Colonel Kitson Clark: I think, gentlemen, considering that many of you have to go away early, we will not allow any more law, and I will ask the Hon. Secretary to read a message from the Chairman, Mr. H. N. Gresley.

The Secretary, Mr. A. T. Houldcroft, read the following letter from Mr. H. N. Gresley:

"I very much regret that I shall be unable to be present at the first meeting of the Winter Session of the Institution of Locomotive Engineers at Leeds on the occasion when Mr. Bamber will read his paper on Coal and Mineral Traffic on the Railways of the United Kingdom.' I have to be in London to-morrow and regret that I cannot get down in time to attend the meeting. Will you be kind enough to convey to Mr. Bamber my regrets at being unable to be present when he has so kindly come down, and particularly as the paper deals with a subject in which I am keenly interested. Colonel Kitson Clark has kindly promised to take the chair in my absence. I shall be glad if you will send me a copy of Mr. Bamber's paper."

The following telegram from Mr. A. C. Stamer was also read:

"Very much regret cannot be present to-night."

Colonel Kitson Clark: Mr. Kelway-Bamber has written a most important paper, which I have read with a great deal of interest. He is going to take the main portion of the paper as read, and will introduce certain important features in addition to his original remarks, and afterwards I shall
preface a long discussion, we hope, on the merits and demerits of this paper.

Mr. H. Kelway-Bamber: Before proceeding to the discussion of the paper on "Coal and Mineral Traffic on the Railways of the United Kingdom" which, having already appeared in the May-June issue (Nos. 29 and 30) of the "Journal" of the Institution, will be taken as read, I would remind you of the objects with which it was written:—

(a) To compare the relative efficiency of British railway coal carrying wagons with that of high capacity vehicles in service on the (3ft. 6in. gauge) railways of the Union of South Africa, the loading gauge of which closely resembles that of the railways of Great Britain;

(b) To show the scope for improvement in the load carrying capacity of British railway coal and mineral wagons; and

(c) To indicate the extent by which such improvement would increase the carrying and revenue earning powers of British railways;

and would reiterate paragraph 45 of the conclusion, namely, that "until the improvements referred to in the paper have been effected British railway practice will continue to fall short of the maximum possible load carrying and revenue earning power of coal and mineral wagons, while the general efficiency of the whole railway system of the country will continue to be unsatisfactory."

The photographs of wagons I propose now to show on the screen are those reproduced as figures Nos. 5, 6, 7, on pages 165 to 167 of the "Journal." The carrying capacity, dead weight and principal dimensions, etc., of these vehicles are given in the paper and compared with British wagons of 10 tons capacity. They are briefly:—

<table>
<thead>
<tr>
<th>Railway</th>
<th>Type of wagon</th>
<th>Coal carrying capacity Tons</th>
<th>Dead weight of wagon Tons</th>
<th>Gross weight per wagon Tons</th>
<th>Gross weight per axle foot of rail Tons</th>
<th>Gross weight per axle foot of wagon Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>South African side Bogie high ...</td>
<td>45.0</td>
<td>17.0</td>
<td>62.0</td>
<td>15.5</td>
<td>1.44</td>
<td></td>
</tr>
<tr>
<td>(3' 6''). Bogie hopper ...</td>
<td>45.0</td>
<td>18.0</td>
<td>63.0</td>
<td>15.75</td>
<td>1.47</td>
<td></td>
</tr>
<tr>
<td>Indian Four wheeled (5' 6''). high side ...</td>
<td>23.25</td>
<td>8.75</td>
<td>32.0</td>
<td>16.0</td>
<td>1.44</td>
<td></td>
</tr>
<tr>
<td>British Four wheeled (4' 8½''). high side ...</td>
<td>10.0</td>
<td>6.0</td>
<td>16.0</td>
<td>8.0</td>
<td>0.89</td>
<td></td>
</tr>
</tbody>
</table>

These figures show what great scope there is for increasing the paying load of British railway coal wagons and
for making better use, not only of main line track, but also of existing siding accommodation.

And here I would invite your attention to the inability of a large number of British railway wagons to carry a full marked load of "screened" coal, due to insufficient space in the wagon body; the following figures illustrate this:

<table>
<thead>
<tr>
<th>Marked load</th>
<th>Cubic contents</th>
<th>Actual body capacity</th>
<th>Percentage of short load for &quot;Screened&quot; coals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons.</td>
<td>wagon body (a)</td>
<td>Unscreened coal (b)</td>
<td>Screened coal (c)</td>
</tr>
<tr>
<td>10</td>
<td>420</td>
<td>10.0</td>
<td>8.75</td>
</tr>
<tr>
<td>12</td>
<td>543</td>
<td>12.93</td>
<td>11.3</td>
</tr>
<tr>
<td>15</td>
<td>631</td>
<td>15.0</td>
<td>13.2</td>
</tr>
<tr>
<td>(d) 20</td>
<td>940</td>
<td>21.43</td>
<td>19.58</td>
</tr>
<tr>
<td>30</td>
<td>1,255</td>
<td>30.0</td>
<td>26.0</td>
</tr>
<tr>
<td>40</td>
<td>1,648</td>
<td>39.24</td>
<td>34.33</td>
</tr>
</tbody>
</table>

(a) Includes 8 per cent. for piled load.
(b) 42 cubic feet = 1 ton.
(c) 48 " = 1 "
(d) N.E.R. wooden four-wheeled hopper wagons.

My recent investigations in the north of England to ascertain the cubic equivalent per ton of various kinds of unscreened and screened coals, also of coke, give the following results which may be useful in the future in designing wagons for the carriage of these materials.

In this connection, for calculating the amount of coal and coke that can safely be loaded and carried above the height of wagon body sides, the unit should be 1 ton (2,240 lbs.) per 100 square feet of wagon body top area for all kinds of coal, and half a ton for any kind of coke.

### Cubic feet per ton

<table>
<thead>
<tr>
<th>Cubic feet per ton (2,240 lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal.</td>
</tr>
<tr>
<td>Gas</td>
</tr>
<tr>
<td>Anthracite</td>
</tr>
<tr>
<td>Bituminous</td>
</tr>
<tr>
<td>Steam</td>
</tr>
<tr>
<td>Wallsend (screened)</td>
</tr>
<tr>
<td>Welsh</td>
</tr>
</tbody>
</table>

| Coke.                      |
| By-product ovens           | 73 to 75 |
| Beehive ovens              | 77 to 85 |
| Gas cinder (retorts)       | 90 to 92 |
OUTPUT OF COAL.

The output of coal in the United Kingdom (paragraph 5) during the year 1913 was about 287 million tons, compared with 232 million tons for the year 1904, the output of 1913 being thus 55 million tons or 23.41 per cent. greater than for 1904. If this rate of progress continues we should be producing 20 years hence about 430 million tons per annum, or approximately the annual output of coal in the United States of America before the war.

Of the 287 million tons of coal raised in the United Kingdom during 1913, 227 million tons (paragraph 11), or approximately 80 per cent. was loaded into wagons for transport by rail.

By 1938, unless large quantities of coal are consumed in creating electrical power near pithead, something like 344 million tons will be rail-borne and certainly the railways of the country, unless enormous capital and other expenditure is incurred, will be quite unable to handle such a traffic in wagons of low capacity.

DISTRIBUTION OF COAL OUTPUT.

Of the total coal mined in 1913 about 66 per cent. was consumed in this country, and the remainder exported to other countries, or used as bunker coal in ocean-going steamers. Of the 227 million tons of coal and coke loaded into wagons in the United Kingdom during 1913 the North Eastern Railway carried 41,500,000, or over 18 per cent., the Midland over 12 per cent., the Great Western and North British Railways about 10 per cent. each, the Taff Vale coming next with 15,682,640 tons, or 6.9 per cent.

It is an interesting fact that the weight of coal loaded into wagons on the Taff Vale Railway during 1913 was almost equal to the entire output (16,208,000 tons) of Indian coal mines for that year.

It has been said that the unit adopted for comparison in all the statements given in the paper, namely, a 10-ton British private owner's wagon, weighing 6 tons, is too low. I should be glad of the opinion of members on that point.

NUMBER OF ROUND TRIPS.

(a) I should also like to know whether the average wagon loading of 35 times per annum given in paragraph 22 of the paper is considered correct.
GROSS GOODS WAGON EARNINGS.

These you will see, in paragraph 23, are estimated at £37.41 per wagon per annum or nearly 47 per cent. of the pre-war cost of the vehicle.

PERCENTAGE OF PAYING LOAD TO GROSS WEIGHT HAULED.

(b) In calculating the percentage of paying load to gross weight hauled (paragraph 29) the weight of wagons hauled empty to coal mines on the return trip must be added. To take into account only the tare weight of the loaded wagon is manifestly incorrect and incomplete.

THE DEAD WEIGHT HAULED.

(c) It seems to me unfair to the magnificent locomotives put on the road in these days to call upon them to haul on the round trip say $81 \times 6 \times 2 = 972$ tons of dead weight for a paying load of $81 \times 10 = 810$ tons, when for the same gross train weight (1,298 tons) the dead weight might have been reduced by the use of 45 ton bogie wagons to $17 \times 21 \times 2 = 714$ tons or by 26.5 per cent. and the paying load increased to $45 \times 21 = 945$ tons, or by 16.66 per cent.

COAL CONSUMPTION.

(d) I should be glad of an expression of opinion on the conclusion under this head.

TRAIN LENGTH.

(e) A possible saving of nearly 108,000 miles of train length and of siding accommodation by the use of 45 in place of 10-ton wagons should provide food for thought.

GROSS WEIGHT PER FOOT OF TRACK.

(f) The figures given in paragraph 34 on this head show a possibility of doubling the efficiency of track and sidings for every pair of loaded coal wagon wheels and axles on the road.

FUTURE TRAFFIC.

Referring briefly to paragraph 37 summarising the probable position of coal and mineral traffic by the year 1930, the following conclusions are reached:—

(u) Reduction in the number of coal and mineral wagons to be handled of 35 millions or 77.77 per cent.
(b) Improvement in the percentage of paying load to gross weight 22.22 per cent.
(c) Reduction in the dead weight hauled of 180 million tons or 33.33 per cent.
(d) Reduction in main line locomotive coal consumption of 4,821,000 tons or 40.13 per cent.
(e) Reduction in the overall length of loaded wagons of 144,886 miles or 47.25 per cent.
(f) Increase in the gross weight per foot of wagon length of 62.92 per cent., the gross weight of wagon per pair of wheels on rail being at the same time doubled.

My hope is that the facts set forth in this paper will be well considered, and that the conclusions may, as far as possible, be acted upon.

DISCUSSION.

Colonel Clark: Gentlemen,—I will begin the discussion by introducing a subject which admits of no discussion. I propose a vote of thanks to Mr. Bamber for his lecture, and will ask some gentleman to second it.

Mr. Bamber, besides having done valuable and important work in India for a long time, on the East Indian Railway, is a distinguished musician, and he has, I think, tuned the whole of his proposals to one key, the present largest standard vehicle for the purpose. I do not pretend to have any railway knowledge of the subject, but I should like to suggest another way of dealing with the thing, and that is to ask Mr. Bamber to supplement this symphony with another passage in which he takes a higher key than is possible under existing circumstances.

I notice he takes his maximum axle load as 16.00 tons and his weight per foot-run as 1.47 tons. Well now, there are plenty of driving axles on the English railways up to 22 tons per axle load. The highest weight per foot-run of a locomotive runs up to as much as 4 tons.

Mr. Bamber: It depends upon whether you take it on the whole length of the engine.

Colonel Clark: Over wheel-base, and it is more than 1.45 over buffers. I suggest to Mr. Bamber that he should consider the extreme possibilities under present conditions of weight. We know that the main objection to the stan-
standardisation of locomotives is not so much the variation of the loading gauge as the variations and troubles due to weight. Mr. Bamber, with his energy and his knowledge of the subject, I feel perfectly certain could arrive at a general average maximum, and I should like to ask him to see what can possibly be done if you used the average maximum at its fullest capacity. He has raised the axle load from 8 tons to 16 tons. Suppose he were to raise his axle load from 16 to 20 tons?

Mr. Bamber: Apart from what the engineer might permit, there is a limit to the load you can carry on a journal with cool running, and that may be taken at 750 lbs. per square inch of the bearing. In India we worked gun-metal bearings to 550 lbs. per square inch, but when wagons increased in weight we had endless trouble with hot boxes. 750 lbs. per square inch gives an axle load of from 22 to 23 tons; with white-metal bearings and rolled-steel journals cool running can be assured.

Colonel Clark: I am unrepentant. I think the last word as to running journals cool when they are heavily loaded has not yet been said. It is certainly a line to which all locomotive and carriage engineers should devote their most earnest attention. If by running a journal cool with a heavier load than 750 lbs. per square inch you increase your capacities almost in the same proportion, you would put it all into the paying load.

Mr. Bamber: Very largely.

Colonel Clark: I therefore commit the discussion into the hands of those who know more about the matter, premising first that you second the vote of thanks to Mr. Bamber for the way in which he has introduced the subject.

Mr. J. R. Bazin (G.N. Ry., Doncaster): I have very much pleasure in seconding the vote of thanks to Mr. Bamber for his most interesting paper, and there is no doubt that, from the remarkable figures which he has given us, he has made out a very good case indeed for the use of high capacity wagons.

Unfortunately, existing circumstances on British railways have been, and are at present, rather against the introduction of these wagons.

So far as the actual running of the train is concerned, there is no doubt that it is a very important point to make the paying load as great as possible, but there are many other points to take into consideration.
To begin with, the collieries are not equipped for dealing with these bogie wagons. Then again, when the wagons have been brought from the collieries they have to be marshalled into long distance trains. The usual form of marshalling is by means of the hump or gravitation system, which means that the wagons are sent down the yard into their respective marshalling roads. Now when wagons are all about the same capacity not much harm can result from this. But a point then arises, what is going to be the effect of marshalling high capacity wagons amongst wagons of lower capacity, say 40-ton wagons against 10-ton wagons.

Also, if the coal the wagons contain is for shipment the docks and the tips are not fitted for dealing with large wagons.

Mr. Bamber states in his paper with regard to the coal which is carried, I think it was about 66 per cent., was for home consumption, and I believe I am right in saying that something like 86 per cent. of that coal for home consumption is required in small consignments of under 20 tons. At least that was so a few years back.

Further, it seems no great point would be gained by using wagons of 40 or 45 tons capacity when the load would probably have to be divided amongst two or three coal merchants.

There is another point which one considers. What is going to be the effect so far as the repair shops are concerned with these high capacity wagons? At the present time we hardly know which way to turn on account of the number of wagons we have on hand for repairs. All railway companies are not equipped at their out-stations for dealing with wagons of large capacity, and it would probably mean an expensive plant and extra accommodation being provided for running the wagons into the shops, with overhead travelling cranes, particularly for wagons under load when the axles run hot, and also it would probably mean a different class of men to deal with them than we have at the present time.

One cannot help feeling that, under present conditions, where the common user wagon is so much in evidence, what would have been the effect on the British railways if the greater part of their stock had been high capacity wagons, because, under the common user arrangement, wagons are sent from one end of the kingdom to the other, and, moreover, a great trouble arises in the fact that wagons break down on systems far away, and we are repeatedly having to send spare parts to put them right again.
Now these high capacity wagons, particularly those of 45 tons capacity, running on bogies, and perhaps fitted with automatic brakes, mean a lot of extra spare parts, which would require a great many more wagon parts to be sent about the country than at present with the smaller wagons.

I noticed on the two slides shown, the first one of the Indian State Railway wagon of 24 tons capacity was on two axles. I should like to know how it was the Indian State Railways, in adopting high capacity wagons, built them to run on two axles, and did not go in for a still higher capacity, as the South African Railways have done.

So far as this country is concerned with the 12-ton wagons, it seems that it is the most profitable at the present time for dealing with coal. There are certain cases, and particularly under the prevailing war conditions, where through trains are being run longer distances than before, taking larger consignments of coal, and in those cases wagons of 20 tons capacity are being used with great advantage. But it is very necessary to keep the trains intact, and if wagons of very much larger capacity were introduced I think that is one of the first things which would have to be done, so that the wagons do not get separated.

In conclusion, I should like to say that the 12-ton wagon seems to be the wagon which suits everybody. It has a fairly high paying load, and it is convenient to be dealt with under the existing conditions which prevail on British railways.

Mr. E. Spencer (Leeds): I should like to ask Mr. Bamber how the difficulty of corrosion is surmounted. The great objection in this country to steel wagons for coal traffic has always been owing to corrosion, especially of steel underframes, which get eaten away quickly and have a very short life.

The next point is the fitting of the vacuum brake on high capacity wagons. This would greatly assist in running, which would be much faster and entail less knocking about.

Another point is that these wagons would be much better built than the present day type of 10 or 12-ton wagons, which I always look upon as the limit in bad construction.

Axleboxes, of course, call for a great deal of attention. A very good type of axlebox would have to be used and I think some remarks by Mr. Bamber on axleboxes would be appreciated, say, on the axlebox which was made standard on the East Indian Railway, which I consider a very excellent type.
If the general workmanship in high capacity wagons equalled the standard of workmanship of the wagons supplied for export, there would be no need for half the repairs there are in this country.

The usual trader's wagon has been badly made because the price would not allow anything decent to be put into it. But if the Railway Clearing House demanded that a respectable wagon should be built, it would assist enormously in every way, and taking all these matters into consideration, the figures shown in the saving in coal consumption would be much improved owing to better running.

Mr. H. Thorpe: As a visitor, and knowing little of the technical side of the business, I should like to say something of the practical. I know the difficulties there are in the way of any developments of the kind indicated in the paper under discussion, and I was glad to hear Mr. Bamber say it was a question more of replacements, which, I take it, means that it is more a question of the old process of evolution than of revolution, and any such departure as is indicated in the paper must necessarily be by evolution.

Mr. Bamber has set his ideal very high when he takes a 45-ton wagon and fixes his figures accordingly. Of course, I know, on the other hand, it means one wagon only to be dealt with in place of four.

There is a great deal of force in what the first speaker said. Gravitation shunting, in the first place, demands a big staff, because every such wagon must be brought to rest at the foot of the grade. A 45-ton wagon involves the maximum difficulty, and it seems to me that if Mr. Bamber will fix his figures on the 20-ton wagon, then he has got a real practical proposition to put before the public, and there is a fine example on the N.E. line. All that Mr. Bamber puts forth in his paper every railway company can appreciate. There is also a saving in transportation, engines, and the whole of the working, but the question of the size of the wagon does not depend by any means altogether upon the railway companies, hardly 50 per cent. of it.

You must carry colliery owners and traders with you because there is practically no plant in this country capable of dealing with a 40-ton wagon. Also at the bulk of the places where they take the bottom door wagons it means new gantries, lifts, turntables, weigh-bridges, coal-tips, cranes, and general equipment, the present arrangements not being fit for anything beyond a 12-ton wagon, generally speaking.
I think that, as regards mineral traffic, there is a fair practical opening for the development of mineral wagons up to 20 tons, but from what Mr. Bazin put forward, if you only have 45-ton wagons you are going to throw the small consumer into the hands of the middleman, a very undesirable procedure.

Mr. Bamber stipulates that we shall always have the small wagon with us, but there is a good deal to be said for progress, and progress must be our aim. We cannot afford to stand still.

In ten years the coal traffic has increased to the large figure named, and the same reasons given in connection with it will operate more and more after the war, so that one welcomes every effort to develop the capacity of wagons to increase the transport power of the railways, but the trader needs converting more than anyone else, and inducements to colliery owners must be in evidence.

Mr. Bamber has made a most lucid and attractive presentation of his case. If the 10-ton load is either low or high it does not affect his comparison. I am disposed to think the 10-ton load is high. If so it reduces the claim that Mr. Bamber might have made, and what I was pleased with is that the figures are reasonable and generous. They are not put together to make a case, but are apparently sound.

I am very glad to have had the invitation to be present, and I think I shall have profited by what I have heard.

Mr. W. Paterson (L. and Y. Ry., Low Moor): I might be allowed, as representing the locomotive department, to take part in the discussion. I should like to say, first of all, that I have listened with intense interest to Mr. Bamber's admirable paper, and I am sufficiently optimistic to believe that the next ten years will see a very marked progress towards his ideal.

I think Mr. Bamber might have strengthened the case by introducing the effect on the acceleration of trains, due to the reduction in the train length which would follow the adoption of high capacity wagons. The length of the trains was hinted at, and it is an important factor.

I agree that the railway companies are not the retarding agents in regard to the progress towards the ideal. It is absolutely the traders.

I will say that on the Lancashire and Yorkshire Railway practically the whole of the locomotive coal is carried in 20-ton wagons, the tare of which is, I think, 9 tons
10 cwts., and they are 24ft. 6in. overall. They include end-door wagons and side-door wagons.

On the L. and Y. Ry. we have a number of high capacity wagons running, which would be increased in number if the private owner difficulty were not in the way.

We have also on the L. and Y. Ry. a number of 30-ton low sided goods wagons, 14 tons 2 cwts. tare, and they are 43ft. 0in. overall. I have seen in connection with the Lancashire cotton trade as many as three "flats," by that I mean the flat part of a lorry, on which were loaded the consignments, probably belonging to three different mills, and these flats were placed inside the 30 tons low sided wagons. It occurs to me, that if the small trader cannot do with more that a ten-ton lot of coal, the wagon builders might be sufficiently ingenious to design a bogie vehicle of that description, and fit it with boxes, perhaps of ten tons capacity, which could be lifted off by existing cranes under ordinary circumstances, on to a special platform if you like, or on to separate trolleys, and so in that way the difficulty could be got over, because on one of these long frame vehicles you would have five separate lots for small traders.

Another idea which occurs to me is, that possibly there might be an extension of the ingenious device for economising the number of bogies under a train, as on the Great Northern Railway. Carry your goods vehicles say on three bogies for two vehicles.

These are suggestions that occurred to me in thinking over the difficulty due to the conservatism of the small trader.

In conclusion, I should like to say that the paper has been very instructive to me.

Mr. J. S. Elliott (L. and Y. Ry., Goole): There is one point which has been missed, and that is the matter of these wagons in transit. I presume Mr. Bamber is referring to mineral traffic. Well, a large amount of mineral traffic is mixed with merchandise, and anybody who has had any experience in long trains which have got intermixed with lighter wagons knows how very difficult they are to handle.

There is also the point about the braking required to bring these large wagons to a standstill, and that is a point which should certainly not be lost sight of.

Also a great portion of the distribution of household coal is done in small lots, and cannot be dealt with in large capacity wagons.
What is really required is a good first class standard 12-ton wagon, which could certainly be made of a lighter type, and could be greatly improved, and there should be an acceleration in the service of wagons. There is room for improvement in the number of trips made in a year.

If we could only get the 12-ton wagon standardised it would help the country, especially if all the present multiplication of parts now utilised could be reduced, and as a result we should do a great deal better.

There is also the cost of the appliances, hoists and tips, etc., of which there are none in the country at present capable of dealing with large wagons, and there you are coming up against other concerns, which would necessitate a big outlay in money to deal with these wagons.

There is the point about weight per foot-run mentioned by Colonel Clark. I think he is right in saying four tons.

I have very much enjoyed Mr. Bamber’s paper. There is a lot of food for thought in it, but has the time arrived yet for such a comprehensive scheme?

Compared with America, the average haul and distances are very much greater there, and if you are taking train loads of high capacity wagons, well and good, but it would be difficult for the English traffic departments to deal with them when they are intermixed.

Mr. A. T. Houldcroft: Mr. Bazin asked a question as to what we should do with high capacity wagons as regards repairs. Well, in India our facilities were very much restricted, but when a repair was required we managed to do what was necessary, very often on the road. It was also mentioned about wagons being sent from one end of the country to the other. Well, even in cases of that kind we had no difficulty as regards spare parts. As a matter of fact the wagons are well built and the percentage of wagons in the shops for repairs was always very small.

A question was asked by Mr. Bamber as to the average mean traffic hauled in the United Kingdom. The United Kingdom practically has the worst record in the world; 24.86 miles is the mean haul. It is a disgrace to the country, and it will be a disgrace to this Institution if we allow it to continue without doing our bit to help in its improvement. Why, even Italy and Japan do better!

I have much data upon the subject, and it would, I am sure, convert everyone of you if time permitted. Why are some of our railway people afraid of high capacity wagons? Briefly put, is it not because, having taken the lead in railways, our facilities are not now equal to the inevitable
developments? Are we to perpetually suffer for our original enterprise? I assure you the present facilities which interfere with high efficiency, rapidity of collection, despatch, and true economy ought to be scrapped, and you will find it would amply repay that scrapping which is also inevitable in the best interests of the nation and even of the railways.

(The Author then showed some interesting photographic lantern slides of the various types of wagons used in India and South Africa, and also showing the means adopted in those countries for loading and unloading into vessels at dock-sides.)

Mr. Bamber: Before proceeding to answer the various questions raised during the discussion, I should like to say that my journey here has been well repaid by your practical remarks and criticisms. Some of the points raised are new to me. I value them highly, and will do my best to reply to them.

With regard to the Chairman's remarks and his suggestions as to the extreme possibilities of gross wagon weights, as I said, this so far as the wagon builder is concerned, is limited only by the weight that can be carried by the journal with cool running.

The largest journals in service are 11in. x 6in. diameter; those on the North Eastern Railway 20-ton wagons are, I believe, 10in. x 5in. diameter. The South African wagons (3ft. 6in. gauge) have 11in. x 5½in. diameter journals. There is a limit to the length of a journal, and there is also a limit to the effective width of a bearing, namely, about 3½in.

In India the use of white-metal lined bearings on cold rolled-steel journals 10in. x 5½in. diameter, with mineral oil and pad or cotton waste lubrication, has ensured cool running under 16-ton wagon axle loads.

With regard to interchangeability of parts, I recall that when wagons arrived in India from England in batches of 200 and upwards, the packing cases were broken open, and any wagon part used on any wagon. I must say that during my whole sixteen years' experience on Indian railways we very rarely had to send a complaint to England on this matter.

About cold rolling of journals, this produces a very smooth hardened surface, which does much to reduce friction.

I was very much interested in Mr. Bazin's statement that existing circumstances prohibit the use of high capacity wagons. They do, but existing circumstances very nearly brought this country to destruction, and I feel that this is
the time when we should break through conventions and overcome difficulties. My view is that such additions and renewals of wagons as must shortly be made should be in high capacity vehicles.

The marshalling of high and low capacity wagons and the manner in which wagons should be brought to a stop was dealt with in India.

With regard to coal shipping facilities at ports, it is quite possible to make such modifications in existing arrangements as will render the use of bogie wagons practicable. Every bogie means half the number of vehicles to be dealt with.

Mr. J. R. Bazin: With regard to the shunting on gradients, it really is a very serious matter for English railway companies while private traders are to be considered. The liability of railway companies is heavy enough now, and if high capacity wagons were introduced it would be a very serious item.

Mr. Bamber: I recognise that, but the difficulty will have to be overcome. The root of the matter is that if something is not done to improve the capacity of wagons we shall soon be in a very bad way. The results of the introduction of high capacity vehicles in India and South Africa, notwithstanding that marshalling and shunting operations are carried out by natives of those countries, has been in every way satisfactory.

With regard to vacuum braked goods trains, the heavy mineral trains composed of 45-ton high capacity bogie wagons, working over heavy grades on South African railways, are vacuum braked throughout. On Indian railways (5ft. 6in. gauge) a number of vacuum braked wagons is attached next to the engine and their brakes used. As a result the drivers gained confidence, and the speed of goods and mineral trains has been increased.

Then as to small consignments of coal for coal traders on British railways, what was said is quite true. It is the vested interest of the private wagon owner and of the small dealer which stands in the way of progress. At the same time it is extraordinary what can be done. People say, "We will not use this thing," but when at last persuaded to do so, they say, "Why did we not use it before?" I would like to give you an illustration. Indian 5ft. 6in. gauge railways had their centre of tracks fixed by early engineers twelve feet apart, and at the same time the overall width of carriage and wagon doors fully opened was 13ft. 3in., so that when trains passed each other with doors
open they were torn off. As outward opening doors caused this serious trouble, and as the centre of existing tracks could not be altered, obviously the thing to do was to make the doors open inwards. That meant that a cross compartment carriage was no longer practicable. The seats were therefore arranged longitudinally, and as at that time lavatories were being introduced for each compartment the longitudinal seating was very convenient. A sample carriage was built, but the Traffic Department said, "We will not take it; we dislike inward opening doors and longitudinal seats." There came a day, however, when they were short of a vehicle, and they put the new carriage on the train. It was seen by other traffic men, who said, "This is exactly what is wanted." Within five years scarcely a carriage was built in India without inward opening doors and longitudinal seats. Such carriages on Indian railways have long since become the standard type.

As to the repair of high capacity wagons, I can assure you the higher quality of workmanship renders the necessity for repairs comparatively small.

A high capacity four-wheeled vehicle is no doubt a useful unit, but I cannot see that a 12-ton wagon would be in the face of the figures given in the paper.

Mr. Spencer spoke about corrosion. That is, of course, a difficulty, but I have recently seen some all-steel coal wagons which were practically as free from rust as when they came out of the shops fifteen years ago. All that is necessary is regular and reasonable attention.

Another important matter raised in the discussion was the necessity for a higher class of axlebox. In India most new axleboxes are made of cast-steel.

Now as to wagons, mostly all-steel, built in England for Indian and Colonial railways. The workmanship is very high class, almost locomotive work, and I can only say that in consequence the working results have been very satisfactory.

Mr. Thorpe spoke of evolution and the difficulties in the way of the adoption of high capacity wagons, also the effects of the shunting operations. Evolution is what I recommend, and as to working difficulties, they have been met and overcome in other countries.

High capacity wagons should be introduced gradually, as existing wagons are broken up and have to be replaced, or as additions to stock become necessary.

Mr. Paterson spoke of the progress in ten years, and the effect on the collieries. The shortening of the train
length, coupled with the security given by the vacuum 
brakes, should make a much greater through speed possible.  
Mr. Paterson's proposal to carry several portable con-
tainers on 30-ton wagons has much to recommend it.  
In India when wagons were returned to the workshops 
badly damaged, but repairable, I found it more convenient 
to condemn the vehicle outright, to return usable parts to 
the stores for subsequent issue, and to replace the con-
demned by a new vehicle. In this way the amount of 
capital lying idle was much reduced and shop space 
economised.  
I was glad to hear Mr. Paterson say he thought the 
high capacity wagon would have to come.  
He spoke of carrying two wagons on three bogies, and 
I think that while that is satisfactory for coaching stock, 
it is not possible for high capacity goods stock with axles 
loaded to their maximum capacity.  
Mr. Elliot spoke of the shunting of wagons in transit. 
These are difficulties that have also been overcome elsewhere.  
I am very grateful to members present for the remarks 
which have been made. 

Colonel Clark: I should just like to say one thing in 
regard to the statement that these high capacity wagons 
must come. My works are situated in a corner, and it would 
be extremely difficult to work in these high capacity wagons, 
though we are prepared to do what is necessary. 
I think you should have two wagons, one the utmost 
capacity on two axles and the other the utmost capacity on 
two bogies, and let people have their choice. They would 
choose the high capacity wagon.  
I am sure we are all very much obliged to Mr. Bamber 
for his excellent paper and his most practical replies. 

Mr. Bamber: Mr. Chairman and Gentlemen,—I thank 
you, and may say what a great pleasure it has been to me 
to come here and listen to such a practical discussion.