

portation had already attained, $2\frac{1}{2}d.$ per car-mile meant $3\frac{1}{2}$ millions Mr. Gribble. sterling per annum on the total. Economics, however, were not everything. The æsthetic objection to overhead wires was always worthy of respectful consideration. It had, however, been subordinated to utility in the past, and would be so also, he believed, in the future. He did not claim for railless traction what the enthusiasts of the tramcar and motor-bus claimed for those vehicles—that it was a panacea for all the ills of congested populations. He claimed, however, that its economic advantages must win for it a wider field than its opponents indicated.

Correspondence.

Mr. E. A. CALVERT observed that although Mr. Clarkson had Mr. Calvert. given many data, both engineering and financial, relating to the three leading systems of traction—petrol, steam, and electric—he had said little or nothing on some vital points. The most important of these appeared to be the life of the different vehicles. Certainly he had stated the life of electric trucks; but he had not stated the life of petrol and steam vehicles. Then, with regard to steering-gear, many accidents were attributed to its faults; the illustrations did not show sufficiently the construction, and Mr. Calvert was unable to find any comment thereon in the Paper. Two well-known methods were employed as a rule in steering-gears, and in both steam and petrol omnibuses he concluded one or the other was used. He would like to know whether it was the worm and sector or the worm and nut? The latter answered best, because there was more bearing surface in the nut than in the sector, where only two teeth were in gear; hence the nut wore better and the rigidity of the levers was greater, which was a great advantage. With regard to the front axle, why did the forks taking the front wheel bearing spindle form part of the axle instead of part of the spindles? He believed it was well known amongst automobile engineers that not only was it

Mr. Calvert. easier to weld them on to the spindles than on to the axle, but, also, when forming part of the spindle the axle was stronger, because there was no weld in it, and it cost less to make. Mr. Clarkson did not say whether metal to metal or metal to leather was employed for the clutch in the petrol omnibus. With regard to this point, when Mr. Calvert was engaged on the design of motor-omnibuses, the clutch used by his firm employed metal on leather, and the disadvantage of the slipping which occurred was overcome by placing small pieces of flat spring at intervals under the leather. Particulars of the distribution of the weight of the parts on the chassis would have been of interest. The springs, too, had not been mentioned, and these did not appear to have been much improved since the early days of the motor-omnibus, while in private cars not only had they been improved, but also shock-absorbers and the like were attached. He considered that the authorities who had obtained powers to compel private companies to surrender to them the tramways, etc., had taken the wrong course. Instead of considering first the cheapest, quickest, and best routes so that the general public could travel most advantageously from place to place, they simply electrified the existing routes, with the result that a portion of the metropolis was crowded with routes while other parts had none at all. Also, had the merits of the various systems been thoroughly investigated the motor omnibus would, he considered, have come out best. Thus the millions spent on tramway line-laying and alteration of streets would have been saved, and the ratepayer not so heavily taxed. With regard to Mr. Clarkson's opinion that tramcars had an advantage over motor-omnibuses in being covered in, omnibus builders declared that the regulations were such as to make it impossible to cover motor-omnibuses without making them too high and top-heavy. Mr. Calvert considered it could be done by arranging the design so that the differential and drive were at the side under the seats instead of under the centre of the body. The latter could be lowered on to the frame, and by making the dimension through the inside-seats cross section greater than that of the top deck of the vehicle it would not be too heavy. Perhaps one set of gear might have to be inserted between the engine and the propeller-shaft, but this would not only be worth while but would also help to reduce the speed of the engine to suit the drive. The authorities would do well to consult engineers more than was their practice before making regulations, and certainly some of those in authority ought to be trained and experienced engineers themselves.

Mr. A. I. GRAHAM observed, with regard to Mr. Gribble's statement that in order to serve a city best the aim should be to reach the farthest suburb and to supply the greater traffic in the centre by means of overlapping services, that in all large English cities this was done by the tramways. For instance, at Glasgow the tramways ran out to Paisley, Renfrew, Uddingston, and other places about 8 miles from the centre of the city, and on all these routes there were overlapping services, so that in Argyle Street, Renfield Street, etc., there was one continual procession of cars. With regard to the York tramways, he would like to point out that they had already been extended once since their inauguration, and that a further extension was to be carried out this year. No doubt, as the authorities gathered experience as to which routes were likely to be remunerative, further extensions would be proceeded with. He could not agree that any tramway system at present showing a deficit would have been any better off had railless electric traction been substituted in the first instance, nor could he find in the Paper any justification for this assertion. So far as the travelling public were concerned, there could be no comparison between the two systems from the point of view of comfort and general utility; and, after all, the travelling public were the chief consideration.

Mr. PERCIVAL T. HARRISON observed that, apart from the comfort of travelling in the steam-omnibuses of the National Steam Car Company, he could testify to the noticeable reduction in damaging effect on the road-surfaces of these vehicles along the omnibus routes of the Borough of Chelmsford, as compared with the petrol-driven omnibuses used previously. He was unable to give actual figures showing the difference, but, being responsible for the upkeep of the roads, he could appreciate the altered conditions.

Mr. E. P. HOOLEY observed that Mr. Gribble stated that the Government which used the roads for military and postal purposes had done its share by making them. Where, and in what manner, had the Government made any roads in England?

Mr. P. W. SHAW observed that on p. 28 Mr. Gribble assumed nine passengers per car-mile as a traffic of ordinary density. Mr. Shaw considered this to be a very fair average, but he did not think the "average density" could be taken as a figure for comparison, since the greatest difficulty any system had to contend with was the rush hours, when the passengers per car-mile reached the maximum; and it was at such times that the electric tramway could, by overcrowding, carry a large number in excess of its seating-capacity; or, without overcrowding, a modern tramway,

Mr. Shaw. with single-deck cars, could handle 11,000 to 12,000 passengers per hour on one line, in one direction, with 20 seconds headway. He doubted very much whether, in a large and densely populated city, any trolley-bus system with "overlapping service" could handle that number in the same time. It appeared, therefore, that to deal satisfactorily with the crush traffic, the railless-car system would require a much larger proportion of stand-by rolling stock than would be necessary for a tramway. Mr. Shaw agreed that the aim should be to reach the farthest suburb, and to supply the greatest frequency of service in the centre of the city, but disagreed with the statement that the tramway could not serve the people so expeditiously as the trolley-bus. He considered there was a useful sphere for both systems in all large and important cities—the tramway for the city and immediate suburbs, and the trolley-bus for the farthest suburbs. An average of nine passengers per car-mile should pay in any modern electric-tramway system, and the tramway had the advantage in quicker acceleration, speed, and saving time, especially in the city areas, which were decidedly conducive to passenger-traffic. Where the average number of passengers was below nine per car-mile, the trolley-bus could be used profitably, other conditions being favourable, with advantage to the district, as well as to the tramway, by acting as feeders to the latter.

Mr. Snyder. MR. GEORGE D. SNYDER observed that the past 100 years had been largely devoted to the development of railways and transportation by rail, one result of which had been the comparative neglect of highways and transport upon them. This was especially so in new countries, where the railways had been built in advance of the highways, instead of after them, as in older European countries. Thanks to the development of the motor-vehicle, a return was now being made to the highway, and in order to obtain the full benefits from these developments, corresponding improvements and developments must be made in the highways. This increase in highway-traffic was causing great congestion in the streets of cities, and while partly due to the natural increase in population, it was also due largely to the stimulation of traffic by the motor-vehicle. Most cities were endeavouring to solve the problem caused by this congestion, and large sums were being expended in the widening and straightening of streets and the making of additional thoroughfares. The motor-truck was demonstrating that its use effected economy of both time and money in short-distance traffic by accomplishing the whole journey by truck instead of the goods being hauled to the railway, taken by rail to the nearest station, and then transported by a road-vehicle again to

their ultimate destination. For the transportation of goods over Mr. Snyder's short distances, the motor-vehicle approached the railway in speed and cheapness, and it could run on any thoroughfare. The steam-locomotive required a special highway, to the rails of which it was confined, but which permitted higher speed and cheaper haulage, and goods could not be received or delivered by a railway, except by other means, at a point not along the line. In certain localities economy might result from the construction of special highways exclusively for motor-trucks; such special highways had been built for pleasure motors. One advantage of railless electric traction was that the continuity of the road-surface was not broken by the rails, which affected injuriously a road's smoothness and life. The increasing use of motor-vehicles had compelled the use of new methods and new materials in road-construction, and what was a fixed and established art had had to be adapted to meet these new conditions.

Mr. H. E. YERBURY considered that the question of railless Mr. Yerbury's electric traction, like many other matters, could be determined in each case only after a careful study of the local conditions. The compliment paid by Mr. Gribble to the municipalities, in pointing out that they had initiated the system in England, also showed that companies or individuals would not be permitted by such authorities to run railless or other cars on the roads under their jurisdiction, except by special licence. Suburban transportation, whether by railless cars or motor-buses, was now considered not only a good commercial undertaking—since they acted as feeders to tramways—but also a necessity, and was often demanded by outlying districts. As Mr. Gribble's comparisons were with tramways, it was regrettable that railless traction and motor-bus statistics were not standardized in the same manner as tramway costs. Possibly they would be standardized in the near future, so that accurate comparisons might then be made. Reviewing the three principal factors governing transportation systems, namely, capacity, capital expenditure, and working-expenses, it appeared to Mr. Yerbury that motor-buses would always be keen competitors with railless electric-traction vehicles, probably on account of their greater flexibility to take up service on any route where traffic demanded. He held no brief for motor-buses, but their use must be considered in comparison with railless electric traction, as their seating-capacity was practically equal. Evidently their useful life was thought to be shorter than trolley-buses, for only 5 years' borrowing powers could be obtained, as compared with 10 years for the other vehicles. Mr. Gribble had

Mr. Yerbury. mentioned 13*d.* per car-mile as the revenue from trolley-buses at Rotherham. From the annual report it appeared that 12·4*d.* was the average for last year, as compared with 10·191*d.* per motor-bus mile in Sheffield, where the vehicles ran in sparsely-populated districts. With regard to capital expenditure, Mr. Yerbury agreed that it was difficult to analyse published statistics accurately. The analysis shown in Table II, List A (p.39), appeared to be fair in respect to tramway working-expenses per car-mile, and he was glad to see that the word "generalizations" was used when dealing with trolley-bus costs, as he believed the figures were open to criticism. He agreed that high power-costs were a burden to many tramway undertakings, and it was well known that a great saving had been effected and rates had been relieved to a large extent where tramway departments had generated their own power. In Sheffield, for instance, where £25,000 to £30,000 per annum was handed over by the tramways department in relief of rates, such relief could only be afforded on cheap power being obtained. To emphasize Mr. Gribble's point, Mr. Yerbury would add that an output of 20 million units per annum, at the Sheffield total cost (including standing charges and distribution up to trolley-lines) of 0·673*d.* per unit, made an annual difference compared with, say, Manchester at 1·046*d.* per unit and Bradford at 1·01*d.*, of more than £31,000 and £28,000 respectively. With regard to maintenance and renewals, tramway track entailed heavy expenditure, and Mr. Gribble's figures were on the low side if the maintenance account included also renewals. On the Sheffield tramways for the past year maintenance of track had cost 0·282*d.* per car-mile, and renewals 0·804*d.* The life of rolling stock and power-station plant, etc., credited in the Paper at 12 and 20 years respectively, was low, as borrowing-powers could be obtained for these at 15 years and 30 years. Mr. Gribble's comparison of energy-consumption and cost per unit needed some explanation, especially where the cost of power for railless traction was assumed to be 0·48*d.* per unit. Mr. Yerbury knew of no system in which power was obtained at that price, and perhaps at that figure "works costs," and not total costs, had been taken. He considered that where electricity was generated by, or sold to, any undertaking, the total cost—including standing charges—should be the basis for calculations. For instance, in the annual reports of the Leeds and Bradford Railless Car Systems, the cost of power for those vehicles in Leeds was taken from their works costs, namely, 0·44*d.* per unit, whereas their total power-costs were 0·87*d.* per unit. How, then, was it possible to make a fair comparison with, say, Bradford, where power was purchased and cost 1·275*d.* per unit,

and where the total costs were stated to be 7·41*d.*, as compared Mr. Yerbury. with Leeds, where 6·76*d.* per bus-mile was the published figure, both totals being, of course, exclusive of depreciation? At the present price of rubber it was well known that 1*d.* per car-mile for tires was a reliable basis for calculation, either for trolley-buses or motor-buses. The subject of road-maintenance was one of vital interest to the general community. The time appeared to be not far distant when it would be recognized by the Treasury that roads were a national concern, and that, as such, they should be maintained out of national funds. At the present moment there appeared to be some justification for railless electric-traction services bearing the burden of a specific charge per mile run. As in the case of motor-buses, it might be said that in the petrol tax they were already bearing their proper share of charges, which, on the basis of 1·5*d.* per gallon tax, and with an average of 7·5 to 8 miles per gallon on hilly routes, worked out at 0·2*d.* per bus-mile run. As the average annual cost per mile for the maintenance of the Sheffield tramway-track amounted to 0·282*d.*, the present tax on petrol appeared to be ample for efficient road-construction and maintenance. He agreed entirely that railless electric-traction schemes should be dealt with under the Light Railways Act, especially as he had had actual experience of the operation of that Act in an electric-tramway extension. Now that actual costs of running trolley-buses and petrol motor-buses were known by many municipalities, speaking from actual experience of the latter, and the fact that the Sheffield motor-buses earned 2*s.* to 2*s.* 8*d.* per mile on football-match services, etc., off their own scheduled route, and the total annual costs (including 20 per cent. depreciation) amounted to 8·779*d.* per mile run for the year ending the 25th March, 1914, it would be seen that trolley-buses had a formidable rival. He believed, however, that there was a useful field for all classes of vehicles, and the Paper would doubtless prove very useful as a guide in such matters.

Mr. GRIBBLE, in reply, explained, with regard to the remark Mr. Gribble. made by Mr. Hooley, that his meaning was that the creation of the present highway-system was principally the work of local authorities, which in this respect were the delegates of the Supreme Government. The ordinary ratepayer, whose contributions had enabled the local authorities to create the roads, had been burdened as heavily as he could bear. The new era of secondary transportation upon the highways, by means of mechanically-propelled vehicles, into which era the world had now entered, brought with it new problems which required new solutions. It

Mr. Gribble. was the vehicle alone which created the need for the highway. Shoe-leather did not wear roads appreciably. Horses' hoofs did not wear them much more. It was the stage-coach which created the clamour for the turnpike road. It was the automobile, public and private, which had created the demand for an improved highway-system. It was therefore not only logical but also inevitable that the proprietors of all vehicles of every description should bear the burden which their necessities entailed, and in fair proportion. The highway was to secondary transportation what the permanent way was to the railroad. In the latter case the fare paid by the passenger and the rate paid by the shipper of freight included what was necessary to cover both capital charges and maintenance of the permanent way, as well as all other charges necessary to render the railroad a remunerative undertaking. The analogy must apply to the highway if secondary transportation was to be lifted out of the present chaos and conducted on business principles.

31 March, 1914.

ALEXANDER ROSS, Vice-President,
in the Chair.

The discussion upon the Papers by Messrs. Clarkson and Gribble, on "Some Recent Developments in Commercial Motor-Vehicles," and "Comparative Economics of Tramways and Railless Electric Traction," respectively, was continued and concluded.
