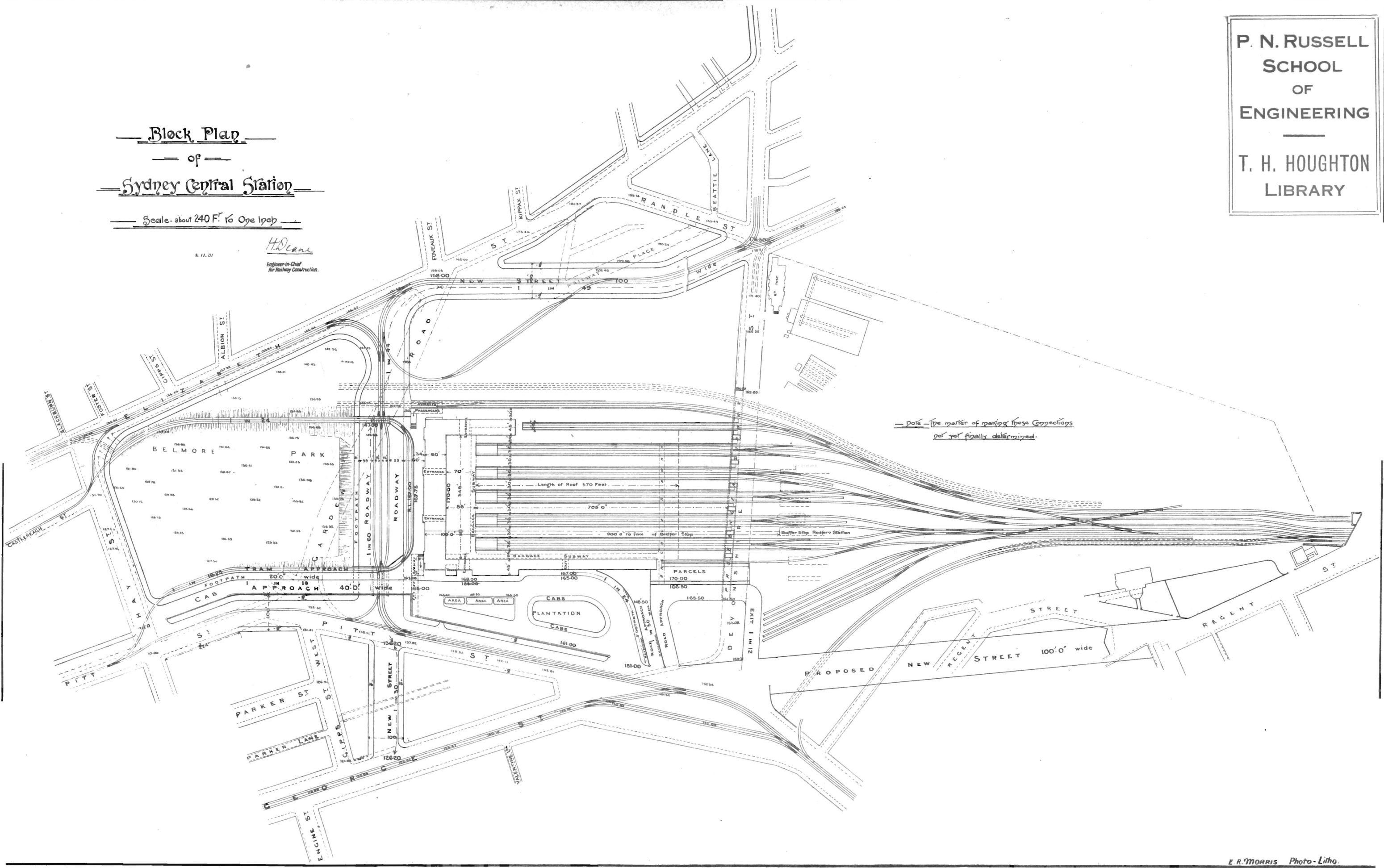


P. N. RUSSELL  
 SCHOOL  
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 ENGINEERING  
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Block Plan  
 of  
Sydney Central Station

Scale - about 240 Ft. to One Inch

H. Deane  
 Engineer-in-Chief  
 for Railway Construction.



— Done — The matter of making these connections  
 not yet finally determined.

The new Station contains the following :—

No. 1 ... ..	715 feet	715 feet.
2 and 3 ... ..	593 „	1,186 „
4 to 13 ... ..	702 „	7,020 „
		<hr/>
Total ... ..		8,921

This shows that the new station contains practically double the platform length of the old.

These figures, however, are very far from representing the actual capacity of the two stations, as the conveniences and readiness with which trains can be handled are vastly greater in the new one. No sooner will a train arrive in the station than a new locomotive can be run in from a refuge siding and coupled up, and as soon as the passengers are discharged, it will be ready to go out again. Moreover, much more work can be got out of the locomotives, and it will be seen that at a time when the intensity of traffic is greatest there is no need for idle standing in the dock, but the arriving locomotives can be shifted at once by means of the traverser on to the middle road and run out of the station to the shed, or otherwise to the refuge siding, where coal and water can be supplied to it, and so prepare it for the next trip. To my mind, there seems to be little doubt that as far as the design of the station and entrances are concerned, the number of trains now accommodated at Redfern could be increased four or five times without inconvenience. This certainly seems to promise that the station will be large enough when the population of Sydney reaches 2,000,000, which, at the average rate of increase during the last ten years, will take 150 years.

At the terminus of the Great Eastern Railway Company in London, at Liverpool Street, which has the largest passenger traffic of any station in the world, an enormous business was done before 1894, when the station was practically doubled. It is stated that during that period 1,000 trains per day came in and out, which means 100,000 passengers to be carried at times. This was done with nine platforms, and a similar number of passengers are now conveyed in and out of King's Cross station with the same number of platforms. I think I may say that we are better off here than the Great Eastern Company ever was in London, inasmuch as we have a much freer hand in laying out the roads running into the new station and are less cramped. The consequence is that we ought to be in a position with our thirteen platforms to do a larger business comfortably than can be conducted at Liverpool Street with eighteen platforms. If doubling the number of platforms means doubling the capacity for handling trains, then at Liverpool Street 2,000 trains and over 200,000 passengers daily could be handled, and thus we ought to be in a position to do some such enormous business as this before the new station grows to be cramped. The present maximum passenger traffic is about 20,000 passengers in and out daily.

The platforms on the new station are arranged to give about fifteen feet clear width to each adjacent road, and the double platforms are therefore made a little over thirty feet wide. The side platforms have been arranged to give a width of twenty feet.

The Americans are satisfied with much less width for their platforms than we are. A width of fifteen feet between each pair of roads suffices them. The difference of practice in this respect is remarkable.

At the New Southern Railway station in Boston and at St. Louis, into each of which about thirty roads are carried, these narrow platforms are adopted. At Philadelphia, where the main roof is considerably less than ours, seven double train docks and two single ones are placed, making practically sixteen platforms in a width of 307 feet, as against our ten in a space of 348 feet.

When comparing the adequacy of a site for a station, it must be conceded that the American system admits of much greater economy of space. The two characteristics before all others of American practice which bear on this question are :—

(a) The flexibility of the rolling stock, and

(b) The corridor and Pullman cars with absence of compartments and side doors.

(a) The flexibility of the rolling stock is due to two considerations. All cars whether passenger or goods, are carried on bogies, and the buffers are central. This permits of the use of sharp curves, in some cases of exceptionally sharp curves such as may be seen at the entrance to Philadelphia station, where it is provided that freight cars will run on curves of less than 100 feet radius into stores.

(b) The absence of side doors admits of narrower platforms being used. Possibly in America sufficient consideration is not given to convenience of passengers in this respect, but it is quite certain that a width of fifteen feet, which reference to the St. Louis plan shows exists, would be altogether impossible when compartment carriages and side doors are used.

Another point in American practise is the absence of heavy baggage, nothing but hand baggage being admitted on to the platform.

The following figures showing the amount of traffic in some of the principal stations in Great Britain are interesting :—

	No. of Platforms.	No. of Trains.	No. of Passengers.
Liverpool Street ...	18	1,100	128,283
		max. 1,200	sometimes even 150,000
King's Cross ...	9	800	100,000
*Waterloo ...	11	1,040	80,000
London Bridge ...	6	665	75,000
Cannon Street ...	4	1,068	—
Broad Street ...	8	794	90,000
Waverley (Edinburgh) ...	17	471	65,000
Sydney ...	—	324	ordinary 40,000

8-hour day 1896, 476 between 50,000 and 60,000

\* Reconstruction under consideration with increase of platforms to twenty-five.

To meet the desires of the Railway Commissioners, each of the five train docks under the main roof has three roads. The middle road has the double purpose of either serving as a road for running the engine out by on arrival, or if this is not required, and in the use of quick suburban traffic when the trains are being handled rapidly and there is no necessity to run the locomotive out before the train leaves, the third road may be used as a store for carriages.

At the ends of all these treble road docks, traversers will be provided. They take up less room than cross-overs, as very little more than fifty feet is thus taken up, namely, the length of an engine and tender. If cross-overs were used, this length would have to be increased to 150 feet, and the train, in order to avoid fouling, would have to stand so much further out from the buffer stops. Two single lines traversers will probably be required, one on each outside road, for it is clear that the roads should be left continuous up to the buffer stops, as it would be difficult sometimes to prevent a train dropping into the pit. The traverser can be worked by hydraulic or electric power with which the new station will be amply supplied, or, what is probably better still, by gravity and automatically. If the middle road is laid a few inches lower than the others, the loaded traverser, on the release of a catch, would run down and take up the middle position, and after the locomotive has run off, a balance-weight might bring it back to its original position.

The most modern kind of buffer stop is the hydraulic, and this will be adopted at the new Station.

One matter which has to be carefully considered, and which has not yet been decided, is the method of providing water for the engines on arrival at the refuge siding and while waiting for their next job. There are several methods available. One is, to have a series of water cranes direct from a main running across the yard. This method is as a rule to be avoided. The water column requires a pipe of eight or nine inches diameter to supply it, and the opening and closing of the valve of such a large pipe means too great a fluctuation and strain on the main.

Another way, and that commonly adopted, is to have a capacious tank at one corner of the yard from which the supply pipes to the water cranes can be run. This is a great improvement on the first method, as a comparatively small pipe always pumping will keep the tank constantly full, but the principle involves a great length of supply pipe of large diameter. A modification of this has been suggested, under which a long narrow tank extending across the yard could supply the water columns without much length of expensive pipe.

A third method is one that has many advantages. It consists of the use of umbrella tanks. This is a small overhead tank, the water column acting as a pedestal to contain a tender tank full. When the engine comes alongside, the tank is discharged rapidly into the tender. After this, and before the next locomotive comes up, a comparatively small pipe fills it.

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*Signalling and Interlocking.*—A modern station with large traffic cannot be safely and expeditiously worked without interlocking. The points and signals are so interlocked that the signal for a train to proceed along a certain route can only be lowered after the line has been made clear in that direction, and the other signals are set that another train cannot attempt to proceed along or across its track without violating them. The usual system now is the rod and lever system of Mackenzie and Holland. The levers are about six feet long, and are placed in a signal box high over the lines where a commanding view can be obtained. The levers require some considerable effort to move

as they have to operate through rods several hundred yards in length. A limit of about 200 yards for facing, and about 300 yards for trailing points exists, so that in the case of a lengthy station yard, additional signal boxes are necessary under this system.

Hydraulic power has been sometimes used and the physical loss is thereby much lightened. Short levers, one foot or eighteen inches, are used which are easily worked.

The most recent system is the electro-pneumatic. There is under this system a distribution of tubes through which compressed air is conveyed throughout the yard and supplied to cylinders, the pistons of which work the points and signal levers. There is also a system of electric wires with a magnetic apparatus corresponding to each pneumatic cylinder. When the particular lever in the operating box is worked it operates on an electro-magnet which opens a valve and admits compressed air to the cylinder. The lever is only a few inches in length and can be moved with the slightest pressure of the finger. The limit to distances is only one of sight, and in this its superiority is shown over the rod system first mentioned. In fact, as repeat signals are now given in the signal-boxes, it is not absolutely necessary for the course of a train to be visible, although it is safer. Another important advantage is that all pipes and wires are buried, and the station hands are not exposed to the danger of tripping over obstructions caused by rods and signal wires. The wear and tear is much reduced. The station at St. Louis is a good example of electro-pneumatic signals.

The extent to which interlocking may be applied in a large modern station is shown by the following figures:—

Edinburgh (Waverley) station—			
Number of levers ... ..	...	...	538
Ditto in east cabin...	...	...	260
Liverpool Street, London—			
Number of levers ... ..	...	...	424
Ditto in main cabin ... ..	...	...	240
Newcastle upon Tyne—			
Number of levers in main cabin ...			244

The subject of signalling and interlocking alone is one to which a paper might well be devoted. \_\_\_\_\_

The foundation-stone of the building was laid on the 30th April last by the Hon. E. W. O'Sullivan, our energetic Minister for Works. This stone is situated at the corner of Pitt-street and the new street, and will form part of what is known as the basement, really the ground floor of the building.

Since then the work of the foundations has progressed and a good deal of masonry above ground, chiefly in the approach road on the north and the bridge.

At the present time, 105 masons are employed dressing stone at Mr. Robt. Saunder's yard at Pymont; 26 bricklayers and masons engaged in setting; 350 hands besides employed in concreting and other work about the station. The work, therefore, is well in hand.

The load on the foundations of such a massive and tall building is necessarily very high. At the base of the tower it is calculated to be about eight tons per square foot, and under the main walls 9·8 to 11·7 per square foot.

It is clear how necessary it is to sink to rock if the latter is within reasonable distance. Were rock not obtainable at a reasonable depth the foundations would have to be spread out with the aid of concrete so as to reduce the load to something like one ton to one-and-a-half tons per square foot, according to the bearing properties of the ground.

A great deal of water has been met with in some parts during sinking. This fact makes it all the more desirable that the principal walls should rest on rock. Water renders the ground very uncertain as a foundation, it makes clay soft, very often unevenly so, and, consequently, unreliable.

Wet sand makes a good foundation, but experience shows that when a building stands on wet sand it may be under those conditions perfectly stable, but if subsequently works at a lower level cause the water to be drained out a settlement takes place.

It would be rather premature to give a detailed account of the material to be used in the structure of the station, as many points have still to be decided on. The proper time for a complete report is when the work is done. I might, however, state the following: With regard to steel, it has been decided to adopt the standard which Professor Warren, Mr. De Burgh and myself fixed upon for the North Shore Bridge, and the specification laid down for the guidance of tenderers for that work has, I may say, been adopted in the Public Works Department of this State as a standard specification.

The stone used, except in the case of corbels, bedstones, &c., will be sandstone equal to the best Pymont sandstone, and the bricks, broken stone and sand will be of the best quality.

The cement will be such as will pass the standard of the Public Works Department, and will, probably, largely consist of what is now successfully made in the State by Messrs. Goodlet and Smith and the Commonwealth Portland Cement Company, but the selection will largely depend upon prices, as the importers will, no doubt, do their utmost to compete successfully.

I wish here to add that Mr. W. L. Vernon, Government Architect, has co-operated with me in the architectural part of the design, and that I have had the able assistance of Mr. John Parry in all matters relating to traffic and traffic arrangements.

I will now exhibit a few slides showing stations in America, Great Britain, and Europe which are worthy of attention.

*Broad-street Station, Philadelphia, Pennsylvania Railroad Co.*—Several views are exhibited showing the basement or street floor plan, platform floor plans, and a perspective view of the building; 250 trains arrive and 255 leave the station daily; and between 7 and 9 a.m., forty-four arrivals and thirty departures. I would point out that in the United States of America, the tramway traffic has undergone such an enormous development that the bulk of the suburban traffic is conducted through this means, and one of the greatest problems before the Railway Companies is to retain the traffic of which, through the extension of the electric tramway system, they are continually being robbed. The train shed has sixteen tracks; span, 306 feet 9 inches; length, 647 feet.

*Union Depot, St. Louis.*—This, in 1894, when I visited America, was claimed to be the largest station in the world, and, as regards number of roads laid into the station, it was so. There are as many as

thirty of them in pairs, and about twenty different railway companies entering the station. Its greatest rival in size is the Southern Railway Station at Boston. The latter station successfully competes, as although in the main station, that is, the upper floor, there are fewer roads, the basement is also devoted to passenger traffic, and here a loop and platform are provided for the suburban traffic, of which there is a large amount. Width of shed, 601 feet, divided into five spans—one in centre, 141 feet  $3\frac{1}{2}$  inches; two of 139 feet  $2\frac{1}{4}$  inches; two of 90 feet 8 inches. Length, 700 feet.

*Southern Terminal Station, Boston, U.S.A.*—The population residing within five miles of the Boston Town Hall numbers 2,392,000. Lines belonging to five different companies are accommodated within a single building. The platforms are constructed on different levels, the sub-rails being seventeen feet below the main floor of the building and forming a complete loop within the station. There are four underground platforms, each of which can accommodate four trains. There are twenty-eight platforms on the main floor above. The train shed is 602 feet long and 570 feet wide, the roof being divided into three bays, one central span of 288 feet 6 inches, and two side spans of 169 feet 9 inches each. 737 trains enter and leave the station daily, 65 of them within a single hour. The signalling system adopted is the electro-pneumatic.

*The Waverley Station at Edinburgh* of the North British Railway Company has not long been reconstructed. The estimated cost was £1,400,000. The number of trains daily in the summer is stated to be 471, and the approximate number of passengers 65,000. It is a through station for a considerable portion of the traffic, and therefore does not resemble ours; but there is a great deal of sub-local traffic carried on, and for this fifteen dock platforms are provided, the total number being nineteen.

*Liverpool Street Station, London* Terminus of the Great Eastern Railway Company.—This is a low-level station, with rails about fifteen feet below the streets. There are eighteen platform roads, of lengths varying from 900 to 485 feet. Contiguous to the ends of nearly all the platform roads short refuge sidings are provided in which engines can stand when waiting for their train or to take water, and thus keep the main running roads clear for trains to arrive and depart without having to shunt engines from one main line to another, as is the case with most large terminals. On an average there are approximately 1,100 trains in and out daily, and on busy holidays upwards of 150,000 passengers may be counted as using the station. Adjacent to, and entered from the platforms and street, is a very fine hotel.

*York Station.*—I have selected this station on account of the picturesque appearance of the buildings and surroundings. The rails and platforms, with their covering roof, are on a curve, and the appearance of the interior may be well known to some of you, as it is often depicted in views of railway works. The large building is an hotel. Compared with some other stations, the amount of business does not look large, the maximum number of trains per day being about 358. The number of platforms provided is thirteen.

*St. Pancras Station*, London Terminus of the Midland Railway Co.—The station was built in 1868 to the design of Sir Gilbert Scott, R.A. It is a high-level station, about fifteen feet from the street level to the rails. The station roof is an imposing structure, 243 feet span; length of roof, 690 feet. There are fourteen roads in the station and seven platforms, the two arrival platforms having a fine wide cab road between them. Attached to the station is the Midland Hotel, managed by the Company.

The last slide is a diagram showing the rate of increase of population between the years 1840 and 1901, or over a period of sixty-one years. The particulars for making this diagram have been kindly furnished to me by the Government Statistician. The form of the curve is remarkable. The rapidity of increase rapidly accelerated after the year 1870, but about 1892 it received a check, and, since then, the increase has gone on in arithmetical rather than geometrical progression. Between 1892 and 1901, the progress has been, roughly speaking, at the rate of nearly 10,000 per annum, and should the rate not undergo acceleration again, it will take about 150 years for Sydney and suburbs to acquire a population of 2,000,000; after which, possibly, the Railway Commissioners of the period may feel themselves under the necessity of applying for an enlargement of the station to meet the growing traffic. Of course, at present we do not know what the result of Federation will be, whether to make the country more attractive to outsiders, or whether immigration may not be stopped as in a recent instance, in which case population may not advance with the leaps and bounds which it has done in the past. But, of course, we have always the natural increase of the resident population to look forward to.

I must now tender my thanks to those gentlemen who have kindly come forward and helped me in collecting the materials for the slides which you have to-night had before you, and among them are Mr. Oliver, Chief Railway Commissioner, Mr. Gullick, the Government Printer, and Mr. Parry, Comptroller of Stores in the Railway Construction Department. To Mr. Cooper, Superintendent of Technical Education, I am indebted for the loan of the slides showing the first locomotive used in New South Wales, and I also have to thank Mr. Quodling, of the Railway Department, for the loan of negatives from which Mr. Degotardi has prepared the views of the trains.

It remains for me to thank you for the kind and patient manner in which you have listened to my address, which I feel has been in many respects imperfect, but which will, nevertheless, have been of some use by bringing forward a subject in which the popular interest is naturally very keen.

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