening, remarked: "The event of yesterday was a triumph not only of science over natural difficulties, but of the spirit of enlightenment and civilisation over prejudice and worldly mindedness." A token was struck to commemorate the event, and a public ball was held in honor of the occasion at the Prince of Wales Theatre on Tuesday, the 2nd October, following.

We have in our midst very few connected with the important event of the 26th September, 1855. Time and fate have dealt sparingly with some, but the large majority have long ago been called home. Those who are here to-day and can recall the initial incidents must indeed have ample food for satisfactory contemplation.

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ADMINISTRATION.

At the opening of the line in 1855 the management was vested in three Commissioners appointed by the Government, namely, Captain Ward (Chief), Mr. Barker, and Mr. Kemp. We find frequent changes between then and 1861. In the very first year Captain Ward resigned as Chief, and Captain Mann filled the vacancy. In 1856 Mr. Kemp resigned, and was succeeded by Captain Hawkins. The followng year Mr. Barker and Captain Hawkins both resigned, and Mr. Hay (Secretary for Lands and Works), and Mr. Donaldson (Colonial Treasurer) were gazetted as Commissioners. A few months afterwards Captain Martindale, from England, superseded Captain Mann as Chief Commissioner, and Captain Ward was re-appointed as a Commissioner, Mr. Hay and Mr. Donaldson resigning their seats. On the 1st December, 1858, an Act was passed vesting the control in one Commissioner, and Captain Martindale was appointed, with the title of Commissioner for Internal Communication. This gentleman held office until January, 1861, when he resigned, and Mr. John Rae (Secretary for Railways) was appointed in his stead.

The year 1878 saw Mr. Rae succeeded by Mr. Chas. Goodchap. Up to 1888 the administration of the railways continued under the Minister for Works, the direct management being undertaken by the respective Commissioners. It was, however, recognised that politics entered unduly into the management of this large public asset, and as a consequence the Railways Act of 1888 (introduced by Sir Henry Parkes) was passed. This transferred the control to three independent Commissioners, the Department nominally coming under the Treasurer. Mr. E. M. G. Eddy was thereupon brought out from England as Chief Commissioner, and the other positions were filled by the appointment of Mr. W. M. Fehon, from Victoria, and Mr. Chas. Oliver, Under Secretary of the Lands Department of New South Wales. These gentlemen took office on the 22nd October, 1888. In 1897 Mr. Eddy died, and shortly afterwards Mr. Oliver was apointed Chief Commissioner, Mr. David

Kirkcaldie (Chief Traffic Manager of the New South Wales Railways) being selected to fill the vacant post on the Board. The administration is in the hands of these gentlemen at the present time.

It is not within the province of this review to criticise any administration, but, without in any way derogating any other regime, it must be at once conceded that the radical changes which have brought our railway system to its present satisfactory condition, almost without exception, date from 1888.

It may not be deemed unfitting here to pay a tribute to the memory of the late Mr. Eddy, the first Chief Commissioner under the present Railway Act. He was a man of striking personality, sterling ability, and great force of character; a strict disciplinarian, possessed of a mind powerful to recognise opportunities and a will strong enough to put them to use; a foresight keen to discern the approach of trouble and a faculty for coping with it in its infancy. He had a marvellous tact for dealing with the waywardness of men, yet withal a just and gentle disposition. Through his instrumentality the dignity of the staff and the prestige of the Department was considerably raised. His sudden demise while in the prime of his manhood and after but nine years' control of the railways here, was a lamentable event, and left the State a loser by one great man.

With regard to the subordinate administration, the first Engineer-in-Chief for Railways was Mr. Wallace, who held office until February, 1856, when he resigned. Mr. John Whitton was appointed in January, 1857, and retained the post until 1889, when he was retired with 12 months' leave of absence. Thereafter the Engineer-in-Chief for Railway Construction remained under the control of the Minister for Works, the Railway Department passing to the Treasurer. In 1876, however, Mr. W. Mason was appointed Engineer for Existing Lines of railway, and he occupied that position until 1880, to be succeeded in 1881 by Mr. G. R. Cowdery. This regime continued until the appointment of Mr. J. Angus in 1890. Mr. W. T. Foxlee, who was brought out from England, was in charge from 1892 to 1895, when he resigned, and was succeeded by Mr. T. R. Firth. Upon the decease of that gentleman in 1903 Mr. J. Fraser, the present occupant, was appointed.

In 1877 Mr. R. H. Burnett was appointed Locomotive Engineer, and he continued in office until 1881. Mr. W. Scott took up the duties in 1882, and held the position until 1887, when Mr. G. Downe assumed control for a short time. In 1888 the title passed to Mr. T. Midelton, who in 1889 was succeeded by Mr. W. Thow. Mr. Thow is to-day the head of the Locomotive Branch as Chief Mechanical Engineer, the title having been altered in 1891.

The first Traffic Manager of the New South Wales Railways was Mr. Terry. He was succeeded in 1857 by Mr. C. J. Nealds, formerly Secretary for Railways. This order continued until 1862, when Mr. E. Owen became Acting Traffic Manager, and the appointment was confirmed a year later. At the expiration of six years (1869) Mr. R. Moody was appointed and held the position until 1873, when Mr. Donald Vernon assumed office. The year 1878 saw Mr. Thos. Carlisle in possession of the chair, and two years later the branch passed to the control of Mr. W. V. Read, and so remained until 1889, when Mr. D. Kirkcaldie became Chief Traffic Manager. In 1897 the last-named gentleman was appointed to the Board of Commissioners, and Mr. John Harper filled the vacant post. There has been no further change to the present time.

DEVELOPMENT OF THE SYSTEM.

Before even a rail was laid, and for a few years after, the battle of the gauges was fiercely fought. The 4ft. 8½in. standard was the one originally recommended in 1851, but upon representations made by the then Engineer-in-Chief (Mr. Shields), 5ft. 3in. was fixed as the gauge by Parliament. A change in the occupant of the Office of Engineer-in-Chief, however, resulted in this being eventually altered, and a further enactment provided for the 4ft. 8½in. gauge. Even then the matter did not rest, for efforts were made to have this decision superseded and the authority to lay 5ft. 3in. tracks restored; but they failed, and the 4ft. 8½in. gauge became definitely the standard for New South Wales. Even so late as 1857, after the construction of the first section of line, the Engineer-in-Chief, Mr. Whitton, pointed out the inconvenience that would result from a break of gauge in the event of inter-communication being established with the neighbouring Colonies, who were adopting the 5ft. 3in. standard, and he (Mr. Whitton) made another attempt to have this the standard for New South Wales, but was unsuccessful. As the line was then only constructed to Liverpool, the alteration might have been effected at a comparatively trifling cost.

Ever and anon we find this subject referred to in the annual reports of the department and other publications, but never once has the matter been within even tangible distance of adjustment. Each mile of line laid in any of the States has rendered the ultimate unification of the gauge more costly.

The Commissioners of 1888, shortly after taking office, drew serious notice to the matter, and in 1897 a Conference of the Premiers of New South Wales, Victoria, and South Australia was held to consider the question. They passed a resolution to the effect that the Railway Commissioners of the three Colonies should meet and report on certain specific points. This was done, the salient features of the report being—

1. To adopt the 5ft. 3in. gauge in New South Wales would cost approximately £4,260,000.
2. The adoption of the 4ft. 8½in. gauge in Victoria and South Australia would cost £2,360,000.
3. The Latter course was deemed the more preferable in the event of action being taken.

No Government action was taken. The subject was again under discussion by the Conference of Railway Commissioners of the various States held last year, and, while it was considered to be a matter for regret that an uniform gauge did not exist, it was not deemed desirable under existing conditions to incur any expenditure towards effecting that end.

The sections opened on the 26th September, 1855, consisted of Sydney to Parramatta—14¼ miles—and Redfern to Darling Harbour—1½ mile.

During the first 10 years the Western line was carried as far as Penrith (with a branch from Blacktown to Richmond) the Southern to Picton, and the Northern from Newcastle to Singleton, with a branch from East Maitland to Morpeth. The length of track opened for traffic at the close of the decade was 143 miles. The stations, which in 1855 numbered seven only, had by the end of 1865 increased to 33.

In 1861, a tram-line (classed with the railways) was laid for about two miles from Redfern Station along Pitt-street, Sydney, horse power being utilised. This was worked under a system of lease to Messrs. Woods (late of Manly) and Adair. A peculiar feature of the construction was the longitudinal laying of the sleepers and the projection of the rails for about two or three inches above the road level. The line was very short-lived, being taken up in 1867 as the result of public opposition.

The second period, 1865 to 1875, saw the huge engineering difficulties of the Blue Mountains overcome, and the line extended to Kelso on the West and Gunning on the South, while the Northern system was carried to Murrurundi, making the aggregate track mileage 437, or 234 miles for the 10 years. These extensions necessitated additional stations to the number of 31, bringing the total up to 64.

The enormous additional length of 1295 miles was laid between 1875 and 1885, raising the total to 1,732, the various extensions being—to the River Murray at Albury on the south (with branches Campbelltown to Camden, Junee to Hay, Narandera to Jerilderie, Goulburn to Bungendore, and Murrumburrah to Young), to Bourke on the west (with branches from Wallerawang to Mudgee, and Orange to Molong), and to Glen Innes on the north (with branches Werris Creek to Narrabri and Newcastle to Bullock Island). In this period, too, the first section of the Illawarra line—Sydney to Sutherland—was opened. The number of stations and platforms throughout the system in 1885 was 350, an increase of 286.

The fourth decade—1885 to 1895—saw another large addition to the mileage, the Southern system being increased by branches from Young to Blayney (thus joining the main Southern to Western lines), Cootamundra to Gundagai, Bungendore to Cooma, Culcairn to Corowa, Cootamundra to Temora, and a line of tramway from Yass Junction to the township. In the Western system the branch line was continued from Molong to Forbes, and a new one opened from Nyngan to Cobar. On the Northern section the line was carried from Strathfield to the Hawkesbury River, Gosford to Waratah (connecting with the line from Newcastle), and from Glen Innes to the Queensland border at Wallangarra. During the same period the North Shore line was laid from Milson's Point to Hornsby. The South Coast line was considerably advanced, further sections being opened from Sutherland to Nowra (an offshoot running from Loftus Junction to the National Park), and a branch from Sydenham to Belmore. A new and isolated system was commenced during this decade in the extreme North-East of the State, namely, that from Lismore to Murwillumbah on the Tweed River. In all, the length opened for traffic during the period under review was 799 miles, the total then standing at 2,531. The stations and platforms at the close of the year 1895 numbered 537, an addition of 251.

The last 10 years have been responsible for the augmentation of a further 750 miles, the details being nearly all branch line constructions or extensions of existing branch lines, namely, Jerilderie to Finley, Koorawatha to Grenfell, The Rock to Lockhart, Goulburn to Crookwell, Culcairn to Germanton, Temora to Wyalong, and Gundagai to Tumut on the South; Parkes to Condobolin, Nevertire to Warren, Byrock to Brewarrina, Cobar to the Peak, and Dubbo to Coonamble on the West; Narrabri to Inverell, Tamworth to Manilla, and Narrabri West to Burren on the North. The Lismore line was also extended to Casino and two

private lines purchased, namely, Broken Hill to Tarrawingee and Clyde to Carlingford.

The total mileage of the New South Wales Railways at present stands at 3,281, made up of 8½ miles quadruple, 193 miles double, and 3,079 miles of single track. The quadruple line extends from Sydney to Homebush, the double from Sydney to Picton, Mount Victoria, Waterfall, Hornsby and Belmore; also from Newcastle to West Maitland, Milson's Point to Hornsby, and a few other short sections. The balance of the system consists of one line of way only.

The number of stations and platforms throughout the railways of the State at the present time is approximately 732.

Three more extensions are shortly to be taken in hand, namely, Burren to Merrywinebone, Manilla to Barraba, and Temora to Barellan.

The capital cost of the 14 miles, Sydney to Parramatta, is set down at £131,408 per mile, the Darling Harbor branch at £509,915 per mile, and the Bullock Island branch at £251,195 per mile. The average cost of the whole system (excluding rolling stock, machinery, &c.) is £10,873 per mile, while the later period pioneer type of construction averages £3,479 per mile for 956 miles.

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TOPOGRAPHY AND PHYSICAL GEOGRAPHY.

Up to the time when Sydney and Newcastle were connected by rail the system practically consisted of two divisions radiating from these two centres respectively; but with the establishment of the North Coast line, Sydney became the one great railway centre.

The main suburban line acts as the highway for the Southern, Western and Northern systems, its junction with the two former being at Granville—13 miles—and with the latter at Strathfield—7 miles. The South Coast line leaves the main track at Eveleigh 1½ miles from the metropolis.

The Great Southern line proceeds from Granville by a series of gentle rises to Campbelltown, running almost parallel with the main Southern Road, and touching George's River at Liverpool. At Menangle the Nepean River is crossed by means of a wrought iron girder bridge with timber approaches altogether 1909 feet long, built at a cost of £95,000. After a consistent ascent, Picton is reached, 59 miles from Sydney, and 1134 feet above sea level. The picturesque viaduct at this point is of five spans in masonry, the total length being 276 feet. It cost £10,437. Passing through the Picton tunnel—198 yards long—a heavy rise in the next 16 miles takes the line to Hill Top, which is the highest point touched on the Great Dividing Range by the Southern Railway. Moss Vale is reached via the Mittagong Range by a tunnel 572 yards long, and a little further on—at Exeter—the altitude is 2331 feet. From this point undulating country is passed through with Towrang, and thence over the Mulwarree by a fine iron bridge, entering Goulburn, the City of the South, 136 miles from Sydney and 2074 feet above sea level. Leaving Goulburn, the track crosses the Breadalbane Plains, taking a

more Westerly course, and ascends the Cullerin Range, attaining its greatest height—2395 feet—at Cullerin. From this point round the range and on through Gunning to Yass, 192 miles, the course is by a broken descent to the 1626 feet level. Making a slight detour north-westerly the descent is continued from Yass through Cootamundra, thence over the Bethungra Range and on to Junee, 988 feet, across the Murrumbidgee and river flats at Wagga by a long steel viaduct (originally wood) and iron bridge, eventually entering Albury, 392 miles from Sydney, at an altitude of but 534 feet above sea level. At Albury the River Murray is spanned by a handsome wrought iron lattice girder bridge connecting Victoria with New South Wales, and over which both the New South Wales and Victorian lines pass. It consists of two clear spans of 150 feet each. The cost was borne in equal shares by New South Wales and Victoria, our moiety being £14,485. The line terminates at Wodonga on the Victorian side of the Murray. The junction of the systems of the two Colonies was made the occasion of an important gathering and ceremonial in the town of Albury on the 14th June, 1883. A commemorative banquet was held, at which Lord Augustus Loftus, Governor of New South Wales, the Marquis of Normanby, Governor of Victoria, and many notable personages from the Colonies were present. At this time only a wooden bridge carried the rails across the Murray, the present iron structure not being in position until October, 1884.

The country traversed by the Great Southern line is mainly used for agricultural, pastoral, and dairying purposes. The scenery along the route is of a quiet but varied description, some pretty glimpses of landscape being obtainable when ascending the range at Hill Top, again at Exeter, then between Razorback and Galong, and as the train follows or crosses the rivers mentioned.

The Southern system, which is the most important, serving as it does the most thickly populated districts of the State, has several offshoots. Two lines branch from the main track at Goulburn, one travelling South to Cooma and the other North to Crookwell. The former has a rising gradient for 30 miles, attaining a height of 2366 feet, and, after passing Bungendore on the shores of the famous Lake George, it falls at Queanbeyan—196 miles—to 1901 feet. By a succession of rising grades it reaches Cooma at an altitude of 2662 feet, the distance from the metropolis being 266 miles. The line maintains a South-West and Southerly course throughout. Travellers to Snowy River, Mount Kosciusko (the roof of Australia) and the Yarangobilly Caves, mostly book their passages through Cooma. The scenery along the line, until approaching Umeralla, where it is very fine, does not call for special remark, but the district is looked upon as a health-giving one of some note, and is famous for its trout fishing, &c. This line brings the rich pastoral district of the Monaro into touch with Sydney, and, should Bombala be selected as the Federal Capital, access will be *via* Cooma.

The Northern branch to Crookwell is only a short line of 36 miles, but rises in the first 25 miles from an elevation of 2074 feet at Goulburn to 3225 feet at Roslyn, thence falling slightly to 2910 feet at Crookwell. The country passed through is both a pastoral and dairying one.

At Demondrille, near Harden, 234 miles from Sydney, a branch line takes off to Blayney, passing *en route* through Young and Cowra and crossing the Lachlan at the latter place by a fine iron bridge. This

branch establishes direct communication between the main Southern and Western systems, and taps Lyndhurst, one of the proposed Federal capital sites. It serves a rich agricultural and pastoral district. The altitude at Harden is 1634 feet, Cowra 978 feet, and Blayney 2844 feet. Running from Koorawatha on this branch is a short line of 32 miles, which has its terminus at Grenfell, the centre of a rich grain growing area.

At Cootamundra two fresh sections take off the main line, North and South respectively, the former going via Temora to Wyalong, and the latter across the Murrumbidgee at Gundagai to Tumut. They are both comparatively level lines, and serve an agricultural country, and one which has in its prime yielded large quantities of gold. On the way to Tumut some of the landscape views are decidedly fine.

At Junee—292 miles from Sydney—the main South-Western line runs away to Hay. Its branch from Narandera crosses the Murrumbidgee by an iron bridge, then proceeds to Finley *via* Jerilderie. The Hay line taps the famous Riverina district, the whole of the country traversed being essentially agricultural. There is a falling grade from Junee to Hay, the heights being 988 and 307 feet respectively, while on the Narandera-Finley section the fall is from 576 to 362 feet.

The remaining branches of the Southern line (all serving agricultural districts) are The Rock to Lockhart, 24 miles, Culcairn to Corowa, 48 miles, and Culcairn to Germanton, 17 miles.

From the main line at Campbelltown a tramway classed with the railways runs off to Camden, the centre of a health resort of great repute and also a famous dairying district. Its length is 8 miles, and it embraces the steepest grade on the New South Wales lines—approaching Kenny's Hill—on the down trip 1 in 20, and on the up 1 in 19.

The Western line, after passing Parramatta, runs uneventfully to Penrith, 34 miles. At this point the Nepean River is spanned by a fine wrought iron girder bridge (road and rail) 612 feet long, which, together with the timber viaduct, cost about £95,000. The viaduct has lately been rebuilt in steel, and the bridge itself, which is only for one line of way, is now being replaced by a double road structure. Shortly after crossing the river, the ascent of the Blue Mountains commences. The small Zig-Zag has been cut out, and the Glenbrook tunnel route substituted. Early in the ascent the Knapsack Gully viaduct is passed over. This is an imposing structure of masonry 388 feet long of 5 spans, which cost £22,724. The Glenbrook tunnel (nearly half a mile long) is then negotiated and, pursuing a tortuous path, the line reaches Blackheath—38 miles from Penrith—by a constantly rising grade, the altitude being 3495 feet. En route the highly popular tourist resorts of the Blue Mountains are passed. The charm of these mountains lies in the rugged majesty of their configuration, precipitous bluffs rising sheer from the valleys hundreds of feet below—unrivalled, perhaps, in the world in this respect. Numberless waterfalls of varying volume course down the gorges, which in their turn are luxuriant in vegetation of every description. Added to this is the invigorating atmosphere for which these highlands are so famed. The mountains are justly admitted the sanatorium of New South Wales. The panoramic view from Glenbrook is in striking contrast with that of the mountains just described. The Emu Plains, lying stretched out like a green carpet at our feet, and backed by the old town of Penrith, through which the steel rails run

shimmering in the sunlight; while in the foreground the Nepean River steals placidly away to hide itself in the hills. From Blackheath a rising gradient takes us to Clarence, where an altitude of 3658 feet is attained—the highest on the line. Leaving Clarence and passing through the long tunnel (539 yards) we come to the Great Zig-Zag, and no history of the New South Railways would be complete without special reference to this marvellous engineering feat, and the formidable difficulties encountered and overcome in its accomplishment. As bearing on this it may not be inappropriate to refer here to a period anterior to the subject of this work.

For many years the Blue Mountains had been regarded as impassable. As early as 1796 George Bass made an attempt to cross the mountain range, but returned unsuccessful, reporting that it was impossible to find a passage even for a person on foot. On the 11th of May, 1813, an expedition, formed of Gregory Blaxland, Lieutenant Lawson, and William Charles Wentworth (aged 22), with 4 surveyors, 4 horses, and 5 dogs, started from South Creek, near Penrith, taking 6 weeks' provisions, and having for their purpose the exploration of the ranges. After meeting with astonishing difficulties, they succeeded, sometimes by creeping through dense forests, at others by scaling tremendous precipices, in opening a way to the vast plain lying West of the great cordillera of Australia. In November following, Governor Macquarie despatched surveyors under Mr. G. W. Evans to follow up the tracks of Wentworth and the others, and in 21 days they had passed beyond the ranges and on to the Western Plains. Convicts were set to work making the road across the mountains, and this was complete by April, 1815.

For very many years after this it was the general belief that no locomotive railway could traverse the rugged ridges of the Dividing Range. When Sir William Denison was Governor-General, the subject of railways or horse tramways over the Mountains was discussed, the Engineer-in-Chief (Mr. Whitton) being positive that the former were practicable. The Governor-General replied that careful surveys had been made by a company of sappers and miners belonging to the Royal Engineers under the direction of Captain Hawkins, R.E., and a line of the kind suggested by Mr. Whitton was proved to be thoroughly impracticable. The people of Bathurst—we are told—offered a premium of £1,000 to anyone who would carry a working railway carriage to their town. Mainly owing to the tenacity with which Mr. Whitton adhered to his faith, the railway line was eventually constructed over the mountains and into the City of the Plains, but it is not recorded whether he received the £1000.

On two occasions during the construction of the Zig-Zag quite a notable gathering assembled to witness the blasting of huge masses of rock, estimated to contain 40,000 and 45,000 tons respectively. The second of these shots was fired by the Countess of Belmore in the presence of a large and representative gathering.

The descent at the site of the Zig-Zag is made by three graceful parallel sweeps on the side of a deep and rocky ravine, where formerly there was scarce footing for the mountain goat, and where the surveyors' assistants had occasionally to be suspended by ropes in the performance of their perilous duties. On the first and second sections massive masonry viaducts add to the general attractiveness of the scene.

For some years the cutting out of this Zig-Zag and the substitution of a tunnel involving lighter gradients has been under consideration. While this would undoubtedly be an improvement from a traffic point of view,

it would certainly be prejudicial from the tourist's standpoint, to whom the sight is the most interesting in our whole railway system.

From Clarence to Esk Bank there is a drop of 630 feet in a distance of 6 miles. From Esk Bank to Bathurst the grade is rising and falling, but with a lowering tendency. Some very heavy cuttings occur in the vicinity of Tarana, one being especially deep—90 feet. The line, after skirting the Fish River, eventually reaches the Macquarie, which it crosses by means of an iron girder bridge 480 feet long, and enters the Western City at an altitude of 2155 feet, the distance from Sydney being 145 miles.

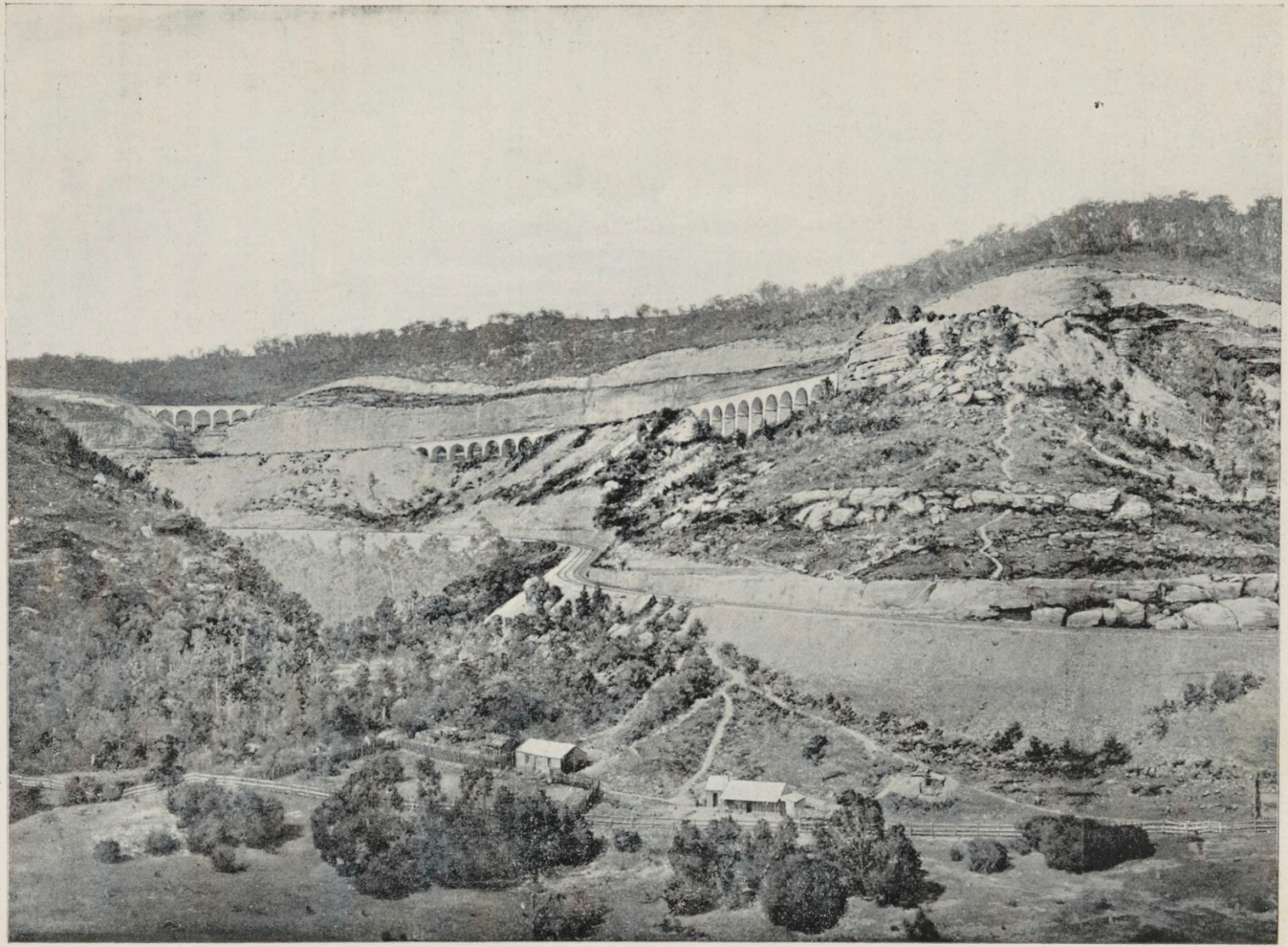
Proceeding to Orange the line regains its ascendancy by a series of gradients, which bring the elevation up to 2846 feet. From this point through Dubbo, across the Bogan at Nyngan, and on to Bourke, there is a continuous fall, Dubbo being 867 feet, and Bourke only 350 feet, above sea level. The terminus is 508 miles from Sydney. The topography of the line, excepting as already mentioned, is not striking. Given good seasons and sufficient rain, the soil has a wonderful grain-producing faculty. The great bulk of the country, however, is under the sway of the pastoralist. This system connects the metropolis with the Western mineral district on the mountains, and at Hartley, Lithgow, and Esk Bank, and also with the rich agricultural lands around Bathurst, Orange and Wellington. Beyond this it enters the pastoral country.

The Western line—like the Southern—has several offshoots; the first running from Blacktown to Richmond, a distance of 17 miles, and serving as a means of access to the glorious Kurrajong Mountains and Grose Valley. The section is richly agricultural, especially along the flats of the Hawkesbury River. At Wallerawang, 104 miles, the line takes off to Mudgee, the respective altitudes being 2929 and 1536 feet. The Mudgee branch is one particularly affected in time of heavy rain, being peculiarly subject to washaways on account of the nature of the soil. The business of the district is agriculture and mining, shale and cement being obtained in payable quantities.

A branch from Orange to Condobolin, on the Lachlan, makes a great descent, the former place standing at 2846 feet and the latter at 653; the distance between being 139 miles. This line passes through Molong and Parkes, and serves a district abounding in all kind of minerals as well as being very remunerative in good seasons for pastoral and agricultural pursuits. A short line of 20 miles runs from Parkes to the town of Forbes, 783 feet above the sea. One of the latest sections opened on the West is that from Dubbo to Coonamble, 95 miles. There is a slight rise to Gilgandra, and then a fall of nearly 400 feet to the terminus, where the altitude is 589 feet. The line follows the Castlereagh River for a considerable distance, and the interests served are purely pastoral.

A 12-mile branch runs from Nevertire to Warren, the district being a mineral one; and, for a community similarly interested, a branch runs from Nyngan to Cobar, the output of the latter place being principally copper. This line is 82 miles long. The general form of the country is level. The most Westerly branch is from Byrock to Brewarrina, 58 miles, on a rising and falling grade, there being nothing worthy of special note in the general aspect of the country traversed.

The Great Northern line leaves the main track at Strathfield, thence crossing the Parramatta River at Ryde, proceeds via Hornsby to



THE GREAT ZIG-ZAG, WESTERN LINE.

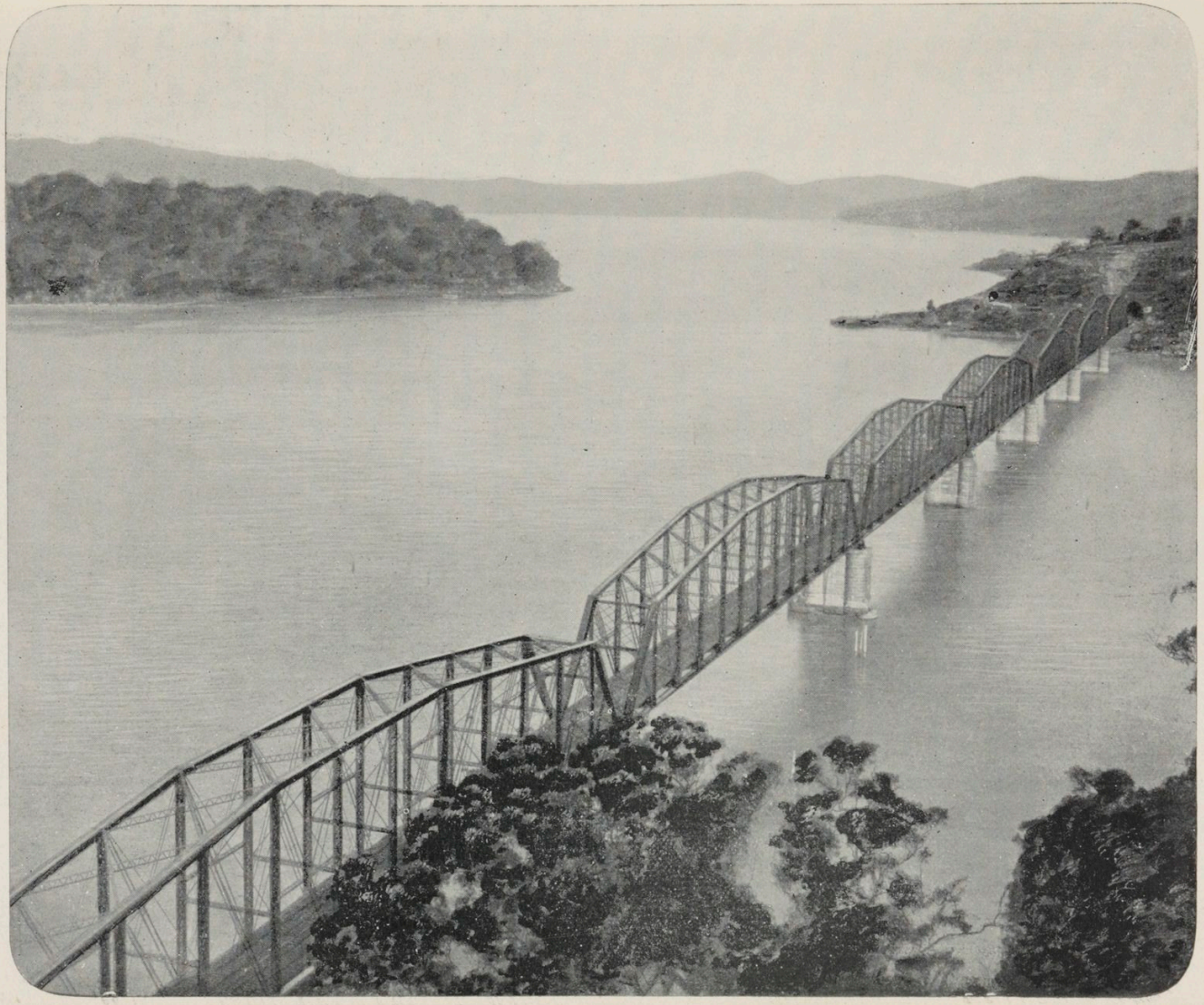
the heights of the Kuring-Gai Chase, attaining an altitude of 702 feet in a distance of 25 miles. A swift descent occurs to the Hawkesbury River station, almost at sea level, the distance being but 11 miles. It was this steep hill that the fugitive train swept down at the time of the Peat's Ferry accident mentioned elsewhere.

The bridge over the Hawkesbury is a feature in our railway construction calling for special remark. It is the largest structure of its kind in the Southern hemisphere, the river at the point of crossing being close upon 3,000 feet wide. The bridge is of the American lattice type, with pin fastenings, and has seven spans of 415 feet each. In its erection, sinking to a depth of 170 feet from high water level had to be resorted to in some parts in order to obtain good bottom for foundations. Add to this the headway of 40 feet and some idea of the magnitude of the construction may be formed. Eleven tenders were submitted (to manufacturers' own designs), the prices ranging from £296,350 to £702,384. In May, 1885, the second lowest tender—that of the Union Bridge Company of New York—was accepted at £327,000, and to this was added £13,000 for alterations in the design made here. The completion of the contract was due in 2½ years. The material for the bridge was all obtained from English manufacturers.

The opening ceremony, which was one of great importance, was performed by Lord Carrington on the 1st May, 1889. The Hawkesbury Bridge formed the last link in a continuous chain of railways traversing four Colonies and extending from Oodnadatta in South Australia to Cunnamulla in Queensland, a distance of 3,100 miles.

From the River to Gosford the journey is almost on sea level, skirting Mullet Creek and piercing the hill at Woy Woy by a tunnel over a mile long, then along the reaches of Brisbane water, which is the north arm of Broken Bay—the estuary of the Hawkesbury. Brisbane water is really a series of lakes, the surrounding scenery being characteristically Australian, and in point of natural beauty rivalling even Sydney Harbor. There is very little variation in the gradient all the way to Newcastle. The great coal metropolis of the North (which ranks next to Sydney in point of commercial importance) is 104 miles from Sydney. Near West Maitland a private line runs to Greta. This place is the coming coal-mining district of the North, and already many collieries have been opened. From 8,000 to 10,000 tons of coal are sent daily to Newcastle. The mineral is of splendid quality, and regarded as superior to the best Newcastle coal.

Many bright dashes of scenery meet the eye as the train runs along the Valley of the Hunter and crosses that river at Singleton, and again at Aberdeen. The bridge at the former place is of ashlar masonry with wooden superstructure; its length is 523 feet, and cost slightly over £50,000. The Aberdeen bridge is of the iron girder lattice type on cast iron cylinders; this was erected at a cost of £25,000, and is 486 feet long. The country at Muswellbrook is still comparatively low, the altitude being 477 feet. From here the rise to the Liverpool Range takes place, the height at Murrurundi being 1548 feet. The tunnel through the Liverpool Range at Ardglen is 528 yards long. The grade falls to 1279 feet at Tamworth, whence the ascent to the New England Range commences, and at mile-post 401, the highest point—Ben Lomond—is reached, altitude 4473 feet. From there to Wallangarra on the Queensland border, 492 miles from Sydney, a heavy drop occurs by varying grades to 2875 feet.



HAWKESBURY

RIVER

BRIDGE.

The highlands of the New England district, Armidale, Tenterfield, Glen Innes, &c., are, like the Western Mountains, considered a health-giving resort, and consequently are much patronised by people in need of change of air.

The most important interest of the Northern line, of course, lies in the almost boundless resources of the Newcastle and adjacent coal-fields. Between the Hawkesbury and Muswellbrook the timber industry affords employment for the inhabitants. Further North, agricultural, pastoral and dairying pursuits are followed with varying degrees of success, and in addition the Armidale district is a gold-producing one of considerable importance.

The North-West line leaves the main Northern line at Werris Creek, crosses the Namoi, and runs through Narrabri to Moree, a distance of 158 miles, then takes an easterly turn back towards the main line in the direction of Glen Innes, terminating at Inverell (after crossing the Gwydir at Gravesend), a further distance of 98 miles. The line falls to 686 feet towards Moree, but rises again on the Inverell section, attaining a height of 2210 feet at Mt. Russell, descending to 1912 feet at Inverell. The country passed through is pastoral and mineral, being specially rich in tin. A second line starts from Narrabri West, and, after passing Wee Waa, crosses the Namoi and runs west to Burren Junction—50 miles—on a fairly level road, serving a country giving good pastoral and agricultural results in favorable seasons. This branch is eventually to extend to Walgett (West) and Collarendabri (North).

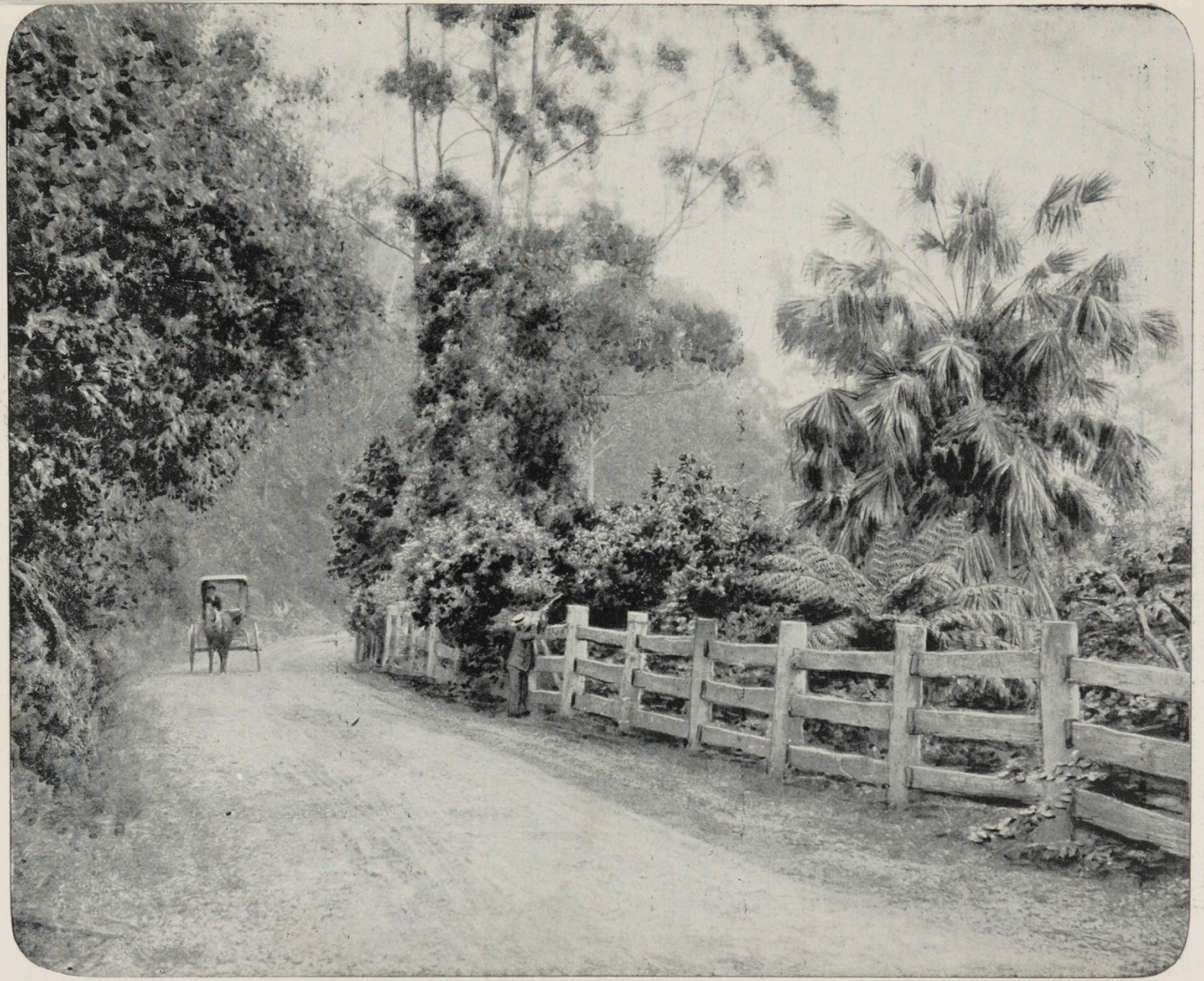
From Tamworth a line proceeds North-West to Manilla, the distance being 28 miles through undulating country. An isolated line runs from Casino through Lismore, thence to Murwillumbah—79 miles in all—with falling grades and an altitude ranging from 37 feet at Lismore to 304 feet at St. Helena. This district is noted for its sugar cane-fields and dairy products. It is possessed of scenic charms in the way of landscape views, which are reputed to be equal to the best in the State.

The short line from Milson's Point to Hornsby, rising 600 feet in 12 miles, is destined to become a great feature in the future of the railways. Serving as it does a health-giving and popular residential district, within easy access of the City, it only remains for the erection of a bridge over Sydney Harbor, and the railway connection by means thereof to make a second great metropolis of what is now North Sydney. With this *un fait accompli*, the present line, Strathfield to Hornsby, will be but a local section, all the Northern traffic beyond Hornsby and on to Brisbane going via Milson's Point, a saving of 9 miles in the journey.

Magnificent views of the City of Sydney and the harbor are obtainable from the train during the greater portion of the journey from Milson's Point to Hornsby.

The South Coast system from Sydney to Nowra, like that from Sydney to Newcastle, is renowned for the beauty spots which abound in close proximity to the line. As those spots are within reasonable access of the City, these lines are, more than any others, chosen by throngs of people as the places at which to spend the frequently-recurring holidays.

The whole length of 92 miles never attains a greater height than 733 feet, which is at Waterfall, and is reached by a continuous ascent after crossing George's River at Como. Thence onward the gradients are varying in degree.



BULLI PASS,

SOUTH

COAST.

The South Coast line renders easily accessible the great National Park of the State, a splendid tract of country having an area of 360,000 acres, a monument to the memory of Sir John Robertson, by whose instrumentality it was secured to the people. The other pleasure resorts adjacent to or served by the line are: Brighton-le-Sands, Sandringham, Sans Souci, Como, Port Hacking, Stanwell Park, Bulli, Wollongong, Illawarra Lake, Kiama and Nowra. The world-famed Bulli Pass is easily reached from the town after which it is named.

The Illawarra range commences at Scarborough, on the sea coast and gradually recedes inland, but never to such a distance as to be out of sight of the traveller. From Scarborough the line runs along the coast to Kiama (except where it skirts the Illawarra Lake), then trends slightly inland to Nowra, which stands on the Shoalhaven River.

The scenery as the train bursts out of the tunnel at Otford, an eminence immediately overlooking the Pacific Ocean, is sublimely grand. There are numerous other beautiful views along the line, ocean and river, mountain and meadow. Several tunnels occur between Waterfall and Bulli, and between Kiama and Gerringong, that at Otford being one of the longest in the State—nearly a mile.

The South Coast is perhaps the best and most prosperous dairying district in the State. The soil is of unusual richness, and the herbage very nourishing. The coal measures extend from Helensburgh to Kembla, and have a very extensive output. The Bombo quarry, on the coast near Kiama, is owned by the Commissioners, and supplies a large quantity of the blue metal used for ballast on the railways.

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FINANCE.

The financial portion of any business is the department which invariably receives the most care and scrutiny in its control. The working of our huge railway system is periodically focussed on to financial statements, so that a single glance shows the assets and liabilities, the revenue and expenditure.

No operation can be performed that is not represented by money either paid away or received.

The administrators have always at their fingers' ends figures of all descriptions bearing on the finances, whether capital invested, interest payable, revenue earned, or expenditure incurred. These are to the Commissioners what the sextant is to the mariner, without one or the other each party would be equally lost. There is no lack of figures on which to work for the purposes of this essay; rather otherwise there is a plethora; consequently only the most important items can be touched on, and they at lengthened intervals.

In September, 1855, the capital invested on lines open amounted to little more than half a million pounds. To the end of the year the gross revenue earned was £9,249. By arrangement with the contractor for the line—Mr. Randle—all the expenses of working the system were paid by that gentleman (with the exception of a few salaries of Station Masters), on condition that he received 55 per cent. of the gross tak-

ings. After payment of this proportion, and also of the other items mentioned, there was returned to the Treasury the sum of £3,290, representing interest at the rate of 0.63 for a little over three months. The percentage of expenditure to gross revenue was 64.63.

Ten years afterwards—in 1865—the revenue had risen gradually to £166,032, while the expenditure by the same process had reached £108,926, the balance representing 2.08 per cent. per annum on the money expended on lines open, namely, £2,786,094. The working expenses at this time absorbed 65.60 per cent. of the gross takings. In the interval between 1855 and 1865 the percentage of expenses to earnings rose as high as 81.58, but was never once below that of the initial result of 1855.

On the 31st December, 1875, the lines open for traffic had cost £7,245,379. The nett return had gradually risen to 4.40 per cent. per annum, while the percentage of expenditure to revenue decreased to 48.18—a result to be proud of, and the best ever attained with the exception of 1874, when it was as low as 48.03. The gross earnings for the last year of this decade were £614,648, and the working expenses £296,174.

From 1875 to 1885—the decade of leaps and bounds in the railways—the revenue had jumped in the latter year to £2,174,368, the expenditure to £1,458,153, and the capital expended on lines open to £21,831,276. In the year 1885, 67.06 per cent. of the earnings were eaten up in expenses, and the interest returned on the debt was 3.37 per cent. per annum.

At the close of 1895 (the financial year in the interim having been altered from December to June), the capital account stood at £36,611,366, revenue £2,878,204, and expenses £1,567,589. The percentage of expenses to earnings showed a reduction to 54.46, and the nett return on the outlay was 3.60 per cent. per annum.

The latest figures available are those for the year ending 30th June, 1904. This year, however, was—like the one immediately preceding it—a disastrous one for the railways owing to the severe drought which afflicted the whole State. The revenue earned was £3,436,413, of which £2,258,940 was spent in working the lines, the percentage of the latter to the former being 65.74. The nett return was equivalent to interest at the rate of 2.80 per cent. per annum on the money invested, £42,288,517.*

Appendix No. 1 shows the result of the foregoing years in tabulated form. A study of the figures reveals several interesting facts. In the comparison of the consecutive 10 yearly intervals, it is shown that the capital expended in 1865 represented an increase of 302 per cent. over that in 1856, while in 1904 the corresponding figure over 1895 was only 16 per cent. The expenditure increased by 400 per cent. in 1865 over 1856, by 7 per cent. in 1895 over 1885, and by 44 per cent. in 1904 over 1895. The revenue for the same comparisons showed increases 414 per cent., 32 per cent., and 19 per cent. respectively. The figures under all three headings illustrate the one fact, i.e., the gradual proportionate curtailment of money invested in the later periods and the consequent lessening (though not in exactly similar ratio), of revenue and expenditure. This result is most pronounced between 1885 and 1904.

* NOTE.—The figures for 1905 were published after the Essay was written. They have been added to the Appendices.

It is very satisfactory to note that while the increase in revenue of 1895 over 1885 was 32 per cent. the expenditure was only 7 per cent. higher.

The greatest outlay of capital in any one year occurred in 1884, when a sum of £3,275,124 was spent. The highest rate of interest ever returned was in 1881, when the nett earnings represented 5½ per cent. per annum on a capital expenditure of £13,301,597. The best result in the comparison of working expenses to earnings was in 1874, when the percentage of the former to the latter was but 48.03. In that year the interest on the capital invested was 4.07 per annum.

In considering the nett return per cent. per annum on the capital invested, it is necessary to bear in mind the effect of the opening of new lines and the direct loss sustained in working them for many years. Although the Commissioners always express their opinion on the expediency of constructing any proposed new line, they have no alternative but to accept it should Parliament decide that it is to be built, no matter whether their opinion is favorable to its construction or not. It will be recognised that the railways have been carried out by the State for the purpose of opening up country and providing means of transport, thereby developing the resources and offering inducement for settlement. It naturally follows that lines have been constructed in many instances, which as a mercantile venture would never have been considered. The prospect of these lines paying their working expenses and interest is a very remote one.

In 1885 the loss on four sections of lines (including an allowance of 4 per cent. interest on the capital outlay) was £159,048. In 1890 the working of 9 sections involved a loss of £219,383; in 1895 the figure stood at £374,200 for 19 sections, while in the last published report (1904) we find that on 36 sections of line there was a loss of £440,697.

This matter has been commented on in several of the Commissioners' reports, and suggestions have been made and renewed for the consideration of the Government, with a view of affording relief to the Railway Department. The Commissioners urge that it should be a *sine qua non* in connection with the making of lines of this character, that land-owners should join together and arrange for the necessary land free fom all question of compensation of any kind to be conveyed to the Government for the construction of the railway. In cases where the line passes through Crown lands, the Commissioners suggested that half the value of the land within 10 miles on either side of the new line should be credited to the railway capital account. These suggestions, however, have not been entertained, and the revenue from the self-supporting lines has still to bear the burden of the unprofitable ones.

With very few exceptions the revenue and expenditure have advanced year by year. Years of retrogression in earnings were 1859, 1892-3, 1893-4, 1895-6, and 1902-3. We find, however, in some of these years what gives a measure of satisfaction, namely a correlative decrease in the working expenses. This occurs in 1892-3, 1893-4, 1895-6, and 1902-3. It is further satisfactory to note that in 1894-5 and 1903-4, although the revenue exceeded that of respective preceding years, the expenditure was lower in the same regard.

A figure always eagerly watched for by railway financiers (and probably by all other business men) is the percentage of working expenses to

earnings. This in the case of railways, is a constantly fluctuating quantity. Our lowest result was as stated, 48.03 in 1874. In 1861 it was as high as 81.58. The average for the 50 years is approximately 62 per cent. But it does not follow that the high figure quoted was the result of inferior administration any more than that the low one was the outcome of perfect management. Adverse circumstances, such as drought and floods, have a very important bearing on the percentage of expenditure to earnings, and these are factors which no manager can foresee or prevent. Again it may, of course, happen that the figure in some instances has a fictitious value. Such a result would eventuate upon the postponement of works properly due to be executed in one year to a later period, or, on the other hand, by paying out of revenue for work rightly chargeable to capital account. The percentage of working expenses to earnings, however, is looked upon as indicating successful management, or otherwise provided it is not affected either by a starving policy or adverse circumstances.

Appendix No. 2 shows the traffic earnings subdivided into passenger and goods—the latter under the principal sub-headings: wool, live-stock, minerals, and general. The intersting features of this statement are dealt with under the chapter on traffic.

Appendix No. 3 shows the expenditure divided into—(1) Maintenance of ways and works; (2) locomotive power and repairs to rolling stock; (3) traffic expenses; and (4) general charges, the latter including all cost of administration, together with compensation, gratuities, &c., &c. The fluctuations shown in the expenditure of the various branches are peculiar, and not readily accounted for. At first sight it might seem that the causes which produce an increase in any one branch of the service would have a corresponding effect in the other; but such is not the case. For instance, in the recent drought of 1904, the locomotive branch had a very large proportion of the unprofitable expenditure to bear in the extra cost of water for engines, while the other branches would possibly be able to curtail their expenditure. Thus we see in the year named the Locomotive Branch had an increase of 69 per cent. over 1895, as against a traffic increase of 36 per cent., and permanent way 30 per cent. Or, again, where one branch may have very heavy expenditure in a certain year (brought about by unusual circumstances), similar necessities would probably occur to other branches in a different year.

In the adverse years of the bank failures it is noticeable that while the Permanent Way expenditure decreased by 8 per cent. for 1895 compared with 1885, the Locomotive Branch increased 24 per cent., and the Traffic Branch 7 per cent. It is very evident from this statement that the costs of the branches do not increase or decrease in relative proportion as the traffic earnings rise or fall.

It is satisfactory to note under the heading "General Charges" in this appendix that, while the figures rose at a greater rate than those of any of the branches up to 1885 (which year was 600 per cent. over 1875), from then they show a remarkable decline until in the year 1904 we find a decrease of 17 per cent. on the 1895 result. Of course, the whole of this reduction canot be attributed to actual savings in expenditure; it is largely due to different methods of scheduling the accounts and the classification of expenditure under headings to which it more rightly belongs. But, on the whole, it may be safely assumed that a large economy has been effected under this head.

TRAFFIC.

In the year 1855 there were six mixed trains daily between Sydney and Parramata on week days and three on Sundays. The running was confined to the day time, the following being the time-table:—Week-days: Leave Sydney, 6, 8, and 10 a.m., 12 noon, 3 and 5.15 p.m. Leave Parramatta 7, 9, 11 a.m., 2, 4, and 6.15 p.m. Sundays: Leave Sydney 9 a.m., 2 and 4 p.m. Leave Parramatta 10 a.m., 3 and 5 p.m. The fares for the single journey were:—

	First.	Second	Third.
	s. d. ..	s. d. ..	s. d.
Sydney to Newtown, 2 miles	1 0 ..	0 9 ..	0 6
Sydney to Ashfield, 5 miles	2 0 ..	1 3 ..	1 0
Sydney to Burwood, 7 miles	2 6 ..	1 9 ..	1 3
Sydney to Homebush, 8 miles	3 0 ..	2 3 ..	1 6
Sydney to Parramatta, 14 miles	4 0 ..	3 0 ..	2 0

The third class was abolished in July, 1863. Omnibuses were engaged by the railway authorities to carry intending passengers free from various points between the City and Redfern Stations and similarly to Parramatta. A first-class return trip to Parramatta in those days must have been regarded somewhat in the light of a luxury to be enjoyed by the rich only. To-day the return fare 1st class is 2s. 2d. The time of journey in 1855 was 52 minutes, with four intermediate stops; to-day the trip occupies from 29 minutes with two stops to 60 minutes with 19.

In 1860 one passenger train was added and two goods trains. The Sunday service was decreased by one passenger train. Four years later the week-day traffic was increased by three passenger trains, and from this time onward the time-table was altered as necessity arose, until in 1885 there were about 60 daily passenger trains leaving Redfern for the Western suburbs and 16 for Illawarra. At the present time the main Suburban and Hornsby service necessitates the running of about 80 trains outwards daily, the Illawarra suburbs 60, and the Milson's Point line 26.

From 1855 to 1864 the fares fluctuated between the rates already mentioned and 3d. per mile 1st class and $1\frac{3}{4}$d. per mile second, at which figures they settled in the latter year. Daily return tickets were, however, issued, and excursion tickets on three days a week. A system of season tickets was also introduced in this period.

In the year 1871 we find the passenger rates thus specified:—

1st Class.—Suburban lines, 2 1-7d. per mile.
Heavy gradient lines, $3\frac{1}{2}$d. per mile.
2nd Class.—Suburban lines, 1 2-7d. per mile.
Heavy gradient lines, 3d. per mile
1st Class.—Level lines, 3d. per mile.
2nd Class.—Level lines, 2d. per mile.

Fares for passengers beyond Goulburn, Bathurst and Murrurundi were reduced in 1876 from $3\frac{3}{4}$d. 1st class to 3d., and from 3d. to 2d. second. For distances over 200 miles they were reduced 50 per cent. The suburban fare area was extended on the South and West to Cabramatta and Seven Hills respectively.

In 1878 the issue of return tickets at reduced rates for long distances was abolished, but certain reductions were made by way of compensation. The issue of return tickets was, however, reverted to in 1886.

There is little alteration to record specifically with regard to passenger fares from this onward. In other directions, however, the travelling public has been considerably studied. For instance: By the lowering of season ticket rates, extension of mileage and hours for which workmen's weekly tickets are available; extension of metropolitan suburban area fares; reductions in rate for persons travelling in parties; and the institution of special excursion trains to the country periodically. In this last respect the tariff is, generally speaking, less than single ordinary fare for the return journey.

The ordinary return fare ruling at the present time on suburban trips varies from 1.6d. to 2.5d. first class, and from ¾d. to 2d. second class, according to distance. Beyond the suburban area the fares go as high as 3.6d. first class and 2.4d. second.

The great boon which the railways have conferred on the travelling public may be realised in one regard at least when it is mentioned that in 1869 the first class fare from Picton to Goulburn (81 miles) was £1 1s. 11d., and the time occupied in travelling 3¾ hours; whereas the stage coach fare was £2 10s. and the journey by road (75 miles) took 13½ hours to complete under the most favorable circumstances. With further reference to this illustration it should be mentioned that railway passengers wishing to make the return journey within a week might do so by paying half the forward fare, thus making fare and a half for the double trip. No such concession applied to the more primitive means of locomotion.

The direct monetary saving, the incomparably superior accommodation, and the lesser time occupied, however, were not the only advantages attached to the new mode of transit. The stage coach was not an "*Amicus certus in re incerta*" by any means, passengers being frequently called upon to walk up hills and through bogs. The following from the pen of Mr. Justice Therry is worthy of a place here.

After describing an exciting ordeal he had to undergo in the coaching days when, on his way to the Bathurst circuit and at a lonely spot on the mountains, he was bailed up by armed bushrangers and robbed of everything worth taking, he adds another circuit incident, not bushrangers this time, but the execrable state of the roads:—

> "We (referring to himself and the Sheriff) were obliged to descend from our carriage and walk—or, rather, crawl—over two miles along a four-rail fence in a bent posture, placing our feet on the second rail from the ground . . . . while we ran the risk of being involved in a charge of manslaughter by directing our coachman, at the imminent peril of his life, to follow with the carriage, as he and the horses were plunged in the water sometimes almost out of view altogether."

On another occasion he recounts where, after arriving at the foot of Mount Victoria hill, on the way to Sydney, the horses refused to continue. Fortunately a team passed, and the driver, *for a consideration*, unhitched his 12 bullocks, which, together with the four horses, took the carriage up the hill!

Another extract, which is calculated to provoke a smile nowadays, is from the records of 1866-1871. A strong feeling was evinced in favour of the discontinuance of night trains on long runs. As an argument it was mentioned that the adoption of the day train would conduce to the safety and comfort of the passengers, as well as acting economically for the department, and, as a further reason, the following was quoted as the last of the rules given by Dr. Lardner in his work on "Railway Economy" for avoiding accidents:—

> "When you can choose your time, travel by day rather than by night; and if not urgently pressed, do not travel in foggy weather, as accidents from collision and from encountering impediments accidentally placed on the road happen more frequently at night and in foggy weather, than by day and in clear weather."

The railway report for the period adds: "If such precaution is necessary on the comparatively level lines of English railways, how much more so is it required on the sharp curves and steep gradients of our Western line."

The carriage of goods was a serious matter in the days before the iron horse, the cost and time of transportation being enormous. In 1857 the teams took 17½ days to make the trip from Sydney to Goulburn, and the freight was £12 5s. per ton. Improvements in the road reduced these figures in 1864 to 7½ days and £3 15s. per ton respectively. By rail, in 1871, the average freight for all classes of goods was £2 8s. 7d. per ton, and the time occupied for the same journey 14 hours. There have been subsequent reductions which bring the average freight to £1 18s., and the approximate time of journey to between 10 and 11 hours.

It is impossible here to do anything more than make a very general reference to the goods tariff. The matter is one of such complexity, that to deal with it exhaustively would occupy much more space than is allowed for the whole of this essay, which is limited to about 20,000 words.

The goods rate list is undoubtedly the *bete noir* of the railway manager's existence. Time out of number has it been revised, altered, and extended with a view to benefiting both patrons of the railway and the department itself; but in spite of all the care that is taken in this regard, anomalies caused by changing circumstances continue to creep in and render further revision necessary. Probably it is safe to say that there never has been, and never will be, a rate list issued which did, or will, satisfy everybody.

In October, 1855, the only record of goods charges is at the rate of sixpence per ton per mile for dead weight, and slightly more for measurement. In November of the same year the first alteration was made, and from then to 1860 the list underwent several changes. The goods clerk of to-day would imagine himself in his seventh heaven if he could only step back for a week or so to the rate list of 1860, which is fully expressed in the following words:—

> "Threepence per ton per mile on materials and goods, unless of a dangerous character."

This uniform rate was abolished in 1861, and a division into two classes made, namely, 4½d. and 3d .per ton. In 1863 a third class was added at 6d. per ton. From December, 1858, to December, 1871, no fewer than 17 rate-lists for general merchandise were issued, varying from one class to eight. There were also in this period 11 issues of livestock rates, 14 of wool, 11 of parcels, and 11 of coal. In 1871 the list contained eight classes of traffic rated on a mileage basis.

After this date we find many pages of the annual reports devoted to the subject. The details, even if reproduced here, would not be interesting, but as a matter of history it should be recorded that the general tendency has been to reduce freights from time to time. The latest list was issued in May of last year, and, like its predecessors, contains concessions and reductions for the benefit of the railway customers.

The following list of reductions will serve as a general illustration. They represent changes in the period, 1888-1898, and the figures are worked on a sliding scale, according to the distance the goods are carried—50 to 600 miles.

	Per Ton.	
	Minimum Reduction.	Maximum Reduction.
Dairy Produce	50 per cent.	52 per cent.
Agricultural produce	11 per cent.	50 per cent.
Hay	16 per cent.	42 per cent.
Agricultural implements & machinery	50 per cent.	50 per cent.
Crude ores	½ per cent.	50 per cent.
Coke	45 per cent.	53 per cent.
	Per Truck.	
Livestock	5 per cent.	22 per cent.

and the following average earnings per ton per mile for all classes of goods traffic will show the general lowering tendency of freights: —

1872	3.6 pence
1875	3.1 pence
1880	2.3 pence
1885	1.9 pence
1890	1.9 pence
1895	1.6 pence
1904	1.03 pence

The main operations of the Traffic Branch can best be shown by means of a tabulated form, which is attached as Appendix No. 2. As the year 1855 embraced only three months of working, 1856 is taken as a starting point for this table.*

An examination of the statement will prove very interesting. The population of the State does not show any spasmodic fluctuation, but rather a consistently falling rate of increase. Comparing the intervals dealt with we find that this increase was highest in 1885 as compared with 1875, namely, 60 per cent., and lowest in 1904 over 1895—16 per cent.

The varying number of passengers carried is not consistent with the changes in the population, the year 1885, as an example, showing the enormous increase over 1875 of 948 per cent. Neither the mileage open for traffic nor the train miles run bear comparison with this marked advance, the figures being but 266 per cent. and 351 per cent. respectively.

Standing out prominently in the statement of passenger traffic is the increase in the number of first class passengers carried in 1885 over 1875—2,043 per cent.—as compared with the corresponding figure for second class—739 per cent. In the next interval treated—1895 as against 1885—there is a remarkable fact disclosed, a decrease of 1.3 per cent. in first class passengers carried. This is most probably one of the effects of the woeful period of the financial crisis of 1892-1893.

A peculiar occurrence in passenger traffic is recorded in 1872, namely, an increase in the first class passenger journeys of 18,169, and a decrease in second class of 23,771 compared with the preceding year. Similarly in 1887 as against 1886 the superior class had an accession to its numbers in the former year of 12,451, while the second class declined by 428,006.

*Note.—The figures for 1905 were published after the Essay was written. They are added to the Appendices.

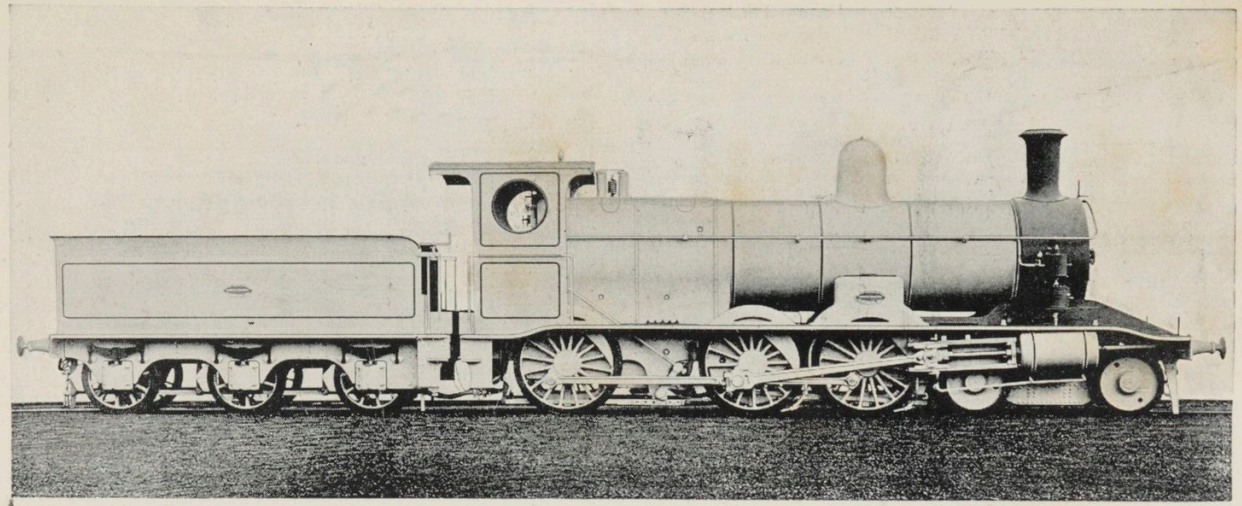
Looking at the goods traffic, the first thing to strike the eye is the leap from 2,469 tons carried in 1856 to 416,707 tons in 1865, an increase of 16,777 per cent. Although the detail figures making up the tonnage are not available, it is known that the great bulk of the increase was due to the rapid development of the Newcastle coal-fields.

The year 1885 produced an increase in livestock carried of 1472 per cent. when compared with 1875, due largely to the extension of the lines into the pastoral and border districts.

As instancing the wisdom of the policy of rapid construction of our railways into the remote and border districts of the State, it is worthy of note that in 1876 both Victoria and South Australia were offering bonuses on New South Wales grown wool, river borne, through their respective colonies,Victoria actually carrying at a loss. In the year referred to, of a total clip from 12,000,000 sheep in the border districts of our State, that of 11,000,000 was transported through the other colonies; where, in 1885, when the lines had been considerably extended in all directions, of the total wool shorn here, the New South Wales railways carried 118,316,151 lb., while the whole of the other States carried but 51,917,420 lb.

A subject which has long received the attention of the New South Wales railway authorities is the system of preferential rates adopted by Victoria for the purpose of attracting trade from places distant from the border—even from the centre of New South Wales—places within convenient distance from New South Wales railway stations. These rates appear to have been initiated about the year 1870, but at this time the trouble was mainly between Victoria and South Australia with regard to the Darling River trade. From 1882 onwards, however, when the extension of the New South Wales railways into the border districts was fulfilling its intention, namely, securing to this State its rightful trade, the struggle between Victoria and New South Wales became accentuated. The New South Wales border is now tapped at about a dozen places on the Murray by the Victorian railways, and these lines, no doubt, have been largely extended to attract New South Wales trade. The geographical position has naturally given Victoria a great advantage in this respect, but this advantage was unduly increased by the institution in that State of an extraordinary set of preferential rates. Here are a few instances:—(1) Wool from a certain pastoral area, situated 240 miles from the Victorian border and only 80 miles from a New South Wales railway station, could be sent cheaper to Melbourne by river and rail than it could be sent to Sydney by rail. From Bourke to Melbourne (1500 miles) it could also be similarly treated. (2) Goods for consumers in the Darling River district were conveyed between Melbourne and Echuca for 22s. 6d. per ton, but if the same goods were consumed at Echuca the freight would be 87s. 7d. per ton. (3) Wool from certain districts in New South Wales was carried on certain Victorian lines at 2s. 9d. per bale, while the same wool, if grown in Victoria, would be charged freight at from 6s. 1d. to 8s. 9d. per bale over the same lines.

The controversy on this subject has extended over many years, and, although agreements were prepared on one or two occasions, nothing of a definite character towards the abolition of competitive rates was reached until the 1904 Interstate Conference of Railway Commissioners, when a Board was apponted to deal with the matter afresh, and subsequently an agreement was arrived at to take effect from the 1st March, 1905, whereby a better return for the services rendered was



EXPRESS AND MAIL TRAIN ENGINE. CLASS P.

Principal Details.

	ft.	in.
Diameter of bogie-wheels	3	3
Diameter of coupled wheels	5	0

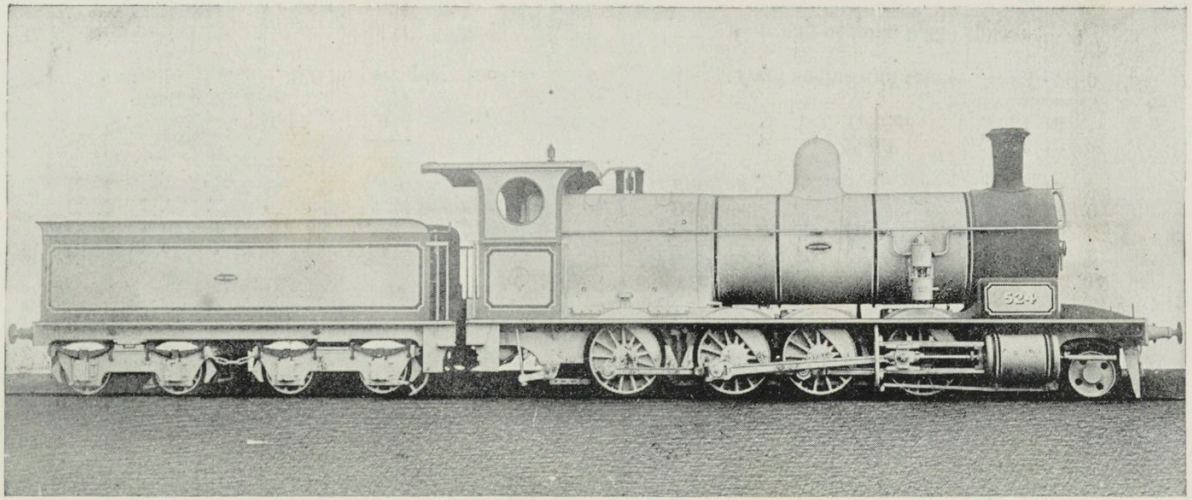
Cylinders 20 inches diameter by 26 inches stroke.

Heating surface : Tubes ..	1,786	square feet.
Firebox ..	130	,,
Total ..	1,916	,,
Total grate area ..	27	,,

Boiler pressure, 160 lb. per square inch.

Weight in working order :—	t.	c.	q.
Bogie (4 wheels)	14	13	2
Leading wheels (coupled) ..	14	10	3
Driving ,, ,, ..	14	13	0
Trailing ,, ,, ..	12	13	2
Total ..	56	10	3
Tender ..	31	16	1
Total engine and tender..	88	7	0

Capacity of tank, 3,030 gallons.
,, coal-space, $4\frac{1}{2}$ tons.



GOODS ENGINE. CLASS T.

PRINCIPAL DETAILS.

	ft.	in.
Diameter of bogie-wheels	2	9½
Diameter of coupled wheels	4	3

Cylinders 21 inches diameter by 26 inches stroke.

Heating surface: Tubes ..	2,032	square feet.
Firebox ..	166	,,
Total ..	2,198	,,
Total grate area ..	29¾	,,

Boiler pressure, 160 lb. per square inch.

Weight in working order:—	t.	c.	q.
Bogie (2 wheels)	6	6	0
Leading wheels (coupled) ..	14	2	0
Intermediate wheels (coupled) ..	15	10	0
Driving ,, ,, ..	15	9	0
Trailing ,, ,, ..	14	8	0
Total ..	65	15	0
Tender ..	41	10	0
Total engine and tender ..	107	5	0

Water capacity, 3,650 gallons.
Coal ,, 6 tons.

secured to the respective railways without in any way disturbing the existing flow of traffic, and a more equitable method of charging introduced.

Returning to Appendix No. 2, the disastrous effects of the drought of 1904 is very clearly indicated in the decreases shown in that year compared with 1895 under the headings "Livestock" and "Wool," the figures being 33 per cent. and 40 per cent. respectively. The general goods carried also show great fluctuations, the year 1885 resulting in a 519 per cent. increase over 1875, and the year 1895 only 3 per cent. over 1885.

Leaving out of consideration the abnormal effect on the figures caused by the Newcastle coal traffic in the early years, we notice a samewhat consistent decline in the percentage of total goods earnings, the figures being:—

1875 over 1865	460 per cent.
1885 over 1875	229 per cent.
1895 over 1885	38 per cent.
1904 over 1895	8 per cent.

The general lowering of freights would account for portion of this decline, but in the last quoted interval the fall is due also to the drought and consequent unprofitable carriage of starving stock and fodder.

———:———

ROLLING STOCK.

If there is one feature in the railway history which stands out more prominently than any other, it is the improvement which has been effected in the rolling stock. Here it has again to be recorded that this most especially applies to the last 17 years.

Appendix No. 4 shows—in addition to the following—the intermediate information for each decade, and the percentage of increase in decades. Leaving the early years out of consideration, the period 1875-1885 is the one of most rapid increases.

In 1855 there were four locomotives with a total tractive power of 35,748 lb.; 28 passenger carriages with an aggregate seating capacity of 924 persons; and 51 goods vehicles with a gross carrying capacity of 306 tons. At the close of last year the engine stock numbered 620, with a tractive power of 12,101,791 lb.; the stock of passenger carriages stood at 681, capable of seating 36,629 passengers; and the total number of waggons was 12,181, which provided for 108,373 tons of loading. These figures exclude a small number of engines and vehicles, which, though still capable of service, are of obsolete types and classed as duplicates.*

Old No. 1 locomotive, built in 1855, was honorably retired from the service in 1879, and to-day its resting place is the museum of the Technical College, Sydney.

It is particularly interesting just now to note that the four tender engines imported in 1855 weighed empty 33½ tons, and cost a little over £3,000 each. They had a heating surface of 1,347 square feet, and

* NOTE.—The figures for 1905 were published after the Essay was written. They are added to the Appendices.

grate area 17 square feet. Their cylinders were 16in. x 24in., working pressure 120 lb., and tractive power 8,937 lb. each. The last heavy passenger tender locomotives obtained weighed 70½ tons, cost each £5,305, had heating surface 1,916 square feet, grate area 27 square feet, cylinders 20in. x 26in., boiler pressure 160 lb. to the square inch, and tractive power 22,187 lb. The last goods engines scaled 79½ tons, cost £5,814 each, had heating surface 2,198 square feet, grate area 29.75 square feet, boiler pressure 160 lb., and tractive power 28,777 lb.

Three tank engines imported in 1864 weighed each 13 tons 4 cwt. nett, cost £1,400, had a heating surface of 378 square feet, grate area 7 square feet, boiler pressure 120 lb., and tractive power 5,016 lb. Our last lot of suburban tank engines weigh 57 tons 14 cwt., cost £4,432, have heating surface 1,452 square feet, grate area 24 square feet, boiler pressure 160 lb., and tractive power 19,116 lb. each.

Reference to Appendix No. 5 will show how the locomotive engines have been from time to time increased in the details of their construction, the main factors being the diameter of cylinders, length of piston travel, boiler steam pressure, heating surface, grate area, consolidation of wheels and extent of rigid wheel base. The tractive power of the engine is computed on the size of the cylinders, steam pressure, and diameter of wheels, and represents the weight the engine could lift if put into steam and suspended over a pit with a band or strap passed round and attached to the driving wheel.

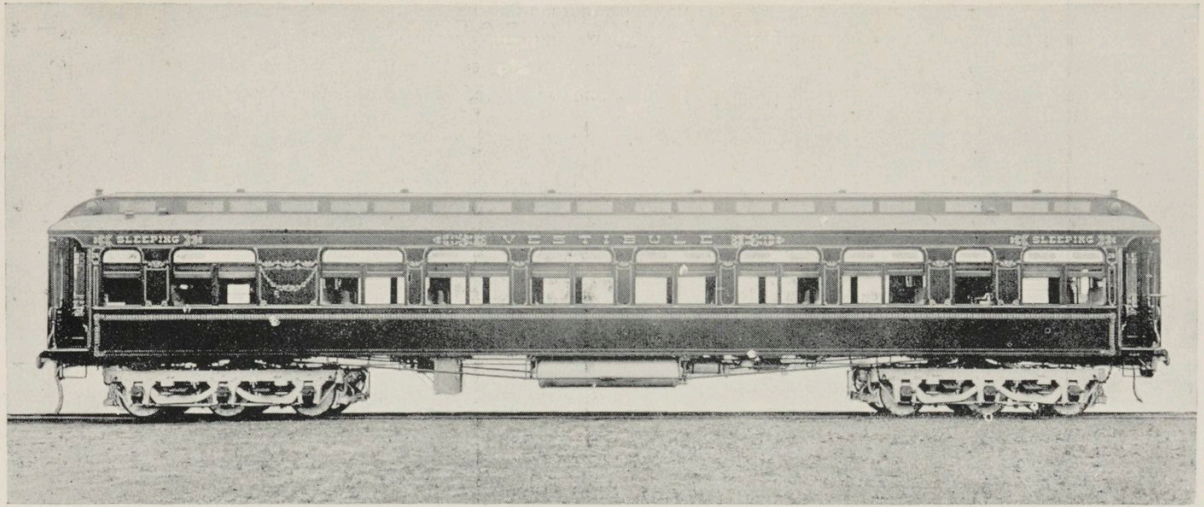
The free expansion of the details of the engines has, of course, carried with it an increase in the dead weight of the machine, but this increase in weight is much more than compensated for by the increase in tractive force. Here are three examples of this:—

	Tender Passenger Engines.	Tank Passenger Engines.	Tender Goods Engines.
	Per cent.	Per cent.	Per cent.
Percentage of increase in weight per engine	113	140	133
Percentage of increase in tractive power per engine	148	165	222

The use of the heavy and improved type of locomotive has, when taken in conjunction with the improvements in the permanent way referred to elsewhere, contributed materially to economy in the hauling of heavier loads. For instance, the latest goods engine would take 750 tons up a 1 in 150 grade at a rate of 18 miles per hour, whereas the old type of locomotive in use prior to 1888 would only take 450 tons up the same incline at a corresponding rate of speed.

From 1877 the Westinghouse brake came into use on passenger engines, but the whole of the goods locomotives have been equipped with this safety appliance in the railway workshops, with the exception of those imported during the last 13 years, which were fitted by the makers when built.

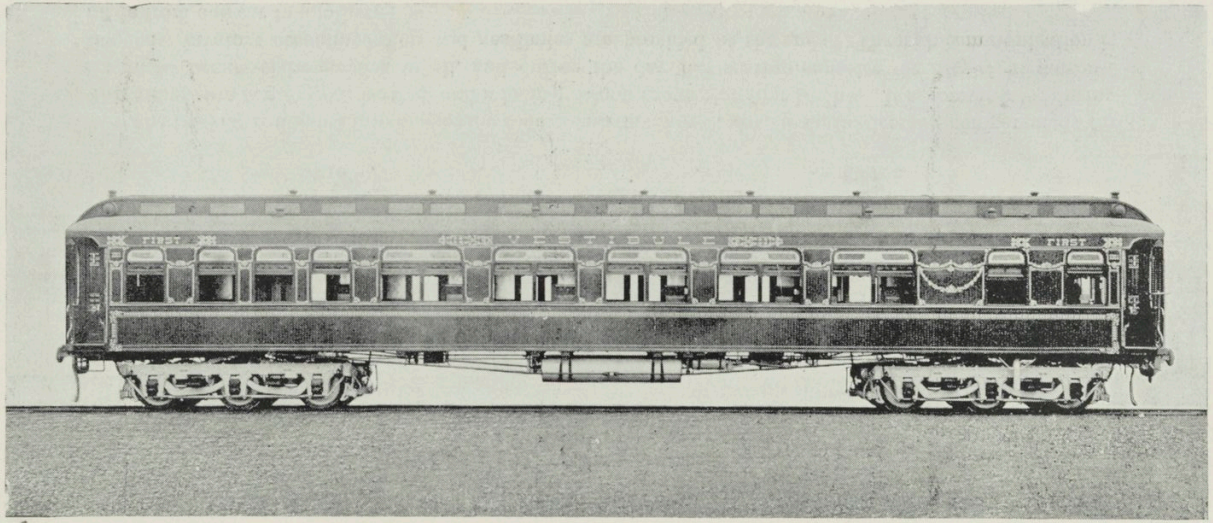
Up to 1861 wood was the only fuel used for locomotive purposes. In the year named, Mr. Whitton, Engineer-in-Chief, personally experimented upon an engine which was specially altered under his direction to permit of the use of coal. The experiment was so successful that the whole of the locomotives were similarly altered, and coal was always used thereafter.



PULLMAN VESTIBULE SLEEPING CAR.

	ft.	in.
Length of body over panels	61	0
Length over platforms	67	11
Width over panels	9	4¼
Height from floor to ceiling in centre of lantern roof ..	9	0¾
Tare	35 tons 10 cwt.	

The interior is divided into a smoking-room, with lavatories, &c., a main sleeping compartment (in which there are twenty-four berths), and a ladies' saloon containing four berths. It accommodates during the night twenty-eight persons in all, and during the day has seating capacity for fifty-eight persons. Requisite lavatory accommodation and vestibules are provided at the ends. Through communication is made from one car to another.



FIRST-CLASS VESTIBULE CORRIDOR CAR.

	ft.	in.
Length of body over panels	61	0
Length over buffers	67	11
Width over panels	9	$4\frac{1}{4}$
Height of body inside, from floor to ceiling, at centre ..	9	$0\frac{3}{4}$
Capacity	45 persons.	
Tare	36 tons 10 cwt.	

The interior is divided into seven passenger compartments, including a lady's saloon at one end and a smoker's compartment at the other. Seating accommodation is provided for nine in lady's saloon, twelve in smoker's, and six in each of the intermediate compartments. Requisite lavatory accommodation and vestibules are provided at the ends. Through communication is made from one car to another.

CARRIAGES.

Those amongst us who can recall the days when the suburban traffic was carried on with four-wheel carriages need very little argument to convince them of the advance which has been made in this direction—second class passengers especially. Thus a typical second class car: The sides, built up only half way between floor and ceiling, admitted plenty of fresh air; but this advantage (if it can be construed as such) was considerably discounted by the fact that they admitted anything else the elements chose to bestow as well. The car was of one compartment with a door in the centre of each side. Inside was a series of seats or forms—bare boards—running in promiscuous and circuitous routes, and so arranged that a maze of passages had to be negotiated before anyone could reach the far side or back seats. This was especially irksome if the car was full and you needed to wade through a sea of human legs. These vehicles were registered to carry 40 passengers each, and their dimensions being 18ft. 4in. x 6ft. 8in. x 5ft. 9in. high, the air space per passenger works out at 23.5 cubic feet, and the floor space at 3.6 square feet.

The convenient and commodious end loading American bogie cars in use to-day carry 60 passengers, and measure 43ft. 3in. x 8ft. 1in. x 8ft. 5in. high, having 47.7 cubic feet of air space and 5.9 square feet of floor space per passenger.

All the old four-wheel carriages as well as the six and eight-wheel radial stock were replaced shortly after 1890, and although most of them have passed out of existence, a good many still remain, and are known as duplicates. The four-wheel car, imported in 1862 and fitted up as a State car for the Duke of Edinburgh in 1867, is still serviceable as a duplicate. The six-wheel State car, built by P. N. Russell and Co. in 1871, and which prior to going into traffic was exhibited at the Agricultural Society's Show in 1870, is at the present time in use for ordinary traffic. Of the four Pitt-street tram cars (two of which were constructed locally and two imported), two were condemned as useless and destroyed when the line was taken up; the other two were converted into railway carriages in 1869 and used as such for many years.

The whole of the regular passenger-carrying stock now consists of vehicles which are carried on bogies, that is, two or more pairs of wheels together with the necessary bearing springs, axle boxes, &c., consolidated into one frame and fixed at each end of the vehicle by means of a king pin passing through the centre casting on the bogie bolster and the underframing of the vehicle, the extent of radial movement and oscillation being limited by stops on the bogie bolster. Bogie carriages were first introduced in 1875, and in 1887 the end loading American type of car came into use for suburban traffic. The latter—together with some sleeping cars of the same type—were imported from America. The first train consisted of four cars, and they were drawn by an imported American locomotive (since extinct). These cars are now made up into regular trains of five vehicles each, additional vehicles being attached as traffic requires. A nine-car train is a common sight during the busy hours of the day. The advantage of these carriages for suburban traffic lies in the saving of time of the staff in shutting a number of doors, the immunity from risk of accident by doors being left open, and the ease by which ticket inspection and collection can be carried out by officials.

Since 1877 constant improvements have been made in the carriages all tending to increase the comfort and safety of the traveller. Some few good carriages, such as the Ashbury and Improved Redfern types, were in service prior to 1888, but it was from then onward that the striking improvements in the design of the vehicles took place. The sleeping and first and second class carriages of the corridor and vestibule types, measuring 68 feet in length, are carried on two six-wheel bogies. They are fitted in the most luxurious fashion internally, and compare with anything of their kind in the world. These stand as a tribute to the ability of the staff at Eveleigh.

The acme of railway car construction, however, was attained in the building at Eveleigh of the carriage for the Governor-General of the Commonwealth in 1901 at a cost of slightly over £6,000. It measures 74ft. 2in. over the buffers, and is carried on two six-wheel bogies. The accommodation consists of three bedrooms (each fitted with lavatory and bathroom), dining-room, observation room and platform, servant's compartment (with berth and lavatory), corridor and vestibule. The car is most exquisitely finished and handsomely furnished, carpeted and draped. Report says that the present Prince of Wales on his visit here at the inauguration of the Commonwealth pronounced it to be the finest car he had ever travelled in.

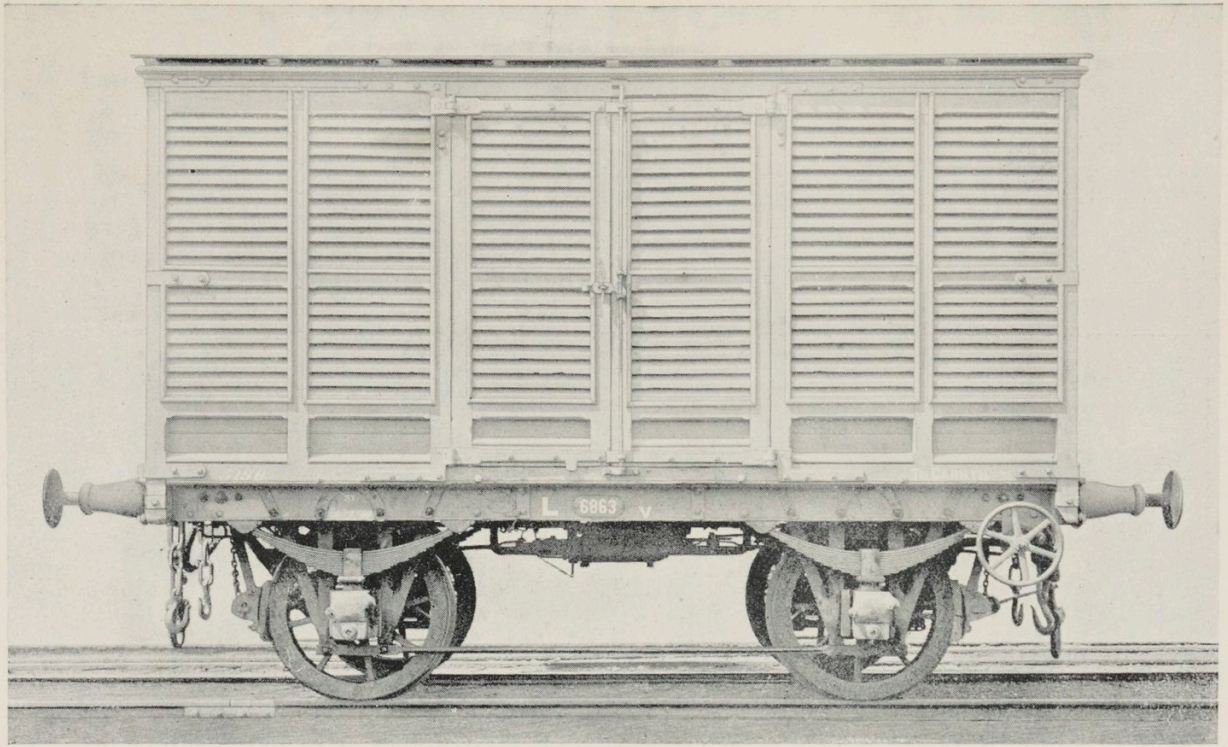
From 1877 the Westinghouse brake came into use on carriages, and in 1890 electric intercommunication between passengers and guards was established in long-distance trains. Up to the year 1878 oil lighting was in vogue, colza being first used, then kerosene. The colza lamps were of four candle-power each. The unsightly appearance of these lamps with oil and grit in the bottom of the globe—to say nothing of the feeble light itself—will be well remembered by many of us to-day. In 1878 gas was first used, Mr. Castner securing a contract for five years' supply. Each lamp was of 8 candle-power. Castner's plant was taken over by the Railway Department in 1884, and since that date the matter has been attended to by a departmental officer. A large generating plant was erected at Macdonaldtown in 1892, and from this the gas is conveyed to Redfern in pipes, and there by means of a compressing plant forced into other pipes ready to be fed into the cylinders under the carriages, at a pressure of 90 to 120 lb. to the square inch.

To-day all the cars are brightly illuminated with gas, the lamps ranging from 17 to 19 candle-power each.

The Commissioners have also generating and compressing plants in the country districts, and the gas from these is forced into travelling reservoirs, which are used to supply vehicles located at outlying portions of the system. Some of the country railway stations are also lit up by the Commissioners' own supply.

A start has lately been made in lighting cars by electricity, the Melbourne express train and a few other vehicles being so equipped. At present this is only in the experimental stage.

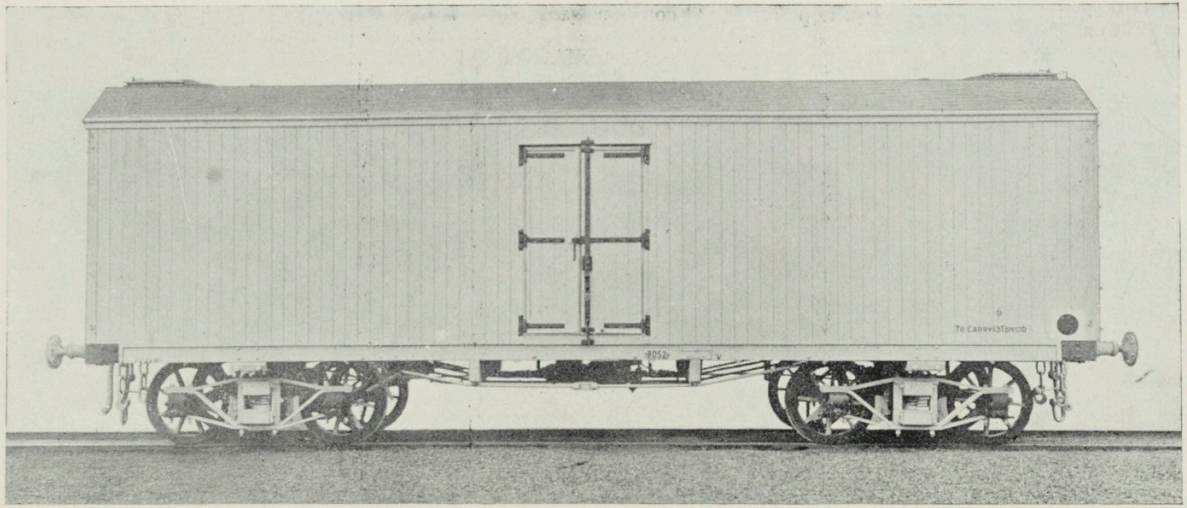
Lavatory accommodation (together with water bottles and tumblers) in long distance trains was unknown up to 1890 except in the sleeping cars. Now all trains running into the country are fitted with these inestimable conveniences for both first and second class passengers. In cold weather foot-warmers also are provided.



LOUVRED VAN.

(Used for the carriage of perishable goods, butter and meat.)

	ft.	in.		ft.	in.
Length of body outside	15	0	Height from floor to roof	7	0
Length over buffers .. .	18	8	Carrying capacity	10 tons.	
Width outside	8	6	Tare	6 ton 11 cwts.	



REFRIGERATOR CAR.

	ft.	in.
Length of body outside	34	2
Length over buffers	37	8
Width outside	9	0
Height, floor to ceiling	8	7½
Tare	17 tons 13 cwt.	
Capacity .. .. 540 chilled sheep, or 675 frozen sheep.		

GOODS VEHICLES.

There have been many important changes in the construction of our goods vehicles since 1855, but almost the whole of such changes have been effected between 1888 and the present time. The advent of the late Mr. Eddy's administration brought with it the free use of iron and steel in waggon construction. The subject had, however, been touched upon as far back as 1869, but without any practical result.

Prior to 1888 our goods vehicles were, almost without exception, composed entirely of wood. Now we have about 3,000 with metal underframe (wholly or partly), and about 1,200 built entirely of iron or steel. The adoption of an improved type of standard axle box, the substitution of stronger draw gear, and heavier wheels, axles and springs have conduced to economic working by evolving a vehicle capable of carrying a much greater load without correspondingly increasing the dead weight or tare. Where formerly a waggon with a nett weight of five tons sustained a load of from 6½ to 8 tons, the new vehicles with a tare under 7 tons are capable of carrying from 10 to 15 tons. This refers to the four-wheel stock.

The old type of bogie vehicle weighed 10½ tons, and had a loading capacity of 15 tons, while the new design of truck has a nett weight of about 12 tons and can take a load of 24 tons.

A further economy arises in the lessened cost of maintenance of waggons of modern design as compared with the old and also in the extended life of the former.

Bogie refrigerator cars and bogie livestock trucks have also been introduced in large numbers since 1888. In 1884 a patent bogie vehicle called a dump car was imported. It is used in connection with the coaling of locomotives, but an elevated stage on which to dump the vehicle is a necessary adjunct to the system. The original purchase consisted of 200 trucks, the transaction subsequently coming under the inquiry of a Parliamentary Select Committee. These vehicles are still in good working order (all having been rebuilt), but no more have been ordered.

In connection with permanent way maintenance, a striking advantage has been gained by the adoption of the hopper ballast waggon and plough brake van, the former discharging the ballast automatically on to the centre of the four foot way, and the latter (running at the end of a train of hopper waggons) distributing it by means of a plough fixed to the underframe. The patent rights were secured in 1890. By means of this apparatus 200 tons of ballast can be discharged and spread by one man in 20 minutes, while under the old system—the shovel wielded by hand—the same work would occupy at least 20 men from 1¼ to 1½ hours.

The introduction of the iron coal hopper waggon marked another great advance, the hopper with its 10 tons of coal being lifted bodily from the underframe by the crane, and the coal automatically discharged into the ship or otherwise in the space of about a minute.

Since 1890 practically the whole of the goods and livestock vehicles have been equipped with the Westinghouse brake, thus adding still another element of safety and economy in the working.

IMPORTATION AND LOCAL CONSTRUCTION.

As far back as 1870 locomotive engines were manufactured locally. In that year a tender passenger engine of 33½ tons weight was built in the Sydney railway workshops at a cost of £3,815. Twenty-six more engines of various types were built from 1870 to 1876, 12 of them by Mort & Co., 10 by Vale & Lacy, and 4 in the railway workshops. The Atlas Co. built 8 in 1882, Henry Vale 24 from 1882 to 1887, and from 1893 to 1896 four engines—originally commenced by Thomas Wearne in 1887, but abandoned owing to his inability to proceed with the work—were completed in the Eveleigh workshops. The cost of engines built in the State ranged from £82 to £115 per ton, with the exception of the last four mentioned, which cost £71.

Except as shown, the whole of our engines have been imported from Great Britain and America.

A few horse-boxes and carriage trucks were made in the Sydney workshops in 1858, but practically the whole of our coaching stock vehicles were imported until the year 1870. Since that time, with the exception of a few Ashbury, American, and Pullman cars, we have relied on local manufacture. The majority of the coaching vehicles built in the State were let to contractors, but the Governor-General's carriage and the latest type of corridor and vestibule cars (sleeping, first and second class), of which the express trains are principally composed, were all built in the Eveleigh shops within the last 10 years.

With trifling exceptions all our waggons and vans have been constructed in the State. Of a total stock numbering slightly over 12,000, we have only about 800 imported trucks. Most of the work of construction has been performed by contract, but a large number of the new vehicles, especially of the bogie type, have been built in the Eveleigh workshops since the year 1888.

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WORKSHOPS, MACHINERY AND APPLIANCES.

Up to the year 1864 the machinery for the locomotive and carriage and waggon repairing shops at Redfern was driven by one 20 h.p. steam engine, fed by two boilers. There were two large and five small lathes, together with about 13 other machines of various kinds, and two steam hammers, one 45 cwt. and the other 15 cwt. The shops themselves were merely corrugated iron sheds of diminutive proportions, with the exception of what was known as the Turning and Pattern shop, and this was a solid-loking stone building of two storeys towards the Cleveland-street tunnel. The first cost of the structures was £10,896, and of the engines, boilers and machinery approximately £7,000.

Workshops equipped with a few simple machines were also at this time in existence at Newcastle, and were driven by one 10 h.p. engine.

Beyond a few small iron sheds, no additions of any note were made to the buildings or plant at Redfern until 1871, when a sum of £30,500 was voted for a new station, workshops, &c., &c. In 1875 the removal of the metropolitan workshops from Redfern to Eveleigh was recommended, and an estimate and plans were prepared, the price being

£170,000. By this time several new machines of improved type had been introduced both at Sydney and Newcastle, requiring two more engines at the former and one at the latter place for driving purposes.

In 1882 work on the foundations of the new locomotive shops at Eveleigh had been commenced, and on account of the locality being all sand special methods had to be adopted in connection therewith. Long heavy piles were sunk at close intervals, and the intervening space arched over with brickwork. By 1885 a start had been made at work in the new shops, the first section open being Nos. 1 to 4.

From this time onwards rapid strides have been made both in accommodation and machinery. The original structures have been considerably added to and new ones erected. From time to time these have been kept stocked with the most perfect and up-to-date machinery for locomotive and carriage and waggon work. Numbers of boilers are constructed each year, and all the details of locomotive repairing are efficiently provided for.

The power available for driving the whole of the workshops' machinery at Eveleigh is derived from 18 steam engines of 370 h.p., and 24 electric motors with a capacity of 500 h.p.

In the locomotive shops huge overhead travelling cranes (one with a lifting power of 35 tons) are driven by electricity, and tools and traversers are similarly operated. Compressed air is also used as a motive power to a large extent.

Amongst the tools may be mentioned a dozen steam hammers (one of four tons, capable of striking a blow of 14 tons), shearing machines, hot and cold saws, hydraulic presses, hydraulic rivetters, pneumatic hammers, nearly 100 lathes, and numerous other machines of all kinds and sizes.

The wood-working machinery in the carriage and waggon shops embraces all tools necessary for the work performed. Here, too, are ground traversers and powerful overhead cranes. These shops are constantly turning out new vehicles of the most improved and modern types, as witness an ordinary ballast waggon costing about £100, and the Governor-General's car, costing over £6,000.

From the paint shops at Eveleigh cars come out with mirror-like faces. The work is the best that can be produced. Few people, perhaps, who ride in or look at our vestibule express cars imagine that the painting of one of them costs about £320—enough to build a small cottage home. The suburban cars are not now painted, but varnished, so as to show the natural grain of the panelling, &c. In the first instance they receive seven coats.

The shops are fitted with a paint-mixing plant, and are reticulated with steam pipes for winter heating. Almost the whole of the goods vehicles are painted outside the shops by means of a mechanical spray, the motive power being compressed air. By this process an ordinary four-wheel truck can be repainted (wages and material) for about 2s., whereas by hand the cost would be more than double the amount.

Before the erection of the present shop, the painting was carried out in the old iron shed adjoining Eveleigh Station, and prior to that at Redfern in a similar building, both quite incomparable with the present shop and appliances.

The whole of the Locomotive Branch workshops at Eveleigh have a floor area of nearly 15 acres, and their cost stands at £310,000 exclusive of land. The machinery, &c., with which they are equipped is valued at £192,000.

The Newcastle shops are also capable of coping with heavy work, but of course are not built or fitted on the elaborate scale of those just described; although, prior to the erection of the Hawkesbury Bridge, all repairs to rolling stock on the Northern system were carried out at Newcastle.

At various points throughout the lines there are workshops capable of dealing with minor repairs and running attentions to locomotives, carriages and waggons; those at Goulburn, Junee and Bathurst are more extensive and better fitted than the others.

The workshops of other branches, although of minor importance compared with those already dealt with, are a very noticeable detail of the general concern. The Permanent Way establishments are at Redfern and Newcastle, the former dating back as far as 1876. Although the bulk of their work consists of the making of points and crossings, of late years higher flights have been attempted, culminating in a task of such magnitude as the construction of the ironwork for the Penrith viaduct, 588 tons, and the new bridge shortly to be erected. The credit for this goes to Newcastle, where there is a fine plant; the Redfern shops undertake the lighter descriptions of work. Up to 1896 this branch had a large workshop at Goulburn, but it has been gradually stripped and absorbed into the Newcastle establishment.

Prior to 1884 almost everything required for interlocking repairs and renewals was imported. From that time the local construction of parts was undertaken, and step by step the branch has advanced until now practically the whole of the interlocking gear for maintenance is manufactured in the Redfern workshops.

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APPLIANCES.

Amongst the advances made in mechanical devices outside the workshops, the Commissioners' facilities for shipping at Sydney and Newcastle merit more than passing notice. The motive power for the hydraulic cranes used for traffic purposes at Darling Harbor is supplied by private enterprise under contract with the Commissioners, and some idea of the magnitude of the work done may be formed from the fact that the yearly consumption of high pressure water is over 2,000,000 gallons. At this depot three steam cranes of 15 tons capacity each are in use for coaling vessels, while for handling general goods there are 35 hydraulic cranes, 31 of them having a lift of two tons each, three of three tons, and one of five tons; and one overhead steam gantry crane, capacity ten tons.

Prior to 1855 the Newcastle coal trade was almost monopolised by the A. A. Co., the only other mines being those of Messrs. Donaldson, Brown and Nutt. The Company's coal was conveyed to their shoots by means of a horse tramway, but that of the other mine-owners was brought to the port in trucks and shipped by wheel barrows. In 1874 the shipping was done at Queen's Wharf by eight steam cranes and four shoots belonging to the Government, and these at a very liberal estimate were capable of dealing with 9,000 tons of coal per day.

In 1877 the first four 15-ton hydraulic cranes were put up at the Bullock Island dyke. Four more were added a year or so afterwards,

and thenceforth the coal shipping business was almost exclusively carried on at that place. There are now three steam cranes and 18 hydraulic cranes installed, the lifting capacity of the former being 12 tons each, and of the latter two at 25 tons, six at 15 tons, six at 12 tons (these are movable, and will shortly be actuated by electricity), and four at nine tons.

The power for the hydraulic cranes is generated at the Commissioners' Power House. It is estimated that the 18 machines are capable of dealing with about 30,000 tons of coal per day of eight hours, all circumstances being favorable. The coal comes to the dyke from perhaps 50 mines, hundreds of tons at a time, in trains of hopper waggons; and, by the instrumentality of the hydraulic cranes, is loaded into the ship 10 tons at a time.

In other directions labor-saving machinery has been largely brought into use. Where in the early days pumping for locomotives was almost entirely done by hand, to-day the whole system is dotted with steam pumping stations. At Wentworth Falls the largest departmental dam in the State has been constructed, with a holding capacity of 36,000,000 gallons. From here a gravitation scheme carries 80,000 gallons of water per day to Lawson (four miles) an intermediate dam of 500,000 gallons being also constructed. At Harden there is a dam with 22,000,000-gallon capacity, which gravitates to Harden station (over two miles), about 70,000 gallons daily. At Glenbrook the heaviest railway pumping lift in the State is found, water being forced a vertical height of over 400 feet.

At Penrith an appliance for coaling engines has just been erected at a cost of over £8,000. It consists of a steam-driven endless chain of buckets which carry the coal from a pit below the rail level to a hopper overhead, a vertical height of about 40 feet. From this hopper it is discharged into shoots and thence to the locomotive below.

We have also air cranes for handling engine coal, locomotive travelling cranes for heavy lifts at varying points, turntables for assisting the conduct of traffic, huge weighbridge for ascertaining the tare of either a 16-foot truck or a 70-foot carriage, and numberless 5 to 10-ton hand cranes at stations all over the State to cope with the station inwards and outwards goods.

Pneumatic jacks and drop pits for quickly changing engine wheels as required are installed at most of the locomotive depots in the metropolis and country.

PERMANENT WAY.

The construction of the line between Sydney and Parramatta was carried out in the first place by the aid of wooden rails, there being no iron rails in the colony at the time. The frequent renewal of these became so costly that the contractor at length capped them with thin iron plate. This was a slight improvement. When it is stated that the price of a draught horse at the time was £85, and hay £35 per ton, it may easily be imagined what a saving in traction alone the arrival of the first shipment of iron rails in 1854 meant to the contractor.

Many changes have been made from time to time in the materials and method of laying the permanent way. Several types of rails, sleepers, spikes, chairs, fish-plates, &c., have been tried, each in turn to be superseded in a short time by something better.

With the exception of the Richmond Branch—for which 40 lb. rails were originally imported, but later on discarded in favor of a 55 lb. section—iron rails, single and double headed, of 75. lb to the yard, were first used. The line, Sydney to Granville, was first laid with the "Barlow" rail (75 lb.), with hollow centre—a fine home for rats in Redfern yard by the way. These were spiked to the sleeper through the flange of the rail. The "Hydra-headed rail" (four heads) was once tried, but on account of the wear at the point of contact with the chair and at the joints, it was found not to answer, as originally intended, namely, to permit of being turned as each head wore. Between 1859 and 1862 several hundred tons of "steeled" rails were imported. These were 75 lb. double-headed. In 1877 an attempt was made to adopt a 40 lb. section on lines beyond Murrurundi and Bathurst, and was only prevented from being successful by the firm and timely action of the Hon. John Sutherland, then Secretary for Works. The single-headed steel "I" rail of to-day ranges from 80 to 100 lb. weight per lineal yard of section.

A line of about two miles beyond Parramatta was once laid with steel sleepers as an experiment, but the solid resistance they offered increased the wear and tear on the rolling stock to such an extent that they were quickly taken up again. The metal ballast when combined with the wooden sleeper has a yielding tendency. Sleepers have not always been of their present shape and dimensions. Originally they were shorter, of smaller section, and frequently left half round on top.

In the original formation of our lines little heed seems to have been paid to grades or curves. It was evidently not deemed expedient then to run a few miles further to save a steep rise or sharp curve; but now, when the strictest economy in working is so carefully exercised, efforts are made to ensure the locomotive hauling the maximum load at the greatest possible rate of speed. Here again it remained for the 1888 administration to make drastic changes. They at once set to work to improve the permanent way, flatten sharp curves and reduce grades. The curves, be it noted, in addition to limiting the speed, have a prejudicial effect on the rolling stock as well as on the comfort of travelling. While some of the processes mentioned have slightly increased the mileage, they have more than proportionately reduced the cost of working. Grades of 1 in 30—of which there were plenty in the olden days—have been cut down to 1 in 55, 1 in 60, 1 in 66, and other proportions, increasing the hauling power of the locomotive in some instances by as much as 120 per cent.

The small Zig-Zag on the Blue Mountains between Emu Plains and Glenbrook was entirely cut out in 1893, and a deviation embracing a long tunnel substituted. Sharp eight-chain curves on the mountains have been flattened to not less than 12 chains radius, thus reducing wear and tear on both rolling stock and rails, and accelerating the speed of the trains in addition.

In 1886 the Redfern tunnel was widened to admit of four lines of track being laid from Redfern to the Illawarra Junction, the addition being necessary in connection with the increased traffic caused by the opening of the Illawarra line.

NEW STEEL VIADUCT NEAR WAGGA WAGGA.

Commencing with 1890 the suburban line was quadruplicated, and single tracks, south and west, have been duplicated for a considerable distance since that year.

Many other notable improvements have been made from time to time, such as the adoption of blue metal in place of soft stone for ballast; deepening of the ballast by about 60 per cent.; increasing the section and length of sleepers; introduction of improved angle iron fishplates instead of straps; and the laying down of rails weighing up to 100 lb. per yard, where previously rails as light as 70 lb. had been in use.

As early as 1866 it became necessary to relay the line from Sydney to Parramatta, and £55,000 was voted for that purpose. In 1872 it is recorded that the iron rails were replaced by steel for a short distance on the Northern line, and with such good results that the Engineer-in-Chief recommended that in future steel rails be used for both maintenance and construction. In 1874 a portion of the Western line was also renewed with steel rails, and from this out their use became general as opportunity offered, over 100 miles being treated up to 1885.

The whole of the main lines originally laid with 70 to 75 lb. section have now been relaid with 80 lb. steel rails, and the 75 lb. steel rails on the suburban line have been replaced by others of 100 lb. to the yard.

Huge improvements have also been carried out in substitution of steel bridges and viaducts for wooden ones. The ravages of the *teredo navalis* and the white ant render the wooden structures very costly to maintain, in addition to affecting their reliability. Notable instances of this work are the viaduct at Wagga (three miles long including the iron bridge over the river), completed in 1901 at a cost of £45,000, the viaduct at Penrith only recently finished, and the bridges over the Styx and Ironbark Creeks on the Northern line.

The acquisition by the Commissioners of splendid quarries at Bombo, Perth, Ardglen, Tarana, Razorback, North Goulburn, and Bethungra, was another factor in the economical management of the Existing Lines Branch, having reduced the cost of ballast by about 70 per cent. At the Ardglen quarry several enormous blasts have been made from time to time, quite overshadowing those of the great Zig-Zag elsewhere mentioned. In January, 1900, one shot dislodged 52,000 tons of stone. In September, 1901, 80,000 tons were similarly displaced, and during the current year a mass estimated to contain 100,000 tons was blown from the face of the rock by the agency of 5½ tons of powder and 25 lb. of gelignite.

STATION ACCOMMODATION AND BUILDINGS.

In the beginning the terminal station at Redfern consisted of a corrugated iron shed. Inside was a long wooden platform with two or three wooden rooms thereon for the accommodation of the public and the staff. The building was erected at a cost of £2,012. On one side of the station proper was a hay shed, and on the other a meat shed, from which the products named used to be sold by auction. The carriage shed, engine shed, and goods shed in the immediate vicinity were also of iron, and cost £7,175. What was known as the Parramatta-

street bridge (now George-street West, over the Darling Harbor line), together with its approach, cost £7,217, while the initial outlay on the Cleveland-street Bridge and the retaining walls was £15,330. The original pumping station is still in evidence, but as a printing office near the present No. 11 platform.

The cost of the terminal station is remarkable when compared with Ashfield (£2,338), or Newtown (£1,760). Ashfield station, however, included a brick residence with a verandah for the use of the Station Master. The first cost of two "roadside stations," Burwood and Homebush, was £275. These were the merest timber platforms, equipped with a small box or shelter-shed similar to, but not so good as, those on the intermediate stations of our pioneer lines of to-day. Up to 1864, however, a further £750 had been spent on additional accommodation at Burwood.

The progress of events soon evidenced the necessity for additional accommodation at Redfern, and as early as 1865 we read in the official report: "Unless it is intended very shortly to build a new station at Sydney, extensive additions to the present building should be at once carried out." From 1871 to 1875 £53,500 was voted for station buildings, workshops, goods sheds, &c., &c., at Redfern. In 1874 a new brick passenger station, consisting of two platforms and two docks, was opened for traffic. The station then embraced what are now platforms 4 to 7, and the entrance to No. 5 was through the centre of the present No. 3. The present booking office and assembly platform northwards came later, when in 1882 a new platform (No. 3) was erected, and the balance of the construction extended.

In 1886-1887 the repairing and paint shops were removed from Redfern to Eveleigh, and further piecemeal additions were carried out to the Station from time to time, until to-day it presents the picture of an incongruous mass of structures equally inelegant as inconvenient.

But the near future holds a bright promise, for, after years of contention amongst different sections of the community as to site, a station is shortly to be brought into use immediately opposite the present one, which, when complete, will rival anything of its kind in the world. It will be an imposing structure of brick and masonry, and will be commodious and convenient. Every known facility both for the management and the public will be provided. There will be eleven platforms, each 660 feet in length, access to which will be by one common assembly platform 70 feet wide by 348 feet long. The administrative building will be of four storeys exclusive of the basement. Electric light will be installed throughout. The total area of the station and grounds will be 22 acres, and the total estimated cost is £421,000 exclusive of land resumptions.

Touching the dispute as to the site for this new station, the following brief account may be interesting.

It is on record that a plan is in existence dated 1857, showing a map of the City and a pencil sketch thereon of a site for a central station in Hyde Park between Park-street and St. James'-road, and also showing a crossing place at the corner of Elizabeth and Wexford streets. From this date onward the matter of extension into the City was constantly under notice and consideration. In the Railway Commissioners' report for 1806-1871 the following occurs:—

> "The number of trains employed for suburban traffic may appear disproportionately large, but it must be remembered that this is a big traffic, and that the short trains are required to be numerous, not only to suit the

> rapid movement of the population, which is induced to settle in the suburbs from the facilities afforded of frequent and easy intercourse with the capital, but also to meet the opposition from steamboats and omnibuses, which land their passengers in the City, an opposition which will continue as long as the railway terminus is at Redfern, and will never, I fear, be successfully resisted until the metropolitan station is erected in Sydney, on the site of the Supreme Court . . . . or some equally suitable site in the heart of the City."

Again in 1876 we read:—

> "The advisability of removing the Redfern terminus to the business part of the City has, for a considerable time, engaged the attention of the Government. Several trial surveys were made during 1875, and in 1876 a proposal was submitted to the Assembly for an extension of the line from Redfern through Hyde Park, terminating at the north-west corner, near the Supreme Court; but the proposal was not approved, and the scheme was abandoned for the time."

Various surveys were made and sites proposed between then and 1890, but no definite action was taken. In the year last quoted a Royal Commission was appointed, 35 schemes were considered, and one having a central station at the top of King-street was adopted. Public agitation against the absorption of any portion of Hyde Park followed, and the Railway Commissioners thereupon submitted an alternative proposal for a central station on the site of the Benevolent Asylum near Devonshire-street, and a suburban main station at King-street, with two lines to Circular Quay and two to the Eastern Suburbs. The Royal Commission favored this alernative scheme.

No action was taken on the report, however, and in 1896 another Commission was appointed, their report being in favor of a central station on the St. James'-road site. This was referred to the Public Works Committee and received their approval. Still no Government action was taken to give effect to the recommendation.

In December, 1899, the Pubilc Works Committee again had the matter in hand, and reported that it was *not* expedient to extend the railway into the City, and gave as their opinion that the best plan would be to construct a commodious station at Devonshire-street. In the same year this recommendation was formally referred by Parliament to the Public Works Committee, and recommended by the latter body, with the result that Parliament approved, and the necessary legal enactment was shortly afterwards passed. Thus was the present site fixed upon.

At the opening of the railways there were four stations between Sydney and Parramatta, namely: Newtown, Ashfield, Burwood, and Homebush. These, as originally constructed, soon became inadequate to the demand, and were altered, added to, or reconstructed in a desultory way. It was not until shortly after the advent of the Commissioners of 1888 that the radical change was effected, and then, on the quadruplication of the suburban line, these stations were reformed—almost out of existence. The present splendid suburban stations, with their island platforms, charming gardens, and overhead or underground approaches, are quite up-to-date in every particular, and replete with all conveniences for the use and comfort of the travelling public.

The main country stations are handsome brick buildings, which have grown with the general march ahead, alterations, improvements, and additions being constantly effected, and, in many cases, old obsolete structures being replaced by new and handsome ones. Standing out prominently as creditable types are those on the tourist section of the mountains (erected since 1888), also those at Moss Vale, Goulburn,

Harden, Junee, Wagga, and Albury on the south; Bathurst, Orange and Wellington on the west; Newcastle, Werris Creek, Tamworth and Armidale on the north. At these places notably, one can enjoy the luxury of a good wash in a quiet way, there being a certain amount of discomfort attending the same operation in a travelling car, no matter how well it may be fitted.

With the extension of the lines and consequent prolongation of the time of travel, it became necessary to provide refreshment rooms. The following is considered worth quoting in extenso as bearing on this portion of the review. It, too, is from the report of 1866-1871:—

> "The keepers of what are facetiously termed 'refreshment rooms' on our railways are little more than apple stallholders and vendors of lolly pops and stale pastry, serving out junks of sandwiches and messes of tea and coffee. . . . . It is now proposed to fit up refreshment rooms at Sydney, Mittagong, Penrith, Mount Victoria, and Singleton, and to lease them by tender for a term of years. . . . . If, instead of a luncheon, a hot dinner is required at any of these refreshment rooms, it will only be necessary for the guard at any terminus to flash an order by telegram, and everything will be in readiness on the arrival of the train at the appointed stopping place."

The rooms referred to were duly erected, but no license to sell fermented liquor in them was granted until a subsequent period. The refreshment rooms at some of the stations mentioned have, owing to time-table alterations, been abandoned and others opened at convenient places. The rooms claiming most notice are those at Moss Vale, Junee, Albury, Newcastle, Werris Creek, Mount Victoria and Wellington.

At the present time the system in vogue is found to answer thoroughly all that is expected of it, the ruling tariff being 2s. per meal table d'hote (reduced recently from 2s. 6d.), and other meals or refreshments at menu prices.

All the important stations are provided with separate sheds for the handling of goods traffic, those at Darling Harbor being especially large. Here, too, the Commissioners own a large refrigerating meat market, which is leased for a term of years to a private firm. At Darling Island is an immense grain shed with a storage capacity of 300,000 bags of wheat.

At Eveleigh and Hamilton there are large sheds for the stabling and cleaning of engines. Smaller buildings for a similar purpose are erected at the locomotive depots throughout the lines. At these depots also are barracks for the use of guards and enginemen while away from their home stations on duty. These are equipped with beds, lavatories, cooking appliances, and conveniences for meals, and caretakers are paid by the Commissioners to keep them clean.

Carriage washing and cleansing is also provided for by shed accommodation at Redfern, Eveleigh, Homebush, Newcastle, and other places.

The enormous quantity of material required for railway purposes renders necessary the existence of a store of large proportions at Eveleigh. Of course, many articles are supplied direct to the department for which they are obtained, the transaction merely passing through the store books; but there is always a large quantity of material stocked at the main depot. A large sheeting shed at Eveleigh is used for the making and tarring of the tarpaulins required for traffic purposes.

At Eveleigh and Alexandria large timber sheds are erected. In dealing with the stock of over 1,000 carriages and 12,000 waggons, a great quantity of timber is used annually, and to obtain the best results it is essential that the timber be thoroughly dry and well seasoned before

being used. Various processes for seasoning have been tried, none of which have given such good results as those obtained by storage for lengthened periods in well covered, airy sheds. In the two mentioned there is stored approximately equal to three years' supply of the various kinds of timber—paricularly colonial—and this stock is always maintained.

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STAFF.

In the phenomenal march of progress which has characterised the New South Wales railways since their foundation, the treatment, pay, well-being, and comfort of the staff have always been kept well in mind. As a result, employment under the Commissioners is eagerly sought, and when obtained, duly appreciated and carefully guarded. The thousands of applicants for employment, whose names are always to be found on the Staff Committee's books, is ample evidence of the popularity of the service. It has been said that "Man's inhumanity to man makes countless thousands mourn," but this charge cannot be laid at the door of the respective administrators of our railways.

Prior to 1888 appointments to the railway service were, with but few exceptions, made by the heads of branches, and submitted to the Commissioner for approval. Shortly after the passing of the present Railways Act a Board was constituted called "The Staff Committee," and all appointments to the service are made by it subject to Commissioners' confirmation. This Board consists of three officers of the department holding high positions, and in addition, each head of a branch is a member ex officio.

Entrance to the service is by examination, and promotion is made under fixed rules to a certain limit of pay. Beyond this limit merit is the governing factor, but, *ceteris paribus*, preference is given to the senior employee in the grade.

The number of servants employed in the railway service at the commencement is not obtainable. For the first year or so, all labor was engaged by Mr. Randle, who worked the line, and was allowed by the Commissioners a proportion (55 per cent.) of the gross takings. Consequently the official records do not contain the number of employees at that time. From an analysis of the expenditure for wages, it would appear that in 1858 there were not more than 200 all told, and in 1865 probably about 400 or 500.

In 1875 the aggregate staff had reached the respectable total of 2,064. Then came the decade of wonderful development. In 1885 there were no less than 9,933 persons employed by the Commissioner. The 1888 regime effected a reduction in this number, for we find in 1895 the total staff is 9,229. On the 30th June, 1904, the army of workers totalled 13,043.

A glance through the list of trades, &c., represented discloses the fact that the staff is a heterogeneous mass. They can sweep a floor or build a cantilever bridge; put a hair spring in a watch or prepare blooms up to a ton weight for making heavy forgings for shafts, foundation bars, &c.; press copy a letter or calculate the distribution of weights or the centre of gravity of a locomotive.

From time to time the hours of labor of the staff have been altered until to-day practically the whole of them enjoy the eight-hour system. Any time worked in excess of this period is, as a general rule, paid for at overtime rates, as is also Sunday duty for the bulk of the callings.

The reduction of the daily hours of labor from 10 to 8 for the mechanical staff took place in 1873. Prior to 1882, an engineman's week's work was 60 hours. This was reduced in the year named to 55, and in 1890 a further reduction to 54 hours was made. Of course it is within the memory of all that in July, 1902, the eight-hour system was applied to these men, thus bringing the working hours equal to 48 per week.

The rates of pay compare more than favorably with those obtaining in private employ or on other railways; and the concessions granted in the way of holidays, sick pay, housing, clothing, and free passes are very generous.

The conditions under which the staff work are also very satisfactory, their comfort and health being particularly considered.

To induce habits of thrift, one of the first acts of the Eddy Administration was to make a regulation compelling every person thereafter appointed to the service to effect an insurance on his life. The amount of the policy is regulated by the emolument received, and has to be increased proportionately with advances in pay up to a certain maximum. The policies mature at the age of 60, which is the retiring age.

In 1890 an attempt was made by the Commissioners to establish a Provident Fund for the benefit of the employees on a very liberal basis, but, unfortunately, and for some reason best known to themselves, the men declined to view the movement favorably, and the Bill which had been prepared for Parliamentary sanction was withdrawn.

An Ambulance Corps, formed in 1889, for rendering first aid to the injured, has also proved very beneficial to the employees, as well as to the travelling public.

In 1891 a spacious building was erected at Redfern as a Railway Institute, and is much appreciated. The yearly subscription ranges from 5s. to 10s., the former rate affecting all country members and others in receipt of less than £125 per annum no matter where located. The Institute affords ample scope for social intercourse, mental improvement, and physical recreation, and a system of classes for the free education of the staff and their families in certain subjects is in vogue and well patronised. There is also a splendid library of over 9,000 volumes, which is at the disposal of the members free. The management consists of a Committee partly nominated by the Commissioners and partly elected by the members. The roll of members stands at 1,900.

Of course times of depression compel the administrators to trenchant action occasionally, but this is always regulated so as to carry the least possible hardship in its train, and is spread over the largest number so as to minimise the loss to the individual. Conspicuous in this regard is the year 1871, when there was a general reduction in wages, and the period 1892-1895, when, amongst other means of retrenchment, adopted, the employees in the workshops were put on reduced time commencing with 5½ days, then 5 days, and later still 4½ days per week. In August, 1895, full time was restored.

When age or ill-health necessitates men being dispensed with they are not cast off unconsidered, but a gratuity is given to them which, in some measure, serves to dull the edge of their distress, and stave off immediate want. Employees killed or maimed in the discharge of their

duty are always made a subject of special consideration, and widows and orphans in this regard invariably receive the compassion and assistance of the Commissioners.

It is always within the province of any member of the staff to appeal to the Commissioners should he consider himself aggrieved by any action of his superior officer, and for the hearing of cases of punishment, &c., an "Appeals Board" has been constituted by legal enactment. This includes certain heads of branches and one member elected solely by the staff. Three forms a quorum, and the appellant may be represented by counsel (at his own cost) should he so wish.

The personnel of the staff has frequently been referred to by the Commissioners and others in high authority in most complimentary terms as being favorably comparable with similar bodies in any part of the world.

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SAFETY APPLIANCES.

This constitutes a very important branch of railway working, and one which, particularly during the last 20 years, has been much improved. There was no interlocking of points and signals of any description in use prior to 1881, and the only protection in the way of signals provided at stations consisted of home and distant semaphores of a type now obsolete.

In December, 1881, the first complete interlocking installation (Mackenzie & Holland's) was opened at Burwood, on the suburban line.

We read that in 1883 points and signals were interlocked at only 16 stations, while in 1888 the number so treated was 78. In 1898 the stations fitted aggregated 417, and at the end of last year there were 577 so safeguarded—72 per cent. of the total.

Up to 1883 Redfern yard was controlled by about half-a-dozen semaphores. In that year two signal boxes were erected, one containing 40 and the other 32 levers. At the present time these boxes have 119 and 104 levers in them respectively.

In the new central station now approaching completion further improvements will be brought into use, an electro-pneumatic system being adopted in the place of the mechanical apparatus at present in vogue.

The "Staff and Ticket" system for single line traffic was instituted in 1877, and a year later what was known as "The Absolute Block System" was brought into use. Up to 1888, however, the mileage treated was very small. From 1888 an apparatus which combines the advantages of the "Staff and Ticket" and "Absolute Block" systems, and known as "Tyler's Tablet," has, in conjunction with "Webb and Thomson's electric staff" system, been brought almost generally into use.

In 1898 there were 1156 miles worked under the block, and at the present time the mileage so treated is 1,320.

Simpler safety appliances are in use where the exigencies of the traffic will admit, and by means of these intermediate tablet stations may be cut out and the attendance of officers thereat rendered unnecessary. For express trains a system of automatic exchanger is in vogue which permits of drivers—travelling at a regulated sped—exchanging the tablet when running through stations.

ACCIDENTS.

Unfortunately the history of the New South Wales Railways cannot be accurately chronicled without mention being made of several disastrous accidents involving serious loss of life and injury to limb. The cause of some few has been directly traceable to the hand of Providence, but the majority are due to a disregard of instructions on the part of the servants of the department. No matter to what extent the administrators may strive by the introduction of mechanical devices to secure immunity from accidents, the intention is always liable to be frustrated by the element of human fallibility. Again, we have had instances where the cause of the accident has been so occult as to tax the powers of our most scientific engineering experts to determine it.

Standing first in point of enthralling interest—though not of numerical magnitude in the matter of loss of life and injury to limb—is the accident at Redfern on the 31st October, 1894, in which 13 people in an incoming morning business train were scalded to death by escaping steam from the locomotive, the back plate of which was perforated by an engine attached to the Southern passenger train leaving Redfern. On this occasion 30 other people were injured. The cause of the accident was a disregard of signals.

The Peat's Ferry (Hawkesbury River) accident on the 21st June, 1887, which was caused by the inexpert manipulation of the Westinghouse brake and the consequent loss of control over the train on a steep gradient, might have been much more dire in its result but for the courage and presence of mind of a pointsman who, sticking to his post, turned the fugitive train off the main line into the siding, thus saving it from dashing into and wrecking another train full of passengers standing at the station waiting to depart for Sydney. The casualties were five killed and 73 injured.

The disaster at Sydenham on the 15th February, 1901, with its large death roll, was said to have been due to a combination of causes, namely, an unsuitable type of engine running at an excessive rate of speed on a road not in first class order. On this occasion the engine and two cars were derailed and nine people met their death, while 39 were injured.

The horrible catastrophe at Tarana on the 27th April, 1892, was due to the derailment of two cars through a broken rail. The details are harrowing. The entire sides of two 46-feet cars were totally demolished and eight people practically torn to death against the ragged edges of a deep rocky cutting. Nine other persons received injuries of a more or less serious character.

Another of the most fearful of our catastrophes was that at Cootamundra on the 27th January, 1885, when the Melbourne-bound train, with its living freight, dashed into the Salt Clay Creek, the embankment having been swept away by an abnormally heavy flood. In this accident seven were killed and 21 injured.

CONCLUSION.

A general retrospect of the period traversed impresses us with two palpable facts. Firstly, the wonderful development of the system during the period 1875-1885, and secondly the marvellous improvements effected in all branches since 1888.

In connection with the first-mentioned fact, it is seen that the capital expenditure was nearly trebled, and the revenue almost quadrupled. The rolling stock was added to by 290 per cent. in locomotives, 173 per cent. in carriages, and 394 per cent. in waggons. The expenditure on permanent way maintenance advanced by 553 per cent. The passengers carried in 1885 were 12 times as many as in 1875, and the goods tonnage nearly three times as great. The mileage open for traffic increased by 351 per cent.

In no other similar period were any such results approached, except we take notice of the first 10 years of the existence of the railways. The figures for this period, however, would not form a criterion, inasmuch as the system could hardly be regarded as established until at least a few years after its commencement. For instance, we find that the goods tonnage rose from 2,469 tons in 1856 to 416,709 tons in 1865—an increase of 16,777 per cent.—due, as already mentioned, to the opening of the Northern line in 1857, and the meteoric development of the Newcastle coal trade. The normal increases in goods tonnage were for each succeeding decade—181 per cent., 179 per cent., and 63 per cent. For general expansion, the period 1875-1885 is undoubtedly a unique one in the history of the New South Wales Railways.

With regard to the second fact, the improvements effected since 1888 must be patent to the majority of the adult population of to-day. No matter what section of the working we analyse the same result confronts us. The stability and evenness of the permanent way, the alterations in grades and curves, the comfort—almost luxury—of travelling, the construction and efficiency of the rolling stock, the conditions governing the staff, the station accommodation, the speed and accuracy of train running, the safeguards against accidents, are all features of the improved working of this large and valuable asset. When it is added that all these improvements have been effected concurrently with a passenger and freight list decreasing in rate, it will be recognised to what an extent the general public has benefited during the period under notice.

Looking at the railway map of to-day and comparing it with maps of previous issue, it is noticeable how, in many instances, anticipations have remained unrealised. Thousands of miles of route in all directions have been surveyed from time to time, only to remain as mementos of projects abandoned or held up.

A journey over the railways of the State affords a constant view of dismantled lines—monuments of early history—which the passage of time and march of events have relegated to a sphere of inadequacy and consequent oblivion.

Peering into the future we can see the possibility of Brisbane, Sydney and Melbourne being connected by an alternative and shorter route, skirting the North Coast from the Tweed to the Hunter, then proceeding via the existing line to Hornsby, through Milson's Point, across

the Harbor by a bridge of striking proportions and design, to the great central station in Sydney. On again by the Southern line to Goulburn, through Cooma and Bombala (perchance the capital of Australia), thence across the border, and finally to Melbourne by the glorious Gippsland line.

On the west, the great Zig-Zag superseded by a tunnel through the mountains, and the ultimate extension of the line through Condobolin or Wyalong to the South Australian border, to junction, may be, with the Transcontinental line to Perth.

The balance of the system, intensified in its maze like tracks, by new lines and extensions of existing ones.

It is by reticulating the country with such a network of railways as is indicated that we may hope to provide means of transport for the produce of our settlers in the pastoral and agricultural districts. But the advantage of such an extended system of railroads would not be confined to the mere increase of traffic, for, with the facilities for regular and constant railway communication, the identity of interests of adjoining districts will day by day become more apparent.

Our 50 years' record is indeed a creditable one. A great national asset has been built up, which, in addition to being reproductive, marks a spirit of enterprise and ability which cannot fail to raise the State and its inhabitants in the estimation of critics. Given favorable circumstances and a continuance of the free constitution which we as Britons inherit, together with wise legislation, the future should hold for the railways of New South Wales a position, which, if achieved, will delight the hearts of the generations yet unborn, and afford future historians a task fraught with pleasant contemplation and accomplishment.

Appendix No. 1.

Statement showing Gross Revenue, Expenditure, Percentage of Expenditure to Gross Revenue, Capital Invested, and Interest per Centum per Annum returned on the Capital Invested.

Year.	Gross Revenue	Expenditure.	Percentage of Expenses to Revenue.	Capital Invested	Interest % per annum.
	£	£	%	£	%
1855 (3 mos.)	9,249	5,959	64·43	513,347	(3 mos) 0·63
1856	32,283	21,788	67·49	683,217	1·53
1865	166,032	108,926	65·60	2,746,373	2·07
1875	614,648	296,174	48·18	7,245,379	4·39
1885	2,174,368	1,458,153	67·06	21,831,276	3·37
1895	2,878,204	1,567,589	54·46	36,611,366	3·60
1904	3,436,413	2,258,940	65·74	42,288,517	2·80
1905	3,684,016	2,192,147	59·50	43,062,550	3·46
		Percentage of Increases.			
	%	%		%	
1865 over 1856	414	400		302	
1875 ,, 1865	270	172		164	
1885 ,, 1875	254	392		201	
1895 ,, 1885	32	7		67	
1904 ,, 1895	19	44		16	
1905 ,, 1895	28	40		18	

Appendix No. 2.

Statement Showing Passenger and Goods Traffic

ALSO

Population, Miles Open for Traffic and Train Miles Run.

Year.	Population.	Miles Open for Traffic	Train Miles Run.	Passenger Journeys, Number.			Total Earnings from Coaching Traffic.	Goods, Livestock, Etc.					Total Earnings Merchandise Traffic.
				1st Class.	2nd Class.	Total.		Livestock. Number.	Minerals. Tons.	Wool. Bales.	General. Tons.	Total. Tons	
							£						£
1856	286,873	23	68,371	31,434	319,290[B]	350,724	29,526	[A]	[A]	[A]	[A]	2,469	2,757
1865	409,147	143	483,446	58,221	693,366	751,587	92,984	23,448	306,578	28,672	110,129	416,707	73,048
1875	594,297	473	1,472,204	207,115	1,081,110	1,288,225	205,941	134,248	557,861	97,630	184,125	1,171,354	408,707
1885	949,570	1·732	6,638,399	4,439,216	9,067,130	13,506,346	830,904	2,110,686	1,996,548	361,118	1,139,724	3,273,004	1,343,464
1895	1,250,760	2·531	7,594,281	4,379,998	15,345,420	19,725,418	1,022,901	4,270,310	2,606,874	747,480	1,175,875	4,075,093	1,855,303
1904	1,445,728	3·281	10,400,503	5,237,250	28,555,439	33,792,689	1,442,733	2,941,973	4,597,774	449,938	1,830,364	6,656,759	1,993,680
1905	1,478,260	3.281	10,467,886	5,594,429	29,563,721	35,158,150	1,469,018	3,644,869	4,538,021	560,426	1,921,198	6,724,215	2,214,998

[A] Figures not obtainable. [B] Includes 3rd Class which existed up to 1863 ; Number, 279,960.

Percentages of Increases.

	%	%	%	%	%	%	%	%	%	%	%	%	%
1865 over 1856	43	522	607	85	117	114	215					16,777	2,549
1875 ,, 1865	45	231	204	256	56	71	121	473	82	241	67	181	460
1885 ,, 1875	60	266	351	2·043	739	948	303	1,472	258	270	519	179	229
1895 ,, 1885	32	46	14	(Dec.) 1·2	69	46	23	102	31	107	3	24	38
1904 ,, 1895	16	30	37	19	86	71	41	(Dec.) 31	76	(Dec.)40	56	63	8
1905 ,, 1895	18	30	38	28	93	78	44	(Dec.) 15	74	(Dec.)25	63	65	19

As the operations of 1855 only covered a period of three months, 1856 is taken as a starting point.

Appendix No. 3.

Statement Showing the Sub-division of Gross Expenditure.

Year.	Permanent Way Branch.	Locomotive Branch.	Traffic Branch.	General Charges.
	£	£	£	£
1857 (A)	7,086	14,466	9,259	527
1866 (B)	27,082	40,648	35,920	2,579
1875	66,542	126,380	88,183	15,069
1885	434,647	505,438	412,588	105,480
1895	399,679	625,433	441,798	100,679
1904	519,389	1,054,168	601,634	83,749
1905	491,164	1,023,551	596,313	81,119

Percentages of Increase.

	%	%	%	%
1866 over 1857	282	181	288	389
1875 „ 1856	146	211	145	484
1885 „ 1875	553	300	368	600
1895 „ 1885	(Decrease) 8	24	7	(Decrease) 5
1904 „ 1895	30	69	36	(Decrease) 17
1905 „ 1895	23	64	35	(Decrease) 19

Note.—General Charges include Administration, Gratuities, Compensation. &c.

(A) Earliest figures obtainable. (B) 1865 figures not obtainable.

Appendix No. 4.

Statement showing Number and Tractive Power of Locomotives. Number and Carrying Capacity of Passenger Carriages. Number of Coaching Vehicles other than Passenger Carriages. Numeer and Carrying Capacity of Goods Vehicles.

Year.	Locomotives.		Passenger Carr'ges		Other Coaching Vehicles.	Goods Vehicles.	
	No.	Tractive Power. lbs.	No.	Seat. Cap'city Persons	No.	No.	Carry. Capcy Tons.
1855	4	35,748	28	924	6	51	306
1865	36	328,092	105	3,836	72	403	2,418
1875	100	1,216,157	184	6,403	160	1,571	9,364
1885	390	5,951,353	502	21,840	354	7,755	54,763
1895	523	8,227,566	562	29,649	482	10,316	79,857
1904	620	12,101,791	681	36,629	445	12,181	108,373
1905	622	12,312,797	695	37,239	427	12,228	108,922

Note.—The above excludes a small number of engines and vehicles which, though still capable of service, are of obsolete types, and classed as duplicates.

Percentages of Increase.

	%	%	%	%	%	%	%
'65 over '55	800	818	275	315	1,100	690	690
'75 „ '65	178	271	75	67	122	290	287
'85 „ '75	290	389	173	241	121	394	485
'95 „ '85	34	38	12	36	36	33	46
'04 „ '95	19	47	21	24	(Dec.) 8	18	36
'05 „ '95	19	50	24	26	(Dec.) 11	19	36

Appendix No. 5.

Statement showing progress made in the type of Locomotive used. The Table shows the most powerful Engines in use at the time quoted.

Year.	Tender Engines.						Tank Engines.			
	Gross Weight—Tons.			Size of Cylinder.	Steam Pressure.	Tr'ctive Power, each.	Gross Weight	Size of Cylinders.	Steam Pressure.	Tr'ctive Power, each.
	Engine.	Tender.	Total.	Inches.	lb.	lb.	Tons.	inches	lb.	lb.
				Passenger Engines.						
1855	26	20	46	16 x 24	120	8,937				
1865	26	20	46	16 x 24	120	8,937	30	15 x 22	120	7,200
1875	33	22	55	18 x 24	120	11,311	30	15 x 22	120	7,200
1885	43	27	70	18 x 26	140	15,467	40	16 x 24	140	11,374
1895	56	32	88	20 x 26	160	22,187	56	17 x 26	150	14,782
1905	57	41	98	20 x 26	160	22,187	72	18½x24	160	19,116
				Goods Engines.						
1855	26	20	46	16 x 24	120	8,937				
1865	30	20	50	18 x 24	120	15,552				
1875	37	26	63	19 x 28	120	16,173				
1885	46	26	72	20 x 24	130	20,375				
1895	63	27	90	21 x 26	160	26,979	66	18 x 26	140	19,656
1905	66	41	107	21 x 26	160	28,777	66	18 x 26	140	19,656

A.C.T.