Although for some years past every effort has been made by locomotive men to lessen the necessity for renewals of wearing parts by the introduction of wrought iron axle boxes case-hardened, cast steel horn blocks fitted with hardened faces, cast steel crossheads lined with white metal on wearing surface, special steel for crank pins, all of which have very largely diminished the cost of repairs, but the cost of renewals and frequent returning of tyres is responsible for a large share of the expense. Further, there are other parts, such as new pistons, re-boring of cylinders, which, if neglected, have a large say in the increase of the coal bill. But, above all, I think the boiler is responsible for the heaviest expenditure in the way of maintenance, and naturally so. Considering the conditions, therefore, too much attention cannot be given to this part of the engine, the removal at stated periods of the tubes, and the stripping of the outer clothing for the purpose of internal and external examination, all of which are absolutely necessary in order that the boiler may be maintained in reliable and efficient working order. As no risks dare be taken, all this tends to increasing the cost of maintenance.

But when the conditions under which our engines and boilers are worked, and the mileage run, are considered, the question of maintenance is not a very large one.

I would like here to give some idea of the work performed by some of the engines on the New South Wales railways as compared with engines in England. For instance, our P Class engines running our heavy express trains have averaged a mileage of 36,102 miles during the past year, and there are other classes, such as the B and M, which have averaged a mileage of 25,971 and 37,608 respectively during the past year, and all performing the heaviest work that engines could be called upon to perform. By comparing the above with work done by engines in the old country, whose average mileage seldom, if ever, exceeds 22,000 miles per year; in many cases the mileage is much less than that figure.

I am aware that in America things are much different on some of the roads, for many of the locomotive en-

gineers believe in putting new engines on to the road and making it pay for itself as soon as possible; in fact, I saw while in America an instance of this on the New York Central, the engine being worked by two sets of men, and was kept in steam almost continuously, excepting when blown off to wash out the boiler and effect running repairs, and the mileage of this one engine averaged some 8000 miles per month

BOILERS.

The life of boilers depends largely upon the material from which they are made, the water used, and the mileage run, or other work they have to perform. Many of the original boilers on our railways were made of the best Yorkshire iron, such as Lowmoor and Bowling, and have been remarkable for their good state of preservation after a life of 25 years and over. Of course, the wear and tear or strain was not so great as at present, nor was the pressure at which they were working so high, but, withal, our experience so far points to the fact that the highest quality of Yorkshire iron gives better results than steel for locomotive boiler construction. It is perhaps a bold thing to say, and might give rise to considerable comment and discussion, but nevertheless there is a good deal to be said in favour of iron for boiler construction on our railways. Our experience during the last ten years with boilers made of steel, using almost exclusively Sydney water, has been anything but satisfactory; in fact, some of the boilers on our suburban engines have been very badly affected in parts, such as the front and tubeplate, bottom of barrel, and outside shell of firebox at the foundation ring, the latter plates wasting through in a very short time, thus necessitating heavy repairs much sooner than was formerly the case. And to such an extent has it gone on in these boilers that it has been found necessary to renew the outer shell firebox after a life of less than a year; but it must be said that the decay has not been so noticeable in some of the out-districts, where the water is more or less impregnated with lime.

I am aware that for marine and stationary boilers steel has given general satisfaction, but the conditions under which they work are very different to locomotives.

In deciding the life of a locomotive boiler on the New South Wales railways, our regulations provide that after 15 years, or a mileage of 375,000 miles, a decision must be given by the Chief Mechanical Engineer as to a reduction of pressure for the further working of the boiler, this being deemed necessary in consequence of the deterioration of material that has taken place, and thus guard the safety of the travelling public.

Of course, locomotive engineers are fully alive to the advantage to be gained by using steel, in so far as the cost compared with the Yorkshire iron, and also being able to use lighter plates; but as a set-off the cost of labour in working and the durability of iron must be taken into consideration. I am aware that I have made some remarks that might give rise to considerable discussion, and which cannot well be dealt with here, but might be dealt with, with advantage, on some future occasion, for it yet remains to be seen what part nickel steel is going to play in the construction of locomotive boilers, for it is possible it will be an important one. So far as I have been able to give the question any thought, it is stated that its cost is somewhat against it coming into general use. This, I hope, will soon be overcome; but I am watching very closely the actions of our American friends, who are ever ready to bring into practical use a material giving such promising results as claimed for this material.

Return showing the average consumption of coal per engine mile for each of the following classes of engines during the year ended 30th June, 1899:—

Class of Engine.	Consumption of Coal in Pounds per Engine Mile.
A	46.79
B	58.45
D 255	39.04
E	42.74

Class of Engine.	Consumption of Coal in Pounds per Engine Mile.
I	54.13
J 483	102.42
L 304	58.05
L 436	58.20
M	55.29
O	79.74
P	52.29
T	81.01
Average for all classes of engines ..	55.86

WORKSHOPS.

In addressing you last year I casually mentioned the fact that very large additions were being made to our workshops in the way of building a new erecting shop, it having been found impossible to keep pace with the repairs to our engines with our then existing plant, for it can be readily understood that it is not a good policy to allow engines to stand after they have been withdrawn from traffic for repairs, but to deal with them and return to service as soon as possible. The shops referred to have been occupied since the first of the present year. The building is in two bays of 55ft. by 400ft. long, and is equipped with four electric cranes, each having a lifting capacity of 35 tons, so that an engine up to 70 tons can be lifted off its wheels and carried to any part of the shop and placed upon the blocks ready for the workmen to get about it to effect repairs. A length of shafting running the whole length of the building is also driven by an electric motor, and when some small machines that are coming to hand are erected the shop will be, though not the largest, one of the most modern of the day. In addition to the new shop referred to, it has been found necessary to obtain some of the latest machinery, such as large milling machines, special lathes, and other tools for dealing expeditiously with repairs and minimising the cost of same. Other branches of the works are progressing just as rapidly, as two large steam hammer or forge shops are now being erected, each

being 140ft. long by 70ft. wide, with the prospect of being duplicated at no distant date. A 70cwt. Davis and Primrose steam hammer, two furnaces, and two hydraulic cranes for same are now being erected, and will occupy a large portion of one of the shops referred to; and in addition a large Ingersoll-Sargeant duplex air compressor has recently been erected, and pipe mains laid for conveying compressed air throughout the shops for working different pneumatic tools, such as hoists, caulking tools, drilling and tapping machines, rivetters, etc. This system of working special tools is very largely used in America, with excellent results. The air main referred to will be laid across the yard to the carriage shops to work special machines to be used for repairs to carriages, waggons, painting, etc. The air will also be conveyed to Macdonaldtown washing shed, and Redfern, for the purpose of carriage cleaning, the work being much more cheaply and effectively done by this means than by hand labour. This system of cleaning has been very largely in use in America for some time, so that it will be readily conceded that on the New South Wales railways we are not slow to avail ourselves of whatever improvements are going on in other parts of the world.

I am pleased to say that all praise is due to the Railway Commissioners for their readiness in adopting the recommendations of their principal officers in the expenditure of large sums of money for the equipment and maintenance of the workshops necessary to carry on the repairs and renewals of the railway system. But beyond the question of repairs, the time is not far distant when, in my opinion, we will have to depend largely upon ourselves for what we require in the way of engines and boilers, for already we are building our boilers at a much less cost than they can be obtained from England at the present time. We are also laying ourselves out to turn out a new boiler per week, this being necessary to keep pace with our demand.

CARRIAGES.

In addition to the improvements that have been going on in the way of engines, tools, etc., the Railway Com-

missioners have greatly improved the accommodation provided in the carriage rolling stock, in the way of providing excellent first and second class lavatory compartment carriages, and there have been constructed within the last three years three first and three second class corridor cars, which are fitted up with every convenience for passengers who do not wish to avail themselves of the sleeping accommodation of the Pullman cars when travelling by the Melbourne express between Sydney and Albury.

The cars referred to are 61ft. long over bodies and 67ft. long over platforms, and are carried on two six-wheeled bogies, each having a wheel base of 10ft., the centres of the bogies being 46ft. apart. There are eight passenger compartments in the car, which is entered from the ends, having a passage or corridor running the full length of the car. At one end is the ladies' bou doir, to which is attached the necessary lavatory and toilet accommodation, and the other end of the car is the smoking compartment, also provided with the lavatory accommodation; each compartment is provided with a sliding door, giving access to the passage. The total seating accommodation in the car is for 64 persons.

The first class cars are fitted and upholstered in white hair cloth, similar to the Pullman sleeping cars, and the second class is upholstered in the best buffalo hide leather; in fact, the second class of to-day is much better than many of the first class of a few years ago. The cars are vestibuled at the ends to allow them to be coupled with the first class Pullman sleeping cars, and thus make a vestibuled train throughout. In addition to the above, two very handsome sleeping cars have recently been built in the Eveleigh workshops, and are precisely similar to the Pullman cars, appearance, fittings, and appointments, with the exception that they are not vestibuled at the ends.

The bodies are 61ft. long, and the length over the platform is 66ft. 8in., and they are carried on two six-wheeled bogies, each having a wheel base of 10ft. The centre of the bogies are 46ft. apart, the total wheel base

being 56ft. The interior of the car is divided into a smoking compartment, with lavatory and toilet accommodation at one end, the main sleeping compartment with accommodation for 24 persons, and a ladies' compartment for four persons. The total sleeping accommodation is for 28, but during the day there is accommodation for 62 persons. The cars are tastefully fitted throughout, and are highly appreciated by the travelling public, as they are much more comfortable than the old sleeping cars that were previously used on our lines for many years.

It has also been found necessary to alter a number of the old compartment carriages for travelling on our branch lines. This has been done by taking out the centre compartment and dividing it into two lavatory compartments, and connecting them with the vestibules by passages running along the sides, in one case connecting with the three second class compartments, and on the opposite side with two first class. These alterations have been highly appreciated, and although there is a loss of seating accommodation for 10 passengers in each carriage taken up by the lavatory space, the Railway Commissioners are always ready to consider the comfort and convenience of the travelling public on our lines.

In conclusion, I would draw attention to the flourishing condition of the engineering trade throughout the world. This, of course, is very gratifying to engineers. So far as locomotive building is concerned, during the last two or three years it has been most prosperous. The value of the locomotives exported from England, as per Board of Trade returns, nearly doubled between the years 1895 and 1898, viz.:—

1895	£798,027
1898	£1,482,759

And the value for the first quarter of the years 1895 and 1899 shows a very large increase, viz., £198,480 and £341,361 respectively.

The value of the engineering produce of all sorts exported from England during the three years 1896-7-8 are:—

1896	£17,036,899
1897	£16,282,085
1898	£18,380,076

And although I have been unable to get the figures of a later date, there is no doubt that they will exceed those quoted above, as we are fully aware that many of the shops in England are working day and night.

I find that the number of hands employed in some of the principal locomotive works are:—

Hyde Park Works	2700
Atlas Works	1800
Dubs, Glasgow	2200
Kitson, Leeds	1500

I have not been able to ascertain the figures for two of the principal firms, viz., Neilsen's (Glasgow) and Beyer, Peacock, and Co. (Manchester), but I have no doubt that could the figures have been obtained they would show to be much larger.

The following figures, taken from the official returns issued from Washington, show that the value of locomotives exported from the United States of America for 1897 was 3,225,831 dollars, or about £645,161, this showing that America, as well as England, is sharing in the prosperity of the engineering trade.

Referring to the shipbuilding trade in England and America, the following figures given in the "Shipping World," which has recently published the world's output of tonnage, gives the total for the United Kingdom, including private and Royal dockyards, at 1,763,914 tons, whereas the output for 1898 was 1,675,055 tons, representing a gain to the extent of 88,859 tons in the year's work for the British shipbuilders; but out of the above, nearly 70,000 tons are due to the output of tonnage by the Royal dockyards. These figures will give some idea of the state of the engineering and shipbuilding trades in England.

In America the increase for 1899 was 283,964 tons, against 216,298 of 1898, showing that in this branch they have had a fair share of prosperity; and I am aware, from private sources, that the engineering trades both in England and America have orders placed for the next 18 months or two years.

"T" Class (8-wheeled coupled), Australian Consolidated.

Outside cylinders	21 x 26
Wheels	4ft 3in diameter
Boiler pressure	160lbs
Diameter of boiler	5ft 0½in
Length of firebox	9ft 4in
Width of firebox	4ft 0½in
Number of tubes (1⅞in)	302
Heating surface	2198ft
Grate area	29.75
Height of centre above rail	7ft 8in
Weight of engine and tender	107 tons 5cwt
Tractive force	28,777lbs