

showed graphically the nature of the problem. It was, however, somewhat dangerous to generalize to the extent attempted by Dr. Holmstrom, and, further, he did not appear to give that amount of consideration to passenger-traffic which such traffic deserved.

NOTE.—Certain points raised in the discussion are dealt with further by the Author in his reply to the Correspondence, p. 634.—SEC. INST. C.E.

Correspondence.

Mr. H. C. M. AUSTEN, of the Mauritius Railway, remarked that the Midland and North lines of that railway, completed in 1864, had been constructed to the English standard gauge, with chairs. Mauritius being a small island, and already provided with very good military roads (made of the excellent basalt stone abounding in island) to link up the various fortified posts round the coast, as well as sea transport, it was doubtful whether a railway, and certainly a standard-gauge railway, was ever required. The development of the Colony would, however, have been retarded if none had been built. The railway, when once constructed, did give very great impetus to the island's sugar production. The output in 1865 was about 120,000 tons, and that in 1933 was 262,000 tons. In 1914, the output was slightly larger than that figure, and it was certain that no system of mechanical transport, other than the railway—obviously not the old mule- or ox-cart system that existed in 1860—could then have transported so large a tonnage. The very important factors of weather and time had also to be considered. Sugar would not keep in the moist upland climate of Mauritius, where a great many of the factories were, and, as the crop was cut between August and December, the sugar had to be carried promptly to Port Louis for storage and, moreover, carried in such a way as to keep in good condition en route. It was generally conceded that the railway was essential for the sugar industry in Mauritius. Unfortunately, there were a number of factories which seemed unmindful of the original impetus given by the railway to the industry, and preferred to send their sugar by road rather than pay the very slightly higher rates demanded by the railway, thereby depriving the railway of about 18 per cent. of the total tonnage available for transport. The sugar rates and general goods rates on the Mauritius Railways averaged $3\frac{1}{4}d.$ and $2d.$ per ton-mile respectively. Those rates could not be considered exorbitant, but the railway had to carry on a perpetual competition (which, in itself, was not an evil) with road-transport

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Mr. Austen. companies, though those companies had apparently considerable difficulty in making both ends meet without dipping into their depreciation funds to pay dividends, or, alternatively, raising fresh capital when their old plant was worn out and new plant became a necessity. Heavy gradients affected the cost both of road- and rail-transport ; the railway, on its Midland line, over a length of 16 miles, had long gradients of 1 in 26 to negotiate, the peak being 1,800 feet above sea-level at Curepipe, about equidistant from the terminal points 36 miles apart, *i.e.* Port Louis, Mahebourg and Souillac. The North line and the other branch lines were reasonably level, and he considered that under present tax and import-duty conditions it would only be economically sound to carry goods by road within a distance of about 10 miles from Port Louis. On the other hand, the revenue derived from motor-spirit and lubricating-oil importations was large, so that all the indications pointed to the need for a unified central control which should hold the balance equitably between the various systems of transport, old and new, that the Colony possessed.

Passenger traffic receipts had fallen from Rs.1,500,000 in 1927/8 to Rs.420,000 in 1932/3, owing to the rapid development of buses and cars. The number of bus journeys made in 1928 was 61,000 carrying 850,000 passengers, as against 186,000 bus journeys in 1933 carrying 3,000,000 passengers ; the buses used in Mauritius were of the "light" type. The Mauritius Railway did not expect to recover all its former passenger traffic, but had cut down and speeded up its train service and reduced its fares in such a way that it had definitely and, he thought, permanently recovered sufficient passenger traffic to yield a revenue in 1934 of about Rs.500,000. Further, a revision of rates and a door-to-door rail-and-road service, the road work being effected by contract, had produced a marked improvement of revenue from general goods traffic, which should be maintained. Railway costs had, at the same time, been thoroughly overhauled. In spite of heavily increased expenditure due to gratuities and pensions, as the result of drastic reductions in personnel, the total expenditure had fallen from Rs.3,230,000 in 1927/8 to about Rs.1,700,000 in 1933/4. Replacements of rolling stock by items of more modern design were gradually being made, and a fixed sum annually would in future be set aside for the renewal of railway wasting assets. He considered that there was no reason why the railway should not continue to function to the economic advantage of the Colony, working side by side with the roadways, provided that the transport situation generally was firmly controlled by an impartial authority, with due regard to the present and future needs of the Colony and a sound technical judgment on all mechanical systems

of transport and their developments, always bearing in mind the ^{Mr. Austen.} commercial and financial issues involved in relation to the local problems which such developments might be designed to assist. Views on traffic control similar to those expressed by the Author were embodied 2 years ago in Mauritius under the Transport Control Board Ordinance, but the issue of regulations putting into effect certain of the powers so conferred has been delayed by other matters.

Mr. H. D. BINDLEY remarked that during the last 10 years the Mr. Bindley. following railway extensions had been constructed in the Sudan :

Haiya to Kassala (1923-24)	347 kilometres.
Kassala to Sennar (1926-29)	455 „
Khartoum to Gordon's Tree (1930)	8 „
Gordon's Tree to Gebel Aulia (1933)	38 „
Total	848 kilometres or 530 miles (of single track).

The average cost of those lines, including station buildings, quarters for staff, telegraphs, signalling, bridging, etc., was approximately £E.3,000 ¹ per mile. Motor-transport competition with the railways began about 1927 and, at first, was limited almost entirely to the cotton-growing area of the Gezira and to the carriage of passengers in that area, but later it extended to the transport of goods as well. Its development progressed rapidly until retarded by the economic depression, but there were indications of its revival. Some years ago the railways introduced motor-transport services of their own in order to obtain first-hand experience of that form of transport as feeder-services. The urgent necessity for retrenchment resulted in the abandonment of the schemes, and unfortunately the comparative results of the working of a motor-transport scheme on a sound basis as against the native-operated schemes were lost. The Author's comparisons of the Government-owned motor-service and the native bus-service was as applicable to the Sudan as to the colonies about which he wrote. The Sudan Railways charges varied from less than 1 millièm (½d.) to nearly 21 millièmes (5d.) per ton-kilometre. The average full working costs amounted to about 2·2 millièmes and average rates to 3·6 millièmes per ton-kilometre. Privately-owned motor-transport operating in the Sudan had as yet little or no public responsibility and was practically free from control. Its method of assessment of charges was therefore bound by no prescribed principle. It would probably not be far wrong to take an average figure of 11 millièmes per ton-kilometre as the present minimum working cost of motor-transport in the Sudan. That

¹ £E1 equals 1,000 millièmes equals £1 0s. 6d. sterling.

Mr. Bindley. figure was no less than five times as high as average railway working cost, but even so was far below the upper range of railway charges, wherein lay the ability of motor-transport to attract traffic from the railway. Motor-transport had not found conditions of operating in the Sudan as favourable as in many other countries. Distances were great, and proper roads practically non-existent. Also, except possibly in the Gezira, there were no areas having an appreciable density of local traffic. Throughout the greater part of the year, nevertheless, the conditions offered considerable opportunities for the resourceful private motor-transport owner to ply alongside the railway, offering to carry passengers at lower fares, and goods at rates lower than the higher ranges of railway-rates.

Mr. Buxton. Mr. M. B. BUXTON observed that the development of African Colonies had been for a long time almost impossible owing to the curse of slavery; the natives would not settle down to cultivation and trade when at any moment raiders might appear and carry them off into slavery. Those who at the beginning of last century fought the slave trade recognized that the building of good roads in such countries as the Gold Coast and Nigeria would open up the country to lawful trade and stop much of the slave-raiding, and constantly advocated their construction. The subsequent history of Africa had proved the correctness of that view and shown the utility of roads both in the cause of humanity and colonial development; he was convinced that in backward countries good roads were of more value than railways.

Mr. Cooper. Mr. P. M. COOPER remarked that the question of road and rail transport in Jamaica had been under consideration for some years, and special reference has been made to it in a Report¹ by Lieut.-Col. F. D. Hammond. The Transport Commission appointed by His Excellency the Governor of Jamaica in May, 1933, was at present taking evidence on transport questions in Jamaica, with a view to co-ordinating the various types to the best advantage in the public interest, the Government of the island having been fully alive to the necessity for investigation in the matter.

The island of Jamaica was 4,450 square miles in area, its extreme length being 144 miles, its greatest width 49 miles, and its least width $21\frac{1}{2}$ miles. It was very mountainous, and the land rose quickly from a very narrow belt of coastal plain into foothills and then up to the higher altitudes of the main mountain ranges, the highest point being 7,360 feet above sea level. In such broken and mountainous country operating expenses of any form of land-transport

¹ "Transport Problems in Jamaica," Jamaica Gazette, the 1st November, 1923.

were bound to be high compared with those in larger countries with Mr. Cooper. a greater proportion of level land. The island was entirely dependent on agriculture, bananas, sugar-cane, citrus fruit, and pimento being the most important produce, and its transport problems were closely allied to that industry. The island also possessed both the advantages and disadvantages peculiar to an old colony. Its road development had been built up around a nucleus of pioneer roads located during a period of nearly three centuries, and though considerable improvements and adjustments had been made within recent years to suit modern conditions, some of the disadvantages of ancient location still existed. On the other hand, the island had the advantage of a very large road-mileage for its area, and most places in the country districts were within easy access of a reasonably good road.

The Jamaica Government Railway was opened under private ownership in 1845, and had been extended from time to time under private ownership, and later under Government control, to a total of 210 miles of standard-gauge single track, and for at least 50 per cent. of the total mileage the lines ran through very mountainous country with a liberal use of 3 per cent. grades and 5-chain curves, necessitating heavy locomotives and rolling-stock, and high operating charges for moderate loads. Further, the railway was burdened with a very large gross debt of £3,232,800, and had to pay £156,900 in gross annual debt charges. Had it been possible to plan the railway system in the light of present experience it was probable that a 3-foot 6-inch or metre-gauge line, located to serve more fertile country, would have been adopted, resulting in lower operation charges and larger scope for attracting traffic, and might at present have been the better able to compete with road-transport. It was, however, too late to alter the existing track. A few statistics dealing with its operation were given in Table VI (p. 598).

At the present time 2,343 miles of main roads in Jamaica were maintained by the Public Works Department, and 2,036 miles of Parochial Roads were maintained by the parish or rural road authorities, making a total of 4,379 miles capable of taking motor-traffic. The Island thus had 1 mile of road suitable for motor-traffic to every square mile of country. The total road mileage, including minor roads and tracks suitable only for animal-drawn and pack-mule traffic, was 6,832. The island was thus exceptionally well served with roads. Within recent years the Public Works Department had constructed a considerable extra mileage of development-roads and feeder-roads to serve the railway. The Department was anxious, not so much to increase the present road mileage, but to embark on a programme of strengthening and surfacing with asphalt some of

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the more important arterial roads, and it was hoped that the Government would see its way to assist in the matter of providing the necessary funds to do so. A few statistics dealing with main-road maintenance costs were given in Table VII.

TABLE VI.—RAILWAY STATISTICS.

(Total railway mileage 210.)

Year.	Revenue: £.	Expenditure: £.	Net receipts: £.	No. of passengers carried.	General merchandise carried: tons.
1923-24	293,398	262,635	30,763	474,513	47,481
1924-25	274,702	254,217	20,485	451,307	40,177
1925-26	321,814	270,257	51,557	503,141	34,190
1926-27	355,951	297,961	57,990	635,734	40,494
1927-28	391,399	334,658	56,741	668,702	43,009
1928-29	319,592	283,414	36,178	564,618	48,249
1929-30	375,458	326,058	49,400	645,537	41,791
1930-31	395,421	302,195	93,226	757,475	34,673
1931-32	365,846	279,310	86,536	657,108	30,556
1932-33	322,224	244,870	77,354	587,890	26,781

TABLE VII.—TOTAL EXPENDITURE ON ROAD MAINTENANCE.

Year.	Approximate mileage.	Total expenditure: £.
1923-24	2,241	212,287
1924-25	2,258	196,461
1925-26	2,263	284,808
1926-27	2,265	207,751
1927-28	2,271	252,069
1928-29	2,276	247,421
1929-30	2,289	230,195
1930-31	2,324	243,019
1931-32	2,371	260,126
1932-33	2,407	222,488

(The cost of new road construction designed to carry motor-traffic, including all charges, varies from £2,500 to £3,750 per mile.)

Regarding competition between road and rail, the mountainous nature of the country was less unfavourable to motor-transport than to rail-transport. A lorry could haul a full load up a 1 in 15 grade

(the limit adopted by the P.W.D. for new road construction), whereas Mr. Cooper. it required the heaviest locomotive to pull comparatively moderate trains over gradients of 1 in 33. In spite of that the railway continued to attract the long-distance haulage of bananas, the principal agricultural traffic of the island, which was so necessary to its prosperity. In that particular traffic motor-transport acted as a feeder-service to rail-transport; there was little or no competition, but rather co-ordination developed on sound economic lines. In other agricultural, general goods and passenger traffic there was however definite competition, especially for distances up to 50 miles.

Road competition came from various types of vehicles. The dual-purpose goods and passenger motor vehicle was generally a light lorry of $1\frac{1}{2}$ to 2 tons carrying capacity, which for three days of each week was engaged on hauling bananas to the railway or port. For the remainder of the week it was converted into a local bus and carried the peasantry as passengers with their market produce to the town, or brought agricultural produce to the towns and returned with a load of general merchandise for local shop-keepers. That type therefore assisted the railway for a part of each week and competed with it for the remainder.

There was also a definite type of goods vehicle which was only used for transporting agricultural produce from the country to important towns, returning with shop goods and general merchandise. Those vehicles in some cases ran on roads parallel to the railway and competed with it, but it was difficult to see how they could be controlled except under license from a Government transport authority. The existing Transport Board had no control over the competition of such vehicles with the railway. The fact that these vehicles provided quick and rapid transport from door to door with little handling, and with the other basic advantages of motor-transport, made them popular with the general public.

The regular bus services were run under licence approved by the Transport Board, a Government Transport Authority which controlled the operation of public-service vehicles in Kingston and the country parishes. Competition with the railway could thus be regulated as far as it was expedient to do so in the public interest. Tourist traffic was carried by 5- or 7-passenger motor-cars, hired under contract for each trip. Those cars were very popular with tourist organizations for sight-seeing purposes, and could traverse country not served by the railway. Private cars had undoubtedly deprived the railway of passenger traffic, but found favour with the public on account of their convenience. There was still a fair amount of animal-drawn transport, which served a useful purpose. Competition

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with the railway from such sources could not be regarded as serious, and was still an economic necessity in certain areas.

In Jamaica he did not think the recommendations of the Salter report as affecting taxation of road-transport could be applied without seriously affecting the transport facilities of the country. It was true that motor-transport was not contributing its fair share to the upkeep of the roads, and that was a matter for Government investigation and legislation. It also appeared that the general public was opposed to increased taxation of any kind, but that might be overcome if the economics of the subject could be brought to light by processes of education and propaganda conducted by a recognized transport authority, especially if it were assisted by the local press. He was of opinion that a contribution of two-thirds of the annual road-maintenance expenditure should be made by road users, leaving the remaining one-third to be contributed by the State for community use on the lines recommended by the Royal Commission on Transport in the United Kingdom, that appearing to be a fair apportionment under the conditions obtaining in Jamaica.

In general, the conditions which appeared to apply in the larger African Colonies and in Malaya did not apply in Jamaica, which was well developed and well served with road- and rail-transport. Competition between those methods of transport could not be regarded as having seriously affected the prosperity of the colony. He did not think there was further scope for railway extension, and every future proposal for road extension should be most carefully scrutinized after a careful traffic survey. If it were decided in the future, as a result of the findings of the Transport Commission now taking evidence, that there should be a Government transport authority to control all traffic, then such an authority could take steps to reduce unnecessary and wasteful competition to the minimum. It would study, develop and co-ordinate to the best advantage the existing transport facilities. It was not anticipated that any very drastic or far-reaching reforms could be made, but by a gradual process of improvement it should be possible to evolve a transport system best suited to the needs of the colony.

Mr. Cox.

Mr. C. L. Cox, of Nigeria, remarked that the Paper would be read with very great interest by colonial officials. It well crystallized the road and rail situation and gave a mass of pertinent information. The dictum in the last paragraph was, he suggested, too stringent ; and he would prefer to say that colonial prosperity was dependent on the efficient and co-ordinated development of all transport services. In Nigeria a considerable volume of traffic was carried by the waterways. The cost of road-transport, including all charges, might well be less than that of a section or branch of a railway

running at low capacity or subject to widely varying seasonal traffic Mr. Cox.—a traffic that road-transport organizations could, if road inter-communication were adequate, more easily adjust themselves to meet.

He suggested that roads were in any case essential to the opening-up and settlement of a country, to the intercourse of its peoples and to its administration, and—if human labour were to be spared—that they must precede the railway which later they might feed. Moreover, the possibility of improvement, perhaps revolutionary, in the mechanics and economics of self-propelled road vehicles and in methods of road construction should not be overlooked. Road-transport rates of less than 3*d.* per ton-mile had been freely quoted in Nigeria, and—whether those rates were remunerative or not, and however uneconomic his financial arrangements might appear—there as elsewhere the native owner as owner-driver had come to stay. The annual maintenance cost of the metalled, gravelled and earth roads maintained by the Nigerian P.W.D. now averaged £28 per mile, and recent experimental work, on the lines of the bitumen-surfaced so-called “low-cost” roads of the United States, indicated that it should be possible, when increasing prosperity warranted it, to provide roads suitable for considerable traffic at a reasonable cost and without recourse to heavy metalled construction.

It was refreshing to read references to the savings in transport costs that could be effected by good roads. Those savings did not accrue directly to the responsible road authorities, and their economic influence was frequently overlooked or disregarded.

Mr. F. D. EVANS observed that a full appreciation of the subject Mr. Evans. required more information than was given in the Paper, or was indeed available, that the relative costs and comparisons of road- and rail-transport would be found to differ widely in different countries, and that the relative deductions and conclusions would differ, in principle or application, from those presented by the Author.

To the considerations (a), (b), and (c) on p. 546 he would add “(d) the ultimate cost and other factors concerning transport of traffic from origin to destination.”

It seemed inappropriate to him to consider only the cost of constructing railway extensions, as on p. 584—from £3,200 to £7,000 per mile—since those figures did not include the cost of rolling-stock and expensive facilities necessary for operation; the inclusive cost per mile of a system should be considered (for example, in Nigeria it was £11,600 at the close of the financial year 1932/33); in particular circumstances it might be reasonable to consider some lower figure than the inclusive cost per mile.

Mr Evans.

The average cost of rail-transport per ton-mile, to which reference was made on p. 555, might be misleading in regard to certain aspects of the subject of the Paper; the low costs per ton-mile on a heavily-trafficked section of a railway might obscure the high costs on other sections; in that connection the appropriate cost per mile of extensions might be important.

The cost of constructing and maintaining roads varied greatly with the nature of country and soil passed through, the climate, the class and weight of traffic to be carried, and the standard of construction and maintenance. The weights and types of vehicles were of importance, as well as their numbers. He believed that the American figures quoted on p. 550 related mainly to cars. In Nigeria, most motor traffic included 70 per cent. or more of lorries and buses.

The high maintenance-charge noted for Malaya was due to the high standard of maintenance, the climate, and the sub-grade difficulties, and not to traffic density on country roads. Some gravel roads in south-west Nigeria, totalling 79 miles in length and in fair to good order, carried average traffics varying from 150 to 230 vehicles per day (say 600 to 1,000 tons gross) at an average annual maintenance cost of £57 per mile in 1932/33. The carriageways only cost £35, and improvements—mainly widening—£3 10s. Those were the most heavily-trafficked gravel roads in the country.¹ The maintenance cost of bituminous surfacing averaged £42 per mile for carriageway only. Those costs were exclusive of engineering and establishment charges, which added approximately 25 per cent. Expenditure on other roads varied from say £5 per mile per annum upwards. While it was true that tractive resistance was less on smooth and costly pavements than on earth or gravel surfaces, he thought that much of the published work on the subject had preceded the recent advances in road maintenance. Earth and gravel roads were not necessarily bad from the point of view of driving comfort or vehicle-maintenance. In any case it was generally true that the cost of roads, when dictated by traffic considerations, was a small proportion only of ton-mile costs, which decreased with increasing traffic. Political considerations in the colonies usually prevented the allocation of funds for roads in excess of the essential minimum.

Small independent transport enterprises were of the greatest value: 25 years ago, when in Malaya, he had been of the opinion that native motor-transport practice was unsound, but experience had demonstrated the contrary. The hire-purchase system, in Nigeria, required

¹ The traffic counts were made in 12 hours' daylight on successive days of record periods. The night traffic was not known, but had been found on some roads to be from 25 to 30 per cent. of daylight traffic during the busy season of produce movement.

cash payment of half the cost of the vehicle, and insurance until the vehicle was paid for. Large motor-transport organizations had no particular public advantage and many disadvantages; European overhead expenses were heavy, and not ultimately necessary in the tropical colonies.

Whatever the form of ownership and organization, transport owners would charge the maximum they could recover—in other words “what the traffic will bear”—which made it difficult to ascertain costs. Evidence, given to a Nigeria Committee on road and railway competition (of which Mr. Evans was a member), showed that, directly parallel to the railway, road charges per ton-mile varied from less than 2*d.* upwards, the variation being governed by the railway rates. Road charges in the same area, not directly competing with the railway, were less than 3*d.* per ton-mile. Petrol cost approximately 2*s.* 2*d.* per gallon. In the case of road-transport, between Lagos and Ibadan (112 miles by road, 120 miles by rail) the charges per ton-mile then varied from 1·9*d.* to 2·7*d.* according to season (at the time of writing they were 1·6*d.*). The average capacity of vehicles was less than 2 tons; all had pneumatic tires. The Committee concluded that even a modern economical (petrol) vehicle would operate at a loss at the lower rates per ton-mile, but that profit was made by charges on casual passengers and loads; that vehicles were reasonably well maintained and operated; and that overloading and overspeeding did not generally occur to a dangerous extent.

An important factor was the ability to obtain full loads on all journeys. Recently, moving some 1,500 tons of ground nuts over a distance of 15 miles in Northern Nigeria, 800 tons were transported by camels at 3·6*d.* per ton-mile and 700 tons by motor-lorry at 6·8*d.* per ton-mile. Pack animals were not available to carry the 700 tons moved by motor-lorry; little return traffic was available, and petrol cost approximately 3*s.* per gallon. An assessment of the average cost of motor transport, without regard to the circumstances of particular cases, was as misleading as the similar assessment of the cost of railway transport.

He suggested that the “common carrier” obligation of railways to accept and provide facilities for all kinds of traffic was not material to the point at issue; in so far as railways did so it was by virtue of legal compulsion on account of their monopoly; any other carriers would quote rates for anything within their capacities, and railways did no more. Any carrier would charge “what the traffic will bear” unless prevented from doing so, and he thought that complicated railway rate-structures, built up under conditions which no longer obtained, were not necessarily sound. They could only

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be maintained by a monopoly. The system might lead to good or evil, but in the colonies he thought the latter was likely ; it would seem preferable to endeavour to establish, and charge in relation to, the real costs, and to subsidize or penalize industries and development by direct allocation to the railway or by import and export duties. When a community exported low-rated produce and imported high-rated produce in reasonable ratio there might be no disadvantage, but when one area exporting low-rated produce on a long haul was given preference against another area exporting on a short haul, the results might be the reverse of those aimed at or desirable. It was pertinent to ask who should bear the loss on transporting nearly 200,000 tons of ground nuts from Northern Nigeria, referred to on p. 564. Traffic that would bear high rates was not everywhere a marked feature of colonial import business ; it became less during periods of depression.

When comparing rail- and road-transport he would add that colonial roads and railways had been and would be built not merely for traffic purposes but with a view to easier pacification and administration, also that the need for taking into account funds invested in railways and road-transport might make the problem of existing or potential competition different from that relating to transport in new areas. While the capacity of railways to transport traffic cheaply when concentrated was often a decisive factor, it did not follow that that would be the case when concentration was wasteful or when the railway route was longer than alternative routes. The use of fuels other than petrol might lessen the cost of road-transport. Minimum road-transport costs, based on full loads on all journeys, were possible only when alternative transport was available to deal with one-way loads.

He would suggest that roads should run parallel to railways, and that they would do so when traffic was developed by roads in advance of successive rail-heads, for the reasons given by the Author. Mr. Evans agreed that road-transport should not be privileged ; studies in Nigeria had shown that petrol duty at 8*d.* per gallon, licence fees, etc., were more than enough to cover inclusive road costs where traffic was moderate, but the greater mileage and expenditure was in respect of roads carrying only a few vehicles each day. He nevertheless thought that road-transport should bear their whole cost.

He suggested that so far as the reasonable operation of colonial railways had been seriously threatened by road-transport, prevention and remedy were largely matters for railway administrations ; it was evident that the efforts now being made by railways in all countries to provide better service were the direct outcome of road-competition. A rate-structure based on costs of service would solve

many of the difficulties of road and rail competition in the colonies. Mr. Evans. The Government of Nigeria, with the advice of the Railway Administration, had recently introduced a flat rate of 2d. per ton-mile for all traffic in the competition zone, with a few minor exceptions. At the same time increased licence fees, and better traffic inspection and control, had been imposed on road vehicles competing with the railway. He thought that regulation should be on behalf of each colony or suitable group as a whole, and should in no case be decided by limited vested interests, however large they might be. He had to confess to prejudice against all large corporations of a monopolistic character. Motor transport was essential to countries generally, as well as to the profitable operation of colonial railways, and its further development was of the utmost importance. The industry was largely native-owned, and was being developed by native capital and ingenuity ; it had naturally developed most where traffic was greatest, and where facilities were greatest for the purchase and maintenance of motor-vehicles. Unregulated motor-transport could become its own enemy, and regulation might be imperative in its own interest. While agreeing with the Author that railways were as essential to-day as ever, he did not agree that they still remained the most effective means of extending the path of civilization however necessary they might be for consolidating such extensions.

Mr. F. W. FURKERT was greatly interested in the conclusions set Mr. Furkert. out by the Author. Some years ago he had reached the same conclusions, and the New Zealand Government had acted on the following arguments, which were very similar to those suggested towards the end of the Paper.

- (a) It was apparent that even under favourable circumstances motor-transport costs were two or three times as great per ton-mile as railway costs. Therefore, the motor traffic could not economically cater for the transport of the low-grade freights, particularly timber, forage, bricks, coal, and minerals generally.
- (b) The railways, as well as being necessary for bulk transport, had been equipped (at the public cost) for handling all classes of freight and passengers, in a volume considerably greater than was offering.
- (c) Any loss on the railways had to be made good out of the public funds, and therefore it was not in the public interest that railways should be subject to unbridled competition. The argument might be extended to the extreme case in which, if the motor-lorry could carry all a country's transport at the same and even a lower rate

Mr. Furkert.

per ton-mile than a railway, then the public, if it sent all its business over roads, would still have to pay millions annually for fixed charges on railways, assuming that they were shut up—or still more if trains were kept running for such business as preferred the railway.

- (d) If the heavy freight on roads became much greater the maintenance cost of the roads, already a very heavy burden on the populace, would become unbearable, and a wholesale increase in the standard of the roads would be inevitable.

Accordingly all motor-traffic was taxed by registration and licence fees, tire-tax and petrol-tax, while commercial vehicles were required to pay heavy-traffic licence fees graduated according to weight from £5 to £75, and an upper limit of weight was fixed of 10 tons on four wheels, or 15 tons on six wheels. The funds derived therefrom were utilized in assisting the upkeep of the main highways and the general road system, the former to a much greater extent than the latter. The balance of the funds went to the general revenue, which meant ultimately that it was applied to meet the deficit on the railway account. Those steps did not prove adequate to prevent cut-throat competition, not only between the railway and the road but also between rival transport lines on the same road routes, leading to over-loading, over-speeding, long hours and improper maintenance. The Transport Licensing Act was therefore passed in 1931, which divided New Zealand into transport districts, each controlled by a Licensing Authority, and also set up an Appeal Board. Before any service could be installed it was necessary for an application to be made which was considered at an advertised sitting of the Licensing Authorities. Before a licence was granted the Act required consideration of the following :—

“ . . . SEC. 26 (1) (a) The extent to which the proposed service is necessary or desirable in the public interest ; and

- (b) The needs of the district or districts as a whole in relation to passenger-transport—

and if it is then of opinion that the proposed service is unnecessary or undesirable it shall refuse to grant a licence.

(2) If after having had regard to the matters mentioned in the last preceding subsection the Licensing Authority proposes to give further consideration to the Application, it shall take into account—

- (c) The financial ability of the applicant to carry on the proposed service, and the likelihood of his carrying it on satisfactorily :

- (d) Time-tables or frequency of the proposed service :

- (e) The fares proposed to be charged or made for the carriage Mr. Furkert. of passengers :
- (f) The transport services of any kind, whether by land or water, already provided in respect of the localities to be served and in respect of the proposed routes :
- (g) The transport requirements of such localities, including such requirements in respect of the carriage of mails :
- (h) The vehicles proposed to be used in connection with the service :
- (i) The conditions of roads and streets to be traversed on the route or routes, and any restrictions of load or speed, or other lawful restrictions affecting vehicles of the type or class proposed to be used, including restrictions arising out of the classification of roads and streets under section one hundred and sixty-six of the Public Works Act, 1928 :
- (j) Any evidence and representations received by it at the public sitting, and any representations otherwise made by the Government Railways Board, local authorities, or other public bodies, or any persons carrying on transport services of any kind (whether by land or water) likely to be affected, and any representations contained in any petition presented to it signed by not fewer than twenty-five adult residents of any locality proposed to be served :

Provided that before taking into consideration any adverse representations made otherwise than at the public sitting the Licensing Authority shall give the applicant and all other persons likely to be affected a reasonable opportunity to reply to such representations.

(3) The Central Authority in considering any application shall also take into account any representations made to it by the Licensing Authority of any district through any part of which the service is to be carried on."

The above referred to passenger licences, and goods licences were similarly considered. Unfortunately the Act was several years too late, and, considerable capital having been invested by the public in motor-vehicles and transport undertakings, the Government deemed it expedient to grant licences to all those lawfully operating prior to the passing of the Transport Licensing Act, licences being subject to similar terms and conditions as for other licensed services. No attempt was made to charge licence fees under the Act which would have a deterrent effect, as suggested by the Author on p. 571.

There were in New Zealand about 3,241 miles of railways in operation, and 197,295 motor-vehicles, including about 128,500 cars, 23,000 lorries up to and including 2 tons and 15,000 of over 2 tons capacity, and 24,800 motor cycles ; the remainder being miscellaneous

Mr. Furkert. vehicles such as buses, taxis, etc. In 1933 the total taxation collected from those vehicles was £2,662,559, of which £1,295,864 was spent on the road-system, while £1,366,695 was paid into the consolidated fund. That figure might be compared with the Railway deficit of that year of £1,380,111. Though it could not be said that the effect of all those measures had been to restore the railways to solvency, they had at any rate prevented the position from becoming worse, and with the return of prosperity and the consequent increase in volume of all business the railways would tend to carry a greater proportion of the total offering between towns served by both methods.

There were many situations and businesses for which traffic by motor-vehicle transporting from door to door was preferable and should be used, even though on a ton-mile method of computation it might appear uneconomical. In making comparisons it was not sufficient to take merely the 2*d.* or 2½*d.* per ton-mile of railway freight costs, because in the majority of cases in New Zealand road freight at each end had to be added to the railway freight, and unless the total distance hauled exceeded a definite distance (which of course varied with circumstances), the total over-all ton-mile cost might approach the road-vehicle cost.

Conclusions arrived at at the present time from existing conditions, with railways built, were not necessarily those that would be reached if development were being planned anew, with present-day knowledge of road-transport possibilities.

Mr. Gardner. Mr. C. T. GARDNER remarked that the Author proposed to lower the railway charges on high-classification goods and to recoup the loss of revenue by raising the rates on low-classification goods. He thought, on the contrary, that if the rates on the low-classification goods were raised the distance over which motor competition would be felt would be increased, and that some of the low-rated goods which previously passed by rail would consequently be lost by the railways to motor-transport.

He felt that the Author had failed to arrive at any very definite conclusions, and he would like to try to extend the Paper, and to wring more out of the very useful data given.

Often it was impossible to say definitely how or why a road was developed. It might start with a bush path, which gradually became wider; some road metal might be put down; the road might then be extended out to a suburb, then macadamized, and a bitumen coat might be applied: in a short time the continuous clamour for good roads would have been yielded to, and a fine metalled road paralleling the railway would have been made. Further, roads were necessary for military purposes and the progress of civilization, and were of a value which could not be expressed in terms of pence per ton-mile.

The following sentence in the Paper was of outstanding importance: "If railways are to continue to carry export traffic at uneconomic rates while higher-rated traffic uses the road, it is doubtful whether they will earn sufficient net revenue to maintain their efficiency." That was the key-note of the situation, and the indicator of future action.

The Paper showed clearly that the diminution in the railway revenue, setting aside the loss of traffic due to the economic depression, was due to loss of passenger-traffic and of the higher-rated goods traffic owing to motor competition. It was certainly hurtful to any country that that skimming of the "cream" by road-transport should either have the effect of raising rates on bulk traffic, or imperil the economic stability of the railways. It was imperative that the consequent problem should be solved without delay, so as to avoid the hostility and greater difficulties which would arise if various interests became established, which might at a later date, when being brought under inevitable control, feel that they were badly used.

It would appear that more co-operation between the Government departments concerned was desirable. It had been thought that conflicting claims between overlapping departments, such as the railways and the public works, and possibly, in some colonies, the marine and harbour authorities, might be avoided if an engineer skilled in economics occupied a permanent place in the administration; but he did not feel that that solution would be effective, nor did he think that the Author's proposals were sufficiently precise and definite. Mr. Gardner would agree to restriction, but he thought it must be constructive restriction, and therefore he would propose the acquisition of all major motor transport by a transport board. That board would permit only light vehicles to run on the roads, or heavier vehicles under special licence: producers would be permitted to own their own transport under licence, but any transport companies would be taken over at a valuation by the board: the economic structures of the roads department and of the railways should be absorbed into the economic structure of the transport board.

He did not think the railways had yet explored every avenue of recovering or retaining passenger-traffic; the possibility of the high-speed motor-coach operating at frequent intervals on railway-lines, which under present conditions were not at all crowded, had not been adequately investigated. Such vehicles should be designed on the lines of the motor-car, should afford the same standard of comfort, must essentially run at regular and reasonably close intervals so that the passenger should not be bothered with time-tables, and should stop on demand anywhere. They could run at the same cost per mile as road vehicles, carry a larger number of passengers, and

Mr. Gardner. offer greater comfort and greater speed. They were being developed on the Continent and in America, but in the colonies they had been put to little, and rather ineffective, use.

Mr. Gordon. Mr. G. M. GORDON remarked that in Trinidad the scarcity of good road metal, the character of the soil, the weather conditions and the concentration of traffic at certain times of the year, which prevented the use of earth roads by even light motor-traffic unless they were surfaced with asphalt, all made the construction and maintenance of motor-roads more costly than in African colonies. Experience in Trinidad regarding the saving effected by sealing road surfaces with bitumen confirmed that in Australia referred to by the Author. Most of the traffic, both by road and rail, was with the sugar-producing plains in the southern part of the island, where unfortunately no good road metal was available, burnt clay having often to be used as a substitute. That was to a limited extent offset by the natural asphalt found at the pitch lake of La Brea, which provided a satisfactory surfacing material and reduced the cost of maintenance. The clayey nature of the soil, however, generally necessitated heavy foundations for all except light-traffic roads, and construction and maintenance costs of roads were higher in the south than in the north of the island. To protect the roads the gross weight carried on them was limited. In no case was a lorry imported since the 1st January, 1932, licensed for more than 5 tons, and the motor traffic on each class of road was restricted to that which it could carry without damage—nil, $2\frac{1}{2}$, $3\frac{1}{2}$, or 5 tons. In spite of those limitations the comparatively short hauls were favourable to light motor-traffic; general merchandise was mainly carried by road, and the amount so carried was increasing. A census taken during 1932 for one week showed a tonnage of 24,978 on the main road into Port-of-Spain, compared with 16,305 for a week in 1926 at a busier season of the year.

Mr. Kemp. Mr. J. R. KEMP, of Queensland, observed that the facts presented by the Author were particularly interesting to Australians, and especially to those in Queensland, where conditions more nearly approximated to those described by the Author than in the other States. Railway construction had practically ceased in Australia; road construction was proceeding rapidly, and roads paralleling railways had been allowed, except in Queensland and Western Australia, where the policy had been to restrict the building of such roads, unless they joined cities or towns of importance or were national intercommunication links, such as the Pacific Highway joining Melbourne and Brisbane. An analysis of the position in Queensland 3 years ago indicated that 85 per cent. of the roads under Mr. Kemp's control as Commissioner of Main Roads were of use

only as railway feeders; 7 per cent. were feeder-roads which also Mr. Kemp. served through and tourist traffic, and the remainder were non-feeder roads.

Queensland, with an area of 670,500 square miles and a population of 949,000, had a railway system of 6,566 miles (mostly of 3 feet 6 inches gauge), laid down in such a manner that four main lines extended westerly from the coastal railway for distances up to 600 miles. Those lines, as well as the coastal system, had smaller branches, and approximately 80 per cent. of the State was within 100 miles of a railway. The western country was devoted mainly to grazing, and mining was carried on in the north-west, whilst the coastal belt was devoted to agriculture, dairying, sugar, mining, timber and secondary industries.

The road system 13 years ago was confined to primitive tracks in the western country, short sections of graded and metalled roads leading to coastal towns and railway-sidings, and one or two steeply graded mountain-pass roads leading from coast to hinterland. The Commissioner of Main Roads now controlled some 10,000 miles of the more important roads, the construction and maintenance of which were so financed that approximately one-fifth of the cost fell upon the ratepayers in the various local-authority areas and the balance directly upon the road-user through the medium of motor-vehicle registration-fees and the "Federal Aid" road grants derived from the Commonwealth petrol-tax. The payment of interest and redemption on road loans was met from the same revenue sources. Heavy vehicles trading on routes competitive with railways were super-taxed to the extent of 1½d. per ton-mile of capacity on goods vehicles, and ½d. per passenger-seat-mile on passenger vehicles, together with an additional tax at a rate varying from 11s. 3d. per power-weight-load unit¹ for a pneumatic-tired vehicle of 45 per cent. or less overhang to 22s. 6d. per unit for a vehicle shod with solid rubber. Vehicles having a greater overhang or shod with metal tires were taxed still higher.

The main road-system was being constructed at costs which varied from a few hundred to many thousands of pounds per mile, according to the requirements of traffic and the physical features of the country. Low-level bridges were general, and Australian hardwoods were largely utilized in their construction. The costs of road construction quoted in the Paper appeared low in comparison with those ruling in Queensland, but comparisons were useless unless conditions of loading, climate and loan periods were taken into account. The

¹ Power unit, 1 HP.; load unit, 1 cwt.; weight unit, 1 cwt.

Mr. Kemp. costs of the Local Authority share of construction in Australia were treated as loans having a 30-year currency.

Experience in Queensland of the carrying capacity of various types of roads agreed with the experience of Mr. C. L. Cox, Director of Public Works in Nigeria, rather than with American data. The surfacing of Australian roads with bituminous materials was economically justified generally at a much earlier stage than was apparently American practice.

The Author's statements of principles governing the economics of road surfaces might be generally agreed with, but he had not touched upon the relation of gradients to pavement types.

The cost of motor-transport would vary in every country. The Queensland Transport Board reported in January, 1933, that the average cost of motor-transport by road was 5·09*d.* per ton-mile with fully laden vehicles (both ways); with vehicles fully laden on the forward journey and with 15 per cent. return loading, the cost rose to 8·19*d.* At the present time the corresponding figures were probably 10 per cent. lower. Out of a total of over eighty thousand motor-vehicles in Queensland, some twenty-three thousand were commercial vehicles and three hundred and twenty were operated, at the date quoted, on routes served by railways, about two hundred of them being fully competitive. The estimated annual loss to the Queensland Railways due to the operation of those competitive vehicles was £200,000.

Railway rate-making in Australia generally was on the principles quoted by the Author. The unearned increment derived from the construction of Australian railways had never been credited to railway capital, and as a result, none of them earned anything towards amortization. About 3 years ago the Queensland Government wrote its railway capital down by £28,000,000, but the railways had not even yet been able to earn any sinking fund on the reduced capital of £36,000,000. The Transport Board report referred to above showed that the net earnings of Queensland railways for the year 1931/32 were 2·88 per cent. on the original capital, the interest charge thereon being 4·38 per cent., and the interest deficit represented 84 per cent. of the income-tax assessments of the State. The average charge for conveyance of all goods, including the haulage of empty wagons, over Queensland railways was 1·83*d.* per ton-mile. It appeared, then, that if an average of 3*d.* per ton-mile for goods and the equivalent for passenger traffic could be obtained, full interest and a small amount towards sinking fund on the original capital could be provided for. If railway capital could be written to its true value, it was possible that freights and fares could be reduced in many undertakings to an extent which would greatly reduce the

losses due to competition of motor-traffic. Mr. Kemp had previously dealt with the valuation of public utilities on the basis of their future earning capacity.¹ Without protection such as that afforded under the Queensland Transport Act, it was quite impossible for the Queensland railways to compete with even partially back-loaded motor-vehicles hauling high-rated goods.

The revolutionary method adopted in Africa for dealing with railway tariff schedules was extremely interesting. A levelling-up of tariffs in Australia would be extremely difficult, owing to the policy of developing new districts by what amounted to a subsidy on goods carried therefrom. The transport of sugar-cane in Queensland from field to mill was almost invariably by light 2-foot gauge railways at a much lower cost than would be possible by road, even if good roads were available.

As mentioned on p. 567, railways could not cater for short distances so satisfactorily as roads, and that fact was recognized by Transport Boards in Australia, which had fixed various limits from 15 miles to 50 miles under which road vehicles on competitive routes were freed from transport fees.

Regarding the privileged character of road-transport and transport regulation, the Queensland transport report quoted Professor Copland of Melbourne, as follows :—

“Where motor transport is not a common carrier and merely takes the cream of the traffic on favoured routes it may return a profit to the private owners and some gain to its customers. To suppose that the existence of such a profit indicates a net economic gain to the community involves a fundamental error. The profit to the individual may be less than the net loss to the community through the reduction of railway revenue on routes where the railways are forced to carry the least profitable freights.”

The Transport Board submitted that an adequate system of transportation could only be obtained by making use of the best means of transport available and by combining them in such a way that they could be operated at the lowest total economical cost, having due regard to the service required. It had proceeded to put that policy into effect in several instances by arranging with common road carriers to deliver goods to rail, transport them long distances by rail, and finally distribute them by road. The carriers involved in that co-ordinated service had indicated that they would be very unwilling to re-engage on the old competitive service, carrying all the way by road.

¹ Presidential Address to the Institution of Engineers, Australia, 1931.

Mr. Kemp.

In a valuable paper dealing with "The Economics of Railway Transportation as applied to New Construction,"¹ Mr. F. J. Jones, M. Inst. C.E., said of the ordinary system of railway rating:—

"To-day this system of rating is not an unmixed blessing, and there is increasing evidence that with the competition of the motor vehicle its day is over."

He also indicated that the limit of most intense traffic in New Zealand would produce £4,000 per mile per annum, and also that on new lines projected the probable average would be below £1,000, whilst the average traffic in New Zealand would produce £2,300. Under that average revenue condition lines costing more than approximately £6,000 per mile could not pay interest. With an annual revenue of £4,000 per mile the cost of construction should not exceed £20,000 per mile if interest charges were to be met. Mr. Kemp understood that the New Zealand Society of Civil Engineers had appointed a Special Committee to examine road construction and transport costs in a similar manner.

He agreed with the Author's conclusion that if the cost of road construction and maintenance were to be kept low, axle-loads should be limited to moderate figures and pneumatic tyres should be insisted upon for all vehicles. The Queensland motor-vehicle and heavy vehicle regulations aimed at that by the imposition of higher registration fees on solid-tired vehicles.

In a report² to the Australian Federal Aid Roads Board Mr. Kemp, in collaboration with Mr. D. A. Crawford, had recommended low speed-limits for solid-rubber-tired vehicles, as follows:—

Four-Wheeled Trucks—Single Solid Rubber Tyres—

Carrying capacity 2 tons and under (maximum wheel load 34 cwt.)	Speed limit.
	16 miles per hour.
Carrying capacity over 2 tons and up to 4 tons maximum (maximum wheel load 61 cwt.)	8 " "

Four-Wheeled Trucks on Twin Solid Rubber Tyres—

Carrying capacity 2 tons and under (maximum wheel load 34 cwt.)	18 " "
Carrying capacity over 2 tons and up to 4 tons (maximum wheel load 61 cwt.)	10 " "
Carrying capacity over 4 tons and up to 5 tons (maximum wheel load 73 cwt.)	8 " "

Six-Wheeled Trucks—

Carrying capacity up to 8 tons (maximum wheel load 53 cwt.)	10 " "
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<i>Pneumatic-Tired Vehicles</i>	30 " "
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¹ New Zealand Society of Civil Engineers, 1928/29, Vol. XV.

² "Weight and Speed Regulation of Road Vehicles," Brisbane, 1929.

Solid Metal Tires—

Not exceeding 4 tons	8 miles per hour.
Exceeding 4 tons	6 " "
Tentatively recommended	4 " "

Mr. Kemp.

Cushion Tires—

Speeds 10 per cent., higher than for solid rubber tires.

The effect of heavy vehicles upon the cost of rural road construction controlled by Federal and State Road Authorities in Australia was indicated by the fact that 1 inch of extra pavement thickness would cost the country over £9,000,000 in a 10-year period.

Mr. G. L. LAURENSEN remarked that in the stating of the problem, Mr. Laurensen. and also on the methods proposed for its solution, he more or less agreed with the Author, but always on the assumption that a large amount of capital had already been invested in railways. To state the particular case of New Zealand, motor-transport was introduced when the country had already invested approximately £60,000,000 in railways, and that investment had to be protected. Many of the remedies suggested by the Author had been adopted in New Zealand, and were briefly as follows :—The motor taxation imposed produced approximately £3,000,000 per annum, while the annual maintenance and interest and sinking fund charges for the roads of the country were approximately £6,000,000. Most of the roads in the country were classified, the general standard adopted for the rural roads allowing for a gross load of 6½ tons on two-axled vehicles, and 10 tons on multi-axled lorries, the maximum allowable axle-load being 5·2 tons. There was a general statutory limitation of 10 tons for two-axled vehicles and 15 tons for multi-axled lorries. Allowable speeds for goods vehicles with pneumatic tires varied from 25 miles per hour to 15 miles per hour, and all solid-tired vehicles were limited to 12 miles per hour. The Transport Licensing Act, 1931, provided that all passenger services should be licensed, and goods services had now been brought under the same Act. Licences were not required, however, for the ancillary user, or for a goods service carried on entirely within any borough or city.

The Author had dealt principally with the transport of goods, and his main conclusion (p. 571) appeared to be : " To use a means of conveyance which costs 6d. per ton-mile for one costing 2d. per ton-mile is not economic, and must result in loss somewhere ; and the greater the use made of the roads the greater the resulting loss." If that represented the whole problem, it appeared that the railways would have nothing to fear from road competition, for it was hard to imagine anyone paying three times as much as the rail charge for the privilege of having his goods transported by road.

The Author drew attention to certain factors which had to be

Mr. Laurensen. taken into account when considering relative costs, one being the principle of rating known as "charging what the traffic will bear," and another being the handling and terminal charges necessary in connection with rail-transport. The first factor had a very important bearing on the position in New Zealand, where freights at under 2*d.* per ton-mile amounted to 57 per cent. of the total goods hauled, and represented only 35 per cent. of the revenue, while freights on which 4*d.* or more per ton-mile was charged represented 44 per cent. of the revenue. Regarding the second factor, the handling and terminal charges in New Zealand were approximately 7*s.* per ton, counting both terminals, which amounted to 3·36*d.* per ton-mile for a 25-mile haul, or 1·68*d.* per ton-mile for a 50-mile haul.

The investigations being carried out by the Oversea Mechanical Transport Committee regarding the cost of road-transport for colonial development appeared to have a very important bearing on the position. The Committee estimated that without return loading in the early stages of development of a new area the transport costs, with a 15-ton pay-load unit, should not exceed 5*d.* per ton-mile, and with a specially designed 30-ton unit the cost should be reduced to about 3½*d.* per ton-mile. The report stated that the roads for such vehicles would only cost from £200 to £300 per mile to construct, and the maintenance charges thereon should not be heavy.

As a general conclusion, allowing for the very rapid development taking place in the motor-vehicle, he would suggest that where the problem was not complicated by a large amount of capital having already been sunk in railway facilities, then the relative merits of both forms of transport should be very carefully investigated, as it was not clear that the railway was always the best transport agency for development. For instance, if it were possible to start afresh it appeared that it would be hard to justify the building of a railway in Mauritius or Trinidad, where the hauls were short and the country apparently not easy.

Mr. Lavis. **Mr. FRED LAVIS** observed that the improvement in commerce which might be expected to follow the depression would require further development of land transportation. While overproduction had been frequently blamed for the depression, bad distribution had probably been a much more important factor. In that, lack of transportation or badly designed transportation had played a part, although methods of distribution and lack of financial wisdom had been important. All those factors should, therefore, be kept in mind when considering future transportation development.

In Asia and Africa certain main trunk transcontinental lines were necessary to form the main framework of the land transportation system. In South America the problem was different and, while

a Pan-American railroad, and more recently a Pan-American highway, Mr. Lavis had been discussed, there seemed to be little economic justification for either, although the latter might develop because of the popularity of touring in private automobiles, which might increase further. The essential transportation problem in practically all of the countries of Latin America, and indeed also of most of the countries or sections of Asia and Africa, was that raw materials and commodities produced in the interior had to find their way to a port for shipment overseas and that manufactured goods had to be imported and then distributed in the interior by river, railway, highway or trail. There was very little traffic between the neighbouring countries.

Up to the present time there had been little, if any, attempt to design or plan a transportation system for a country as a whole, to say nothing of a continent. Most existing developments had simply grown. The apparent tendency was to build highways just because highway transport was thought to be modern and railway transport obsolescent. Perhaps one of the most conspicuous instances of that was the so-called "Highway to the Sea," some 250 miles in length, which was projected and partially built from Medellin in Colombia, South America, towards the Gulf of Urabá. The cost of the first 60 miles of that highway was about £100,000 per mile. It crossed the central Cordillera at an elevation of about 10,000 feet above sea level and was paved with water-bound macadam.

The problem of land transportation, especially in countries only partially developed, was seldom studied from the Author's viewpoint (which should, of course, be the viewpoint of the engineer), namely, that of the total cost of transportation. Where highways were built with government funds and paid for out of taxes, the cost of construction, and even the cost of maintenance of the road, was quite likely to be neglected or forgotten in calculating costs of transportation. Mr. Lavis had discussed the economic problems involved in a paper entitled "Highways as Elements of Transportation,"¹ and, although it referred specifically to the design of important highways in densely-populated areas, and its relation to the costs of operation of vehicles, the underlying theory applied equally to the design of other highways and the corresponding operating costs. That paper, however, did not refer to the effects of differences of road surfaces on the costs of vehicle operation which, in the case of development roads, were extremely important. Fortunately in the tropics much of the crop movement occurred in the dry season, and not in the rainy season, when earth roads might be impassable except for light vehicles.

¹ Trans. Am. Soc. C.E., Vol. 95, p. 1020 (1930).

Mr. Lavis.

The Author made one important observation which had not been sufficiently appreciated, namely, that improved surfaces reduced the costs of maintenance as well as costs of vehicular operation.

It was unfortunate that the narrow gauges (3 feet, metre and 3 feet 6 inches) for railways, had been to a large extent fastened on the continental systems of Africa and South America, especially as there was little saving in costs of construction and usually an increase in the costs of operation.¹

Mr. Lavis believed that in the future, so far as could be foreseen, railways would generally have to form the backbone of any important system of transportation, especially for distances much over 100 or 200 miles, but that highways might well be utilized as feeders. It seemed to be fairly well established in the United States that from 50 to 100 miles was the usual limit of haul for trucks in competition with railways. Although there were many instances of road hauls up to 300 or 400 miles or further, the railways were at present hauling 90 per cent. of all the freight moved in the United States, despite the highly developed system of splendidly paved highways. It was frequently forgotten that highway competition by lorries was often carried on at a loss, if all the operating costs were taken into consideration. He had found in Santo Domingo, West Indies, that, while actual operating costs, making due allowance for amortization or depreciation, were probably about 10 cents (5*d.*) per ton-mile, freight was actually being carried for 4 or 5 cents (2*d.* to 2½*d.*) per ton-mile—about the actual cost of petrol, oil and drivers' wages.

There could be no general rule about the utility or feasibility of either railways or highways, and each particular case should be studied on its merits. In undeveloped countries estimates of economic values should be based on the probable volume of traffic to be expected at some future time, and not simply on that which was immediately visible. Further, it had to be considered whether the section proposed was complete in itself, or whether at some time it was to form part of a larger unit. In the case of the Gold Coast lines referred to by the Author, if they were to go no further than 100 miles roads might well be better than railways. If, however, those lines would probably be extended 300 miles or more into the hinterland, then railways might be better. Those considerations should be elementary principles to competent engineers, but they were apparently often neglected because so many persons assumed that they could lay out roads without knowledge or consideration of the economic factors which should determine whether a railway or a highway ought to be built and should control its design. Even among

¹ "The Gauge of Railways," Trans. Am. Soc. C.E., Vol. 78 (1915), p. 312.

engineers there was not always adequate recognition of the difference Mr. Lavis between the design of the route and the design of the structure, and of their intimate relation to each other.

In considering costs of construction, it might be well to remember that just as railways could be built in the first instance with light rails and equipment, even in some instances with second-hand material, although that was doubtful economy, so also highways, provided they were well drained, could be built first as earth roads, later surfaced with a light coating of gravel or stone, later on with an oil or bituminous coating, and so on. As the Author pointed out, however, the lack of surfacing might increase maintenance as well as operating costs. Lack of available funds was, of course, a factor, and it might be necessary to lay down a longer mileage of earth road rather than a shorter mileage of paved road.

Regarding the construction of highways parallel to existing railways, he thought that that was difficult to avoid. He had known of many countries of Latin America where capital funds were difficult to obtain and where from a strictly economic point of view such funds as were available should be used for development and feeder routes, and yet the tendency was to build highways parallel to the railways, as the latter were originally built connecting established centres of population, the people in which had usually sufficient political influence to get roads built where they wanted them, and generally demanded connecting highways, for convenience in automobile travelling, through the towns and cities already connected by railway. All that the railways could do was recognize the competitive situation and take such steps as might be possible to meet it. He thought that had been accomplished to some extent in England, and more or less successful attempts and experiments were being carried out in the United States.

It seemed probable now that railways could ordinarily meet road competition, except for short hauls up to perhaps 50 miles. Their loss of the short-haul business was not altogether a matter for regret. Many railways in the United States entering large terminal areas were, at least during the prosperous period of 1927, 1928, and 1929, becoming anxious about the limitation of their terminal areas and were faced with the possibility of extensions being required in areas where the costs would have been almost prohibitive. The competition for passenger business was, however, quite a difficult problem; the privately-owned and driven automobile was a far more formidable competitor than the bus, and did not relieve the terminals of the low-rate season-ticket business they were required to handle. If it seemed necessary or desirable to compete actively for the long-haul passenger business it would have to be on the basis of more adequate

Mr. Lavis.

service, higher speeds, possibly lighter equipment, more frequent service, and better-appointed and more comfortable cars with air-conditioning and freedom from heat and dust, especially in the tropics.

He was in general agreement with the Author regarding the conclusions expressed in the last two paragraphs of the Paper, and felt that he was to be congratulated on a carefully-considered presentation of the subject.

Colonel Maxwell.

Colonel G. A. P. MAXWELL, of the Tanganyika Railway, remarked that on pp. 547 and 548, new railway construction and its cost in various Colonies, Protectorates and Mandated Territories was dealt with. The following Table ¹ gave particulars of railway construction carried out in Tanganyika in the last 10 years, and some notes on the cost thereof.

Line (metre-gauge).	Characteristics.			Miles.	Correct relative cost, to nearest £1,000.	Cost: £ per mile.
	Rail weight: lbs. per yard.	Per- cent- age ballast.	Type of country.			
Tabora— Mwanza.	45	20	25 per cent. flat bush-covered; 75 per cent. open sheet-flood country.	235.5	£1,054,000	4,480
Moshi— Arusha.	45	70	Hilly with heavy bridging.	44.5	£322,000	7,240
Manyoni— Kinyangiri.	45	Nil	35 per cent. flat bush-covered; 50 per cent. open sheet-flood; 15 per cent. heavy forma- tion.	94	£545,000	5,790
Total . . .				374	£1,921,000	5,140

NOTE.—Parts of the lines tabulated above utilized second-hand permanent-way material, or included short sections of existing track. The figures of cost have therefore been corrected as for construction with new material throughout.

Regarding the cost of road construction, his impression was that in Tanganyika road-making was rather more expensive than any figure mentioned in the Paper, owing to the almost complete lack of suitable road-making material. For the construction of metalled roads he had found it necessary to allow approximately £2,000 per mile.

¹ Compiled by Mr. C. Gillman, Chief Engineer, Tanganyika Railway.

A great deal of the competition arising in Tanganyika between road and rail was due to privately-owned vehicles being run on uneconomic lines without regard to interest on capital, depreciation, etc. A vehicle obtained on the hire-purchase system was often run to death before it was paid for, and final payment might never be made. In the course of dealing with many problems of marketing native produce, he had gone most carefully into the figures of the cost of road transport, and he was convinced that even near the coast the actual operating expenditure of motor transport, allowing for all charges, was in the neighbourhood of 5·4*d.* per ton-mile, and that up-country on rather poorer roads it increased to between 6·5*d.* and 7*d.* per ton-mile. Those figures took no account of direct payment towards the upkeep of roads. At the present time, owing to the fact that lorries were actually in existence and their owners trying to make a living by keeping them going, rates as low as 6*d.* per ton-mile were being quoted in the interior of the Territory, but he was quite convinced that those rates could not be maintained for any lengthy period if capital cost and depreciation were taken into account.

The cost of rail transport was of major importance. Tanganyika Territory was rather over 365,000 square miles in area, and had a population of about 4½ millions. The railway was about 1,458 miles in length, and the main line from Dar-es-Salaam to Kigoma, which might be said to have followed the engineering line of least resistance, was 772 miles in length. The population was centred in well-defined parts of the Territory, and many of the centres were some distance from rail. Also, about five-eighths of the total area of the territory was infested with tsetse fly and was practically uninhabited. The present annual tonnage on the railway was about 220,000 tons, and the receipts 1·75*d.* per ton-mile, which did not cover the total expenses of the railway, so that it was actually run at a loss. He calculated that 2·5*d.* per ton-mile on the present very small tonnage would cover all expenses, and that if the tonnage could be worked up to 600,000 tons, an average receipt of 1·5*d.* per ton-mile would cover all expenses.

The rating employed was almost exactly similar to that in force on the Kenya and Uganda Railways. The export rates differed very considerably from those quoted as in force in Nigeria. The main centre of ground-nut production in Tanganyika was 700 miles from the coast, and 35*s.* per ton was the maximum rate which it was considered that industry could afford, so that the railway was faced with carrying some 10,000 tons of ground-nuts 700 miles for 35*s.* per ton, the average rate being 0·6*d.* per ton-mile, which was actually below the cost of working. Obviously no form of road-

Colonel
Maxwell.

Colonel
Maxwell.

transport could possibly cope with such bulk traffic at that price, and so in 1931 a Bill was introduced placing a heavy licence fee on road-transport along roads running parallel to the railways. Those licences were not sufficient to stop competition altogether, but did a great deal to return import traffic to the railways, and a Bill was introduced in the Council April, 1934, to prohibit competition by road-transport along roads parallel to the railway. No licence or penalty of any kind was imposed on motor-transport using feeder-roads to the railway.

He had considered very closely the question of abolishing the highest rate on the railways, but he had concluded that revenue would be actually lost by that proceeding, even though some of the traffic which had gone to the road might be recovered, and those final figures had induced the Government to bring in the new Bill. On a long system of rail such as that of Tanganyika, it was almost impossible to retain the short-distance passenger for the railway, as the service could not be made sufficiently frequent and sufficiently fast to attract him from the road. He considered it equally certain that to raise the low-class rates would only result in stifling the development of the country, so that, as long as the tonnage remained small, the country must face a deficit on its railways.

The following was an extract from a report he had written some little time ago :—

“ Taking past history, it may be stated generally that all Colonial Government Railways have actually, in the beginning, been run for the benefit of the country, and not with the view of placing them in a sound financial position, although I agree that the degree of soundness varies largely. Practically none of them, however, have built up a sufficiently large Reserve fund to carry them over any extended period of general depression or over a period of continued failure of the staple crop of the country. I do not say that the object should not be to put Colonial Railways on a sound financial basis, and in periods of reasonable trade activity once the Colony has become properly established, it should be the desire of all concerned to have a sound and separate Railway Budget, but, in the early days of a Colony or in a period of extreme depression, I maintain that the Railway should be used for the general welfare of the Colony for quoting low export rates in order to enable the Colony to establish a favourable balance of trade, out of which a subsidy to the Railway can easily be forthcoming. I also consider that any grants so given should not be repayable until

the Railway has been put on a sound financial basis during the boom period following the depression. Colonel Maxwell.

"Looking at Colonial Railways another way, the Railway Budget is ordinarily charged with the whole of the interest on Railway Construction, whereas development benefits the Government by Customs Returns and by general taxation probably far more than it ever benefits the Railway, so that, as long as the Government is satisfied that their Railway is well and economically managed, they should assume that the period of depression is not a permanency and should, during this period of depression, be prepared to shoulder the interest charges on the original capital expended on Railway construction for development purposes. It must be borne in mind that a Government Railway is given no grants of land or no control over mineral rights in the country over which it is built such as would be demanded by a private Company undertaking railway construction."

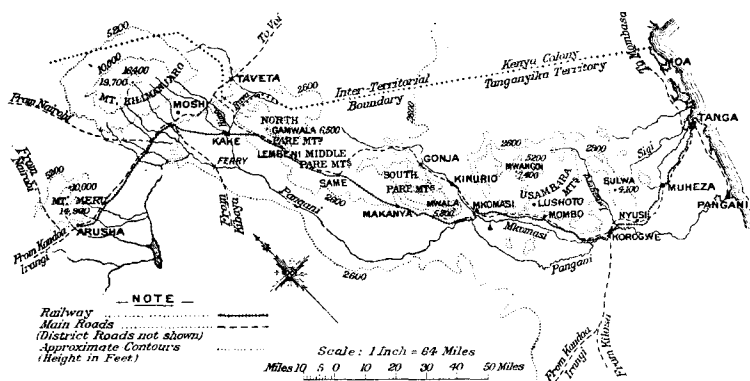
Mr. H. C. PLATTS remarked that, although conditions in many colonies were similar, it was often difficult in one colony to reap the benefit of experience in another, and the pooling of information carried out by the Author was of great benefit. It seemed a pity that, in spite of the interchangeability of technical personnel between colonies, there was no centralized co-ordination of colonial engineering services, and it was well that The Institution provided a means of exchange of information that was not always readily obtainable through official channels. Could the Author give any figures relating to the ton-mileage cost on railways with a short average haul, such as in Trinidad and Mauritius? Mr. Platts had spent rather more than five years in the East African islands of Zanzibar and Pemba, mostly on the construction of new roads and road-bridges, as after the war a vigorous policy of road construction was pursued as the best means of developing internal communications, and he did not think that a railway was ever seriously considered as an alternative. An economic reason for favouring road rather than railway development in those islands was that the principal product, cloves, was comparatively high-priced in relation to its bulk; also Pemba was topographically unsuited to easy railway construction. The calculable facts of economics were not, however, the only points to be taken into consideration, because a road system offered social and administrative advantages of a value that it was almost impossible to assess. In a small island like Zanzibar with an average population density of about 200 per square mile, those advantages were so important that a road system was indispensable. A railway could

Mr. Platts.

not be regarded as an alternative, but only as a supplement to be added if potential traffic should justify its construction.

Mr. Platts was subsequently, from 1927 to 1929, responsible for over 600 miles of main roads in the Tanga and Northern Provinces of Tanganyika Territory (*Fig. 9*). That district was served by a metre-gauge railway running about 220 miles inland to Moshi on the slopes of Mount Kilimanjaro, with an extension, recently constructed, to Arusha, 50 miles west of Moshi. The greater part of the railway existed before the roads, and he had soon come into contact with the road-rail problem, and with "parallelism" in particular. The area served by the railway was developing rapidly during that period, but in 1927 through road communication parallel to the railway was only possible from the port of Tanga to Mkomasi, about

Fig. 9.



117 miles along the railway. That route was rather hazardous because the Lwengera bridge near Korogwe was very primitive, and liable to submersion during the rains.

During his term of office, a number of war-demolished bridges on the pre-war road connecting Mkomasi and Same were rebuilt, and although technically that road was a railway feeder because it served the side of the South Pare Mountains remote from the railway, the work had the effect also of extending "parallelism" as far as Same. In the area of the Middle and North Pare development had not advanced to the same extent as farther south-east, nor to the same extent as in the European-settled areas of Moshi and Arusha, but it was making progress and motor tracks were opened between Same and Lembeni, "parallelism" being thus extended still farther north.

The nearest centre of any consequence for the North and Middle

Pare area was Moshi, but access by road was at that time blocked Mr. Platta. by the River Ruvu. It was suggested that the existing railway bridge over the Ruvu near Kahe should be decked to allow the passage of road-traffic, and that a toll-system should be operated by and on behalf of the railway. That suggestion was made, not only with the intention of advancing essential road communication, but because it occurred to him that it would place a strong weapon in the hands of the railway for defeating unfair parallel competition by lorries. Such a precedent of policy required time for consideration, and the proposal was not developed during his period of office. Meanwhile, however, the necessity for some sort of communication by motor with Moshi became urgent, and some of the local planters, with the assistance of the District Officer in charge of the recently established Pare District, constructed a primitive timber bridge over the Ruvu. Approach tracks were cleared, and thus parallel communication, possible for light lorries and private cars, was established between Tanga and Moshi. Incidentally, the building of that rather shaky structure opened the Tanga, Usambara and Pare areas for road-communication with the main roads leading to Kenya and Uganda in the north, and the Rhodesias and the Union in the south. The bridge was much too frail to withstand heavily laden lorries, but it was inevitable that public opinion would in the future press for and ultimately obtain a superior structure, and the danger of lorry competition with the railway goods traffic would arise. The Lwengera Bridge near Korogwe previously mentioned was an example of that process; it had a similar and equally humble beginning, but in 1929 the money was found by the Government, and a steel girder-bridge clear of flood level was completed in 1930.

Those examples confirmed the opinion expressed by the Author on p. 571, that it was impossible in practice to confine a road-system to feeders radiating from a railway. Not including the 62 miles from Mkomasi to Same along which the bridges were reconstructed by the Government, about 60 miles of parallel track, passable for private cars and light lorries, came into use in a period of less than 2 years without either direct initiative or expenditure on the part of the Government. That could only be the result of the pressure of necessity, and it was certain that the tracks would ultimately acquire the status of recognized roads, and that the Government would find itself compelled in the interests of the community to undertake their maintenance and improvement. That process of development by roads and motors was inevitable if progress was not to be retarded, and if, indirectly, the welfare of the railway itself was not to be prejudiced. Freedom of movement for people was essential for social, administrative and

Mr. Platts. business purposes, and railway passenger services could never be adequate to fulfil the requirements.

Regarding lorry competition in goods-traffic, no reasonable person could disagree that control of some sort was necessary. The difficulty was to decide what form that control should take, and the method must vary with the conditions peculiar to different localities. Restriction of lorry-size and axle-loads might be suitable in some countries, but it might affect adversely the efficiency and economy of feeder-services. Restriction from the use of roads parallel to railways by licensing or other means might also be possible, but difficulties would arise in practice, because most parallel roads were feeder-roads as well. It had to be borne in mind also that the temporary transfer of lorries to other districts, or to the larger centres for repairs, was not unusual, and it would be unreasonable to restrict such movement. He had concluded that a toll-system operated at key points, such as major bridges, had much to commend it. Control would be concentrated at a few points, and the details of administration should thus present no great difficulty. The tariff could be adjusted according to lorry-size and to the nature of the goods transported, so that adequate protection to railway freight-traffic would be afforded. The revenue would provide funds for maintenance and interest charges, and any surplus might well be applied to stimulating services of which the legitimate road-user stood so much in need. The combined road-rail bridge was no new conception, and if such bridges were built at important river-crossings where railway construction or reconstruction was undertaken, the control of "parallelism" by tolls could be conveniently exercised should it become necessary. There was a natural reluctance on the part of railway-engineers to contemplate such action, which suggested facilitating road-transport, but a concession to the class of road traffic for which the railway could never cater adequately could be the means of affording effective control of traffic that was truly competitive.

Railways had played, and continued to play, a magnificent and indispensable part in colonial development, but it was well to remember that the monopoly which they once enjoyed for all kinds of land-transport no longer existed. The road and the motor-car had provided a new sphere of convenience and utility to mankind for which, under colonial conditions, the railway could offer no adequate substitute. Both roads and railways had their own place, and it was misleading to think of them in the general sense as alternatives. The question of alternatives arose in a different way when a certain stage of development or potential development was reached in any locality; the choice then lay not between roads and railways

in the general sense, but between roads of a higher standard of Mr. Platts. construction on the one hand, and a railway and roads of relatively low standard on the other.

Mr. C. I. ROBINSON remarked that the Author had made the best Mr. Robinson. of the railways' case against the competition of the roads and of the voluminous statistics at his command. Those, however, were the products of various colonial governments, and the whole truth might not always be found therein. The Author was inclined to deduce rather more from his figures than was justifiable. On p. 555 were stated the rates per ton-mile on certain colonial railways in 1932. On the Federated Malay States Railway, the lowest of the four examples quoted, it was given as 1.37*d*. The Author thence deduced that the "cost of movement by rail is certainly not more than one-third the cost of movement by road," but he was careful to state that the 1932 rates quoted were "not entirely economic." That was insufficient to indicate the limitations of his figures, which might be of sufficient magnitude to affect the value of his deductions. The gross cost of movement per ton-mile was required if a comparison was to be made with the cost of road transport. It was just that important railway figure which was so difficult to obtain. The F.M.S. Railway had for some years, including 1932, been a charge upon the general revenues of the country. It was obvious, therefore, that the rates paid did not represent the true cost of movement. It might be urged that recent years had been years of depression. How they would be related to the future was a subject for speculation rather than calculation. The F.M.S. Railway was a government railway, and had been constructed out of State revenue; it owned large areas of land for which it paid no rent to the State, and its numerous buildings within town limits escaped the municipal taxation borne by those of private individuals. It was not easy to assess the cost to the State of those advantages enjoyed by the railway. On the other hand, the railway had to submit to the issue of many free passes, and had undoubtedly spent large sums in surveys dictated by "political expediency" rather than sound railway administration. It was not possible to proceed to sound deductions from statistics published under such conditions, and it would be remarkable if the figures quoted from other colonies were free from defects similar to those of the F.M.S.

Since railways no longer enjoyed the monopolistic position that was once theirs, it seemed likely that some change would be necessary in the classification of goods rates so long in vogue. Colonial railways could undoubtedly derive benefit from well-planned road development, but that development was not essentially for the benefit of the railway, but should be for "the greatest good of the greatest

Mr. Robinson. number." Road traffic should pay its proper due towards the cost of the roads. That was usually achieved by taxation upon vehicles, fuel, and stores. Axle loads should be limited in the interests of road upkeep, though probably not down to the Author's 2-ton limit. Vexatious restrictions of loads, particularly without adequate notice to road users, were to be avoided. They did not materially assist the railways, while they exasperated the trading community, as also did the imposition of tolls designed to force road-borne traffic back to the rail. Nearly 40 years after the last turnpike trust had disappeared in England a toll was introduced upon a newly-constructed bridge on the main trunk road of the F.M.S. The added traffic brought to the railway by that reversion to an obsolete system was not worth the public feeling it aroused.

While it was admittedly desirable to avoid, as far as possible, road construction parallel to railways, such conditions already existed in many parts. It was interesting to compare the F.M.S. railway system, with its parallel road competition, and the Siamese system to the north with its railway monopoly. It would be of interest to see how long road development in Siam could be retarded in the interests of the railway, or limited to the function of railway feeders. The competition of air transport would also have to be faced in the immediate future, and would recognize no route-limitations.

There had been too little co-ordination of road and rail development in colonial administration. Extraneous influences too often handicapped railway management. Even where road and rail development committees had been set up, they had not been adequately used. It was so easy to appoint a commission or committee, and at the same time to ensure that it should achieve nothing unless consonant with the wishes of those in command. Despite the limitations of his material the Author had produced a valuable and stimulating Paper.

Mr. Salkield. Mr. TOM SALKIELD remarked that the Author's findings leaned definitely towards railways, but he agreed, as all who knew anything about the subject must do, that roads and railways were so closely married that it was impossible to divorce them. Long before railways came into existence roads of varying types were the only means of intercommunication, as they had been ever since the beginning of civilization. If transportation was really civilization (though that might be doubted) then all the means possible for the development of means of intercommunication should be explored. Some years ago he had made a survey along the eastern frontier of Persia with a view to the construction of a highway from India to Meshed and beyond into Russia, but political upheavals (to say nothing of the physical difficulties to be overcome) had made it impossible to

proceed. He had learned on that survey, if never before, how Mr. Salkield. essential were roads and railways for the opening up of vast territories. East Persia was rich in minerals and possibly oil, but was unexploitable except by camel. He had explored that region with the aid of motor-lorries and motor-cars, and had traversed its salt deserts and its almost impassable mountain ranges. Camel transportation in that part of the world cost from 2s. 9½*d.* to 4s. 10½*d.* per ton-mile, according to the kind of merchandise; and at rail-head at Dazdab, near the frontier of Baluchistan, much merchandise for the interior had accumulated, which could not be delivered owing to lack of transport.

It might appear somewhat ridiculous to attempt a comparison of transport conditions in India and Great Britain, but the figures did demonstrate the wide differences between them. The Indian Empire had an area of 1,805,000 square miles, or 46·78 square miles per mile of rail, while Great Britain had an area of 89,030 square miles, or 4·49 square miles per mile of rail.

Would the railways of India be rapidly extended in the future? Would the rail-and-road system of transport be developed? Would the two systems be evolved together and properly co-ordinated? Road-transport was developing in India at a greater rate than were the roads, but the demand upon the roads was for short distances only, which emphasized the importance of railways, and of roads as feeders for them. In 1880 a Commission demanded 20,000 miles of railway, but made not a single recommendation for the improvement of road communication. That was probably because roads in India were practically non-existent until the advent of British rule, and no one in 1880, and even much later, realized their importance. Times, however, had changed, and the importance of roads as well as railways was now realized. If the road system in India were to be developed, the abolition of the road-destroying springless country carts would be necessary. Until the knife-edge wheels of the bullock-cart were seen only in museums, and vehicles with small wheels made illegal, highway development in India would be slow. The low country cart had front wheels of about 1 foot 8 inches diameter and rear wheels about 2 feet 7 inches diameter, with tires about 2½ inches wide. The front wheels being so much smaller than the back wheels, those vehicles could turn in their own length, causing much damage to the road surface when they were loaded to their utmost capacity with heavy merchandise. In India all but about 10 per cent. of the roads outside the large cities and the Grand Trunk Road were merely tracks which received a certain amount of surface attention, and represented the cheapest form of construction possible. In those circumstances it was easy to realize that the problems of civilization and education in India—which

Mr. Salkield. were serious—were closely connected with that of transport. If India was to progress along the lines which were indicated by the Author as essential for colonial development, then her engineers should be advised about the cheapest form of transport to meet the situation; there was no doubt that the road-motor services should act as auxiliaries and as feeders for both main and subsidiary lines of railway. India was too immense a country for competition between road and rail services; consequently under sagacious central control she should secure co-operation and co-ordination of both methods of transport, and thus avoid the antagonism between the two which had been experienced elsewhere. In connection with road-transport the Government ought to encourage private enterprise by making and maintaining the highways. More roads, more railways, and more co-operation were what India needed more than politics.

Mr. Temple-Richards. Mr. H. B. TEMPLE-RICHARDS observed that too much stress could not be laid upon the desirability of applying the experience gained in England to the problem of transport in the colonies. A very careful analysis ought therefore to be made of the causes of defects which had arisen in the transport system of the British Isles, before formulating the general principles upon which transport should be developed in the colonies. He did not intend at the moment to make that analysis in detail, but to mention briefly some of the causes from which defects had arisen. Firstly, owing to the advent of the steam engine long before the internal-combustion engine, a primary monopoly of transport had been given to the railways: secondly, the consequent development of railways in the British Isles was on the basis of their being the only prime means of transport. Later, as the railways grew and became large employers of labour, trouble arose with the powerful trades-unions formed, causing the State to place various restrictions of wages, working hours, freight rates, etc., upon the railway companies. Those provisions were sound in themselves, but similar restrictions should have been applied also to any new national means of heavy transport which might develop, if the different systems were to evolve by fair competition between themselves.

The actual position was very different. On the termination of the Great War, work had had to be found for thousands of men demobilized from the army, and vast road developments had been put forward. Extensive permanent roadways were thus created, available for any heavy motor-transport, free to them of any capital cost, and with very few restrictions regarding labour or freight rates. The railways, on the contrary, at the end of the War were in a very depreciated condition regarding their permanent way and rolling stock, though a capital sum, less than that for which they asked, was

allowed to them by the Government for war depreciation. Under those circumstances, road-transport was in effect heavily subsidized in competition against the railways, so that numerous concerns entrenched themselves in a strong position which they would not have reached under a system of combined development in the best interests of the nation. Again, the differing systems of taxation of the two modes of transport tended to prevent fair competitive development.

Mr. Temple-
Richards.

The present transport system in the British Isles was thus the outcome of the growth of different systems, without any comprehensive planning beforehand, and at times with unfair advantages given to one side or the other. To some extent that was inevitable in an old country, which was the inventor and pioneer of modern heavy transport, and for that reason particularly advantage should be taken of the lessons so learnt, and a comprehensive survey and planning of transport in the colonies should be carried out before unsound systems had time to become entrenched as vested interests.

It would appear advisable that each colony should be considered separately, having regard to its natural resources, possible industries, and the lines upon which the colony was likely to be developed in the future. It should then be possible to work out a joint rail- and road-system for the future economic expansion of the colony, so designing the combined system that expansion to the full might take place in stages, finance for such joint development being under the single control of the Colonial Government. Comparisons between costs of road- and rail-transport under the system existing in the British Isles would not afford any true basis for conclusions with regard to a colony where the road- and rail-transport system had been considered jointly in its infancy and planned accordingly.

Mr. T. F. TOMLINSON remarked that he could find nothing to criticize in the Paper, which was extremely instructive and valuable. The Author had given the cost of road-transport in the Colonies as 6d. per ton-mile, but that was certainly higher than the cost in Trinidad. In that colony, with excellent asphalt-surfaced roads, lack of road-transport restrictions, cheap licences for road-transport vehicles, and by overloading, all classes of goods were being transported by road at a cost of from 4d. per ton-mile for short distances to 2½d. per ton-mile for long distances. Those rates were doubled where there were no railway facilities or other competition. For lorries to work at such rates, their work had to be continuous throughout the year. As the Author pointed out, 365,741 tons were transported over the Trinidad Railway in 1932; 434,000 tons had been carried in 1933, but 131,000 tons only, or 600 tons per day, were transported in the out-of-crop months (June to January) and 303,000 tons, or 2,500 tons

Mr. Tomlinson.

Mr. Tomlinson. per day, in the other 4 months of the year. If the railway were forced to shut down, it was difficult to believe that a large fleet of lorries would be kept idle for 8 months in the year in order to transport 1,900 extra tons per day in the 4 months of crop at the rates at present charged by the railway, which were as low as $1\frac{1}{2}d.$ per ton-mile for canes reaped at some distance from the factories; it was certain that the present rates at which that large tonnage was being transported would be doubled, which would be disastrous to the industry on which the colony's prosperity depended.

Mr. Wood. Mr. FRANCIS WOOD remarked that the railways in England were in the hands of public companies, but the roads were under the administration of the local and county authorities. In the case of railways, the cost of building the track, subsequent improvements, widenings, alterations and additions, was usually charged to capital, and although much of the original track had been substituted, the capital cost had not in any part been redeemed; interest was expected to be earned on the total, which was always increasing, although some of the work might become redundant. The principal roads had been in existence for centuries, and there was no capital cost as a debit. Most of the other highways had been built by land owners for the development of their estates; a considerable mileage of arterial roads had been constructed either by the local authorities themselves, or in recent years with the aid of the Ministry of Transport from the Road Fund which was built up from the taxes on motor vehicles. In those cases, and where widenings and improvements had been made, the cost incurred by the local authority was paid by a loan redeemable in 7 to 20 or more years; they finally became free of capital cost. Further, as the Ministry of Transport's contribution to the cost of new roads and reconstruction was paid out of revenue and charged, apparently to "maintenance," those costs gave an erroneous idea of the actual maintenance expense, as a great part of the cost of such work ought to be spread over a much longer period than the year in which it was paid. Also, many of the roads had footpaths, which were used without payment by authorities controlling electricity, gas, water, etc. The taxation of motor vehicles was supposed to be based on the damage done by them to the roads, and the above-mentioned maintenance costs were used as the basis of the so-called damage. Many of the highways, as had been stated, were only necessary for the development of estates, carried little traffic apart from tradesmen's vehicles, and would have had to be maintained if motors had not been in existence. In fact, those roads cost less to maintain with pneumatic-tired motor vehicles than with the horse-drawn steel-tired vehicles. The cost of the damage actually done to a modern road was calculated to be

less than $\frac{3}{4}$ d. per vehicle-mile on arterial roads carrying considerable traffic. Since then, pneumatic and balloon tires had come into more common use, and there was little doubt that the damage was much reduced. In fact, had those classes of tires been universal, the necessity for the strengthening of foundations would not have arisen. He had heard of a colonial engineer, who was examining road-construction in England, being told that nothing less than about 15 inches of concrete foundation was adequate for the traffic to be carried. Personally, he had never put in concrete foundations thicker than 7 inches, and had known 5 inches withstand very heavy traffic, even when underneath it was not supported for a width of 15 feet. An ordinary pitched road, with a bituminous surfacing, properly drained, was quite a good foundation for modern traffic. The cost of the form of construction could best be obtained by full knowledge of the availability and cost of surfacing, water-proofing and binding materials. Where a road carried light traffic, and the capital cost had not been redeemed, that cost, if divided by the number of vehicles, would be out of proportion to the cost per vehicle-mile given above. The cost of maintenance depended largely on the ability of the authority to maintain the surface in an even and regular manner, which was best achieved by using bituminous surfacing. A road that would easily be disturbed on its surface through weather and traffic would cost much more in the long run. It was the unevenness of and the consequent impact on poor roads which caused them to deteriorate rapidly.

He thought that in England transport of goods by motor-vehicles was cheaper for any distance up to 60 miles, and particularly if the vehicles had regular work and full loads, as the road vehicle collected the goods at the premises of the consignors and delivered them directly and without delay to the consignees. Rail-transport entailed cartage from consignor's premises, unloading at the railway after an average journey of at least a mile, loading into the truck, possible delay, then railway transport to the town of the consignee. The goods had then to be loaded into a road vehicle and delivered to the address of the consignee. There was evidently greater risk of delay, damage and loss, which were material factors to the consignor and consignee, particularly with manufactured goods, though they did not appear in the cost of transport by the railway. Road-transport might also be advantageous for a greater distance. There had been a recent instance of farmers collecting their produce in the country in the afternoon, and delivering by road into the market in London by 6 a.m. the next day, the railways having been unable to meet the requirements.

Railway-transport was advantageous when full train-loads could

Mr. Wood. be loaded at the consignor's premises and had to be carried long distances, and also in the case of small consignments for various stations and districts. If, however, railways had to be confined to those classes of traffic, the cost of transport would probably be considerably increased.

It was difficult to visualize the position in the colonies, where goods might have to be transported hundreds of miles, but he thought that the railway should be the concern of the Government, and should have its capital redeemed so that the cost of transport would eventually be the cost of maintenance alone. The railway could then compete with the road, and transport charges would come down. The cost of transport of a manufactured article was quite a large proportion of its selling price.

It was argued that, where railways were in existence, the traffic on roads should be reduced and thus diverted to the railways in order that the latter should pay their way; but each member of the public, having paid for the roads on the unwritten understanding that he could use them for transport purposes, was at a disadvantage if he was compelled to pay for the carriage of his goods by rail at a higher cost than by road.

The Author.

The AUTHOR, in reply, stated that the following examples of road transport costs and rates could be quoted from particulars furnished by contributors to the Discussion and Correspondence.

South Africa.

4*d.* per ton-mile.

Persia.

Mohammerah to Tehran, 748 miles :—

3·7*d.* per ton-mile in one direction.

1·8 ,, ,, in the other direction.

Bushire to Tehran :—

6·7*d.* per ton-mile in one direction.

2·7*d.* ,, ,, in the other direction.

Syrian Desert; Damascus to Bagdad :—

4½*d.* in one direction.

2½*d.* in the other direction.

General Mance had remarked that the figures for Persia “showed not what the transport cost, but the rates that a native could offer, by overloading his vehicle and forgetting all about depreciation until it was too late.”

Sudan.

Minimum road costs 2½*d.* per ton-kilometre or 4*d.* per ton-mile.

Nigeria.

The Author.

Lagos to Ibadan :—

1·9*d.* to 2·7*d.* per ton-mile.

Northern Nigeria.

6·8*d.* per ton-mile.

Queensland.

Average cost of motor transport 5·09*d.* when fully loaded both ways and 8·19*d.* per ton-mile when fully laden in one direction and with 15 per cent. return load.

Santo Domingo.

Road costs 5*d.* per ton-mile, but goods carried for 2*d.* to 2½*d.*—"about the actual cost of gasoline, oil and driver's wages."

Tanganyika.

5·4*d.* per ton-mile near coast.

6·5*d.* to 7·0*d.* per ton-mile up country.

Trinidad.

4*d.* per ton-mile for short distances.

2½*d.* „ „ „ long „

Those rates were doubled where there were no railway facilities or other competition.

It appeared to be generally agreed that the lower rates were only possible when vehicles were operated constantly with full loads in both directions. In the colonies railway traffic was not balanced and was to a large extent seasonal, and it was necessary to estimate what road costs would be when operating under similar conditions to the railways. Mr. Kemp had stated that motor-transport costs in Queensland were 60 per cent. higher when the return load was only 15 per cent. of capacity, and Mr. Evans had quoted an example in Northern Nigeria where the cost of transport of 700 tons of ground-nuts by motor-lorry amounted to 6·8*d.* per ton-mile, although between Lagos and Ibadan the charges varied from 1·9*d.* to 2·7*d.* There would be a further material addition to road rates if motor-vehicles had to be laid up during a large part of the year. Mr. Tomlinson had pointed out that in Trinidad the railway handled 2,500 tons of goods per day during 4 months of the year and 600 tons per day during the remaining 8 months. Similar conditions, if not so severe, existed in other colonies. If the whole of the tonnage in Trinidad were to be carried by road, 75 per cent. of the motor-vehicles would be idle for 8 months of the year. If road transport were called upon to operate with no alternative form of transport to deal with one-way loads in districts remote from as well as near to the

The Author. seaboard, it was difficult to believe that the average rate would be less than 6*d.* per ton-mile, or three times the cost of rail transport. In South Africa road-transport cost four times as much as rail-transport, and Mr. Bindley had stated that in the Sudan the cost of motor-transport was five times higher than average railway working costs. After careful consideration of all the information which had come to light during the discussion and from the correspondence, the Author believed that in suggesting that road costs were treble rail costs he had understated rather than overstated the difference. He doubted whether it was generally realized that the tonnage conveyed on roads was small compared with that carried by rail. He had pointed out on p. 568 that in islands of small area, such as Mauritius and Trinidad, 80 per cent. of the goods traffic was not susceptible to road competition, while in countries of large area, such as Kenya and Nigeria, that percentage was considerably greater. Even in America, where cars and petrol were cheaper than anywhere else in the world, and despite a highly-developed system of splendidly-paved highways, the railways were, as pointed out by Mr. Lavis, hauling 90 per cent. of all the freight moved in the United States.

Mr. Evans had suggested that the costs of constructing railway extensions quoted on p. 549 were inappropriate, as they did not include the cost of rolling stock. The figures given were, however, fairly comparable with the costs quoted for road construction, which also did not include the cost of vehicles. It was certainly inappropriate to use for purposes of comparison an inclusive cost per mile, as suggested by Mr. Evans, because the figure he quoted would include the cost of building railways through difficult country, where roads would cost much more than the figures quoted in the Paper, and would also include the cost of such items as raising loans, constructing wharves and jetties, terminal and intermediate stations, warehouses and transit-sheds, staff quarters, signalling equipment, sleeping and restaurant cars, electric lighting and power plant, coal-conveyors, transporters, cranes, etc., none of which were included in the cost of road-construction.

Mr. Laurensen had quoted the following extract from the Paper :—

“ To use a means of conveyance which cost 6 pence per ton-mile for one costing 2 pence per ton-mile is not economic and must result in loss somewhere ; and the greater the use made of the roads, the greater the resulting loss.”

and commented upon it as follows :—

“ If that represented the whole problem, it appeared that the railways would have nothing to fear from road competition, for it was hard to imagine any one paying three

times as much as the rail charge for the privilege of The Author.
having his goods transported by road."

The Author would refer Mr. Laurenson to a quotation from Professor Copland's report on Queensland Transport included in Mr. Kemp's contribution (p. 613). A simple example might serve to elucidate further the Author's meaning. If the average cost of rail-transport was 2*d.* per ton-mile and the railways, for certain high-grade commodities, were paid 6*d.* per ton-mile, they made a profit of 4*d.* per ton-mile, which helped to balance the lack of profit on low-rated commodities. If, however, the high-grade goods were conveyed by road at a cost of 5*d.* per ton-mile the consignor or consignee saved 1*d.* per ton-mile and the transport company possibly made a profit of 1*d.* per ton-mile, but the railway lost a profit of 4*d.* per ton-mile, and that loss had to be made good in one way or another by the community. The result was a net loss of 2*d.* per ton-mile on the transfer of goods from rail to road.

Mr. Platts had given an interesting example of the way in which roads developed parallel to a railway, even though their construction was not undertaken by Government, and that confirmed the Author's view that where movement of commodities and merchandise in considerable quantities was required roads were sooner or later to be found, even though an existing railway might be available to furnish the transport facilities required.

Mr. C. I. Robinson had suggested that the railway rates quoted in the Paper were not economic, and the Author would refer him to his reply to the discussion, where a similar question had been raised by Sir Henry Fowler.

It seemed to be generally conceded that road and rail competition must be controlled, and various suggestions had been advanced. General Mance, after referring to the evils of unrestricted competition, thought "it was safer to regulate road and rail competition by licence." Mr. Bulkeley suggested the country should be divided up transversely into 30-mile zones and public road-vehicles licensed for one zone only. Mr. Cook expressed the view that it was essential, particularly in new countries, that road and rail development should be so controlled that they proceeded with due regard to the needs for which each was best adapted. Mr. Leeming felt that the best and most economical results would be obtained from road and rail development if road and rail were dealt with jointly under one control and as one interest of the type of the London Passenger Transport Board. Mr. Austen expressed the opinion that in Mauritius the transport situation generally should be firmly controlled by an impartial authority, with due regard to the present and future needs of the colony. Mr. Cox considered that colonial prosperity was

The Author. dependent on the efficiency and co-ordinated development of all transport services. Mr. Gardner proposed the acquisition of all major motor-transport by a Transport Board. That board would permit only light vehicles to run on the roads, or heavier vehicles under special licence; producers would be permitted to own their own transport under licence, but any transport companies would be taken over at a valuation by the board: the economic structures of the roads department and of the railways should be absorbed into the economic structure of the Transport Board. Colonel Maxwell referred to the fact that in Tanganyika a Bill was introduced in 1931 placing a heavy licence-fee on road-transport along roads running parallel to the railways. Those licences were not sufficient to stop competition altogether, but did a great deal to return import-traffic to the railways, and a Bill was introduced by the Council, in April, 1934, to prohibit competition by road-transport along roads parallel to the railway. No licence or penalty of any kind was imposed on motor-transport using feeder-roads to the railway. Mr. Platts concluded that a toll-system operating at key points, such as major bridges, had much to commend it. While there was unanimity as to the necessity for control there was lack of agreement as to the method of exercising it.

He had suggested in his Paper that motor-transport services parallel to a railway should be restricted by licence, but the suggestion that road and rail should be dealt with jointly under one control of the type of the London Passenger Transport Board deserved consideration. That Board, which controlled the whole of the tramway, tube, and omnibus systems in the metropolis, had been formed because it was thought that full efficiency could not be achieved without unity of management and ownership. In the colonies the railways were owned and operated by the Governments, who provided the roads and could, if they wished, operate road services and create monopolies of all internal transport. If that were done, any traffic offering could be conveyed by rail or by road, whichever was the cheaper or more convenient, and rates could be so adjusted that transport-users paid the whole cost of transport-services. Further, a rate-structure could be adopted which, by means of low rates on export produce, would encourage development. The principal objection to such a monopoly would be a possible lack of efficiency due to the absence of competition, but important advantages would be gained by unity of ownership and management.

He thanked Mr. Furkert and Mr. Kemp for furnishing so many interesting facts regarding the transport problems of New Zealand and Queensland.