Roads and Railways.

NOTES ON

TRANSPORT PROBLEMS IN N. Z.

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TRANSPORT PROBLEMS IN N. Z.

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INTRODUCTION.

The most urgent transport problem in New Zealand is unquestionably that of co-ordinating the work of railways and motor vehicles. The revolution in transport that is taking place before our eyes is not the first we know of. In 1830 travelling was no faster than in the days of the Romans; in fact, a messenger travelling urgently from London to Rome in 1834 to recall Sir Robert Peel took exactly the same time as was occupied by a messenger sent from Rome to London by one of the early Emperors.

But by 1845 the construction of railways had enabled a great reduction to be made in the time of travelling. The revolution in transport that began a hundred years ago with the construction of the Manchester-Liverpool railway is worthy of study, as the problems raised then are many of them re-appearing now. Competition was the order of the day then, while regulation is the order of the day now, and the losses recently incurred by the railways have drawn attention to the

dangers of unrestricted competition.

Regulation of transport, however, is not a simple problem. This has been clearly recognised by the Transport Department, who, in their first annual Report, have concentrated attention on collecting the information necessary for the discussion of the problems involved.

Perhaps the most surprising information in the Report is that the capital already invested in roadways (£108 million) is almost double that invested in the railways (£58 million), while the annual cost of road transport (£32 million) is more than three times the annual cost of railway transport (£9 million).

Much of the matter contained in the following chapters appeared in the Auckland Star in a series of articles signed "Wayfarer"; permission to reproduce parts of these has kindly been granted by the Editor.

SUMMARY.

Railway losses due to Motor Transport competition have so far been caused mainly by the use of the touring car for both business and pleasure.

In 1921-2 Railway Passenger Revenue was £2,418,000.

In 1928-9 Railway Passenger Revenue was £2,125,000.

In 1921-2 Railway Goods Revenue was £3,646,000.

In 1928-9 Railway Goods Revenue was £4,846,000.

But apart altogether from motor competition, railways are in a much weaker position financially than they were. Cost of construction of railways has risen from an average of about £5,000 per mile built before 1900 to an average of about £30,000 and a maximum of £80,000 per mile of line built recently.

Rate of Interest and ratio of working expenses to revenue have both risen, and the combined effect of these three causes may be illustrated by an example given (Proc. N.Z. Soc. C.E. Vol. XV.) by Mr. F. J. Jones, late Chief Engineer and Manager of Railways.

For a railway built for £5,000 a mile with interest at 3 per cent. and working expenses 60 per cent. of revenue, a revenue

of £375 per mile is sufficient to meet all charges. For a railway costing £32,000 per mile to construct, with interest at 5 per cent. and working expenses 80 per cent. of revenue, a revenue of £8,000 per mile is required. The average revenue per mile for New Zealand is £2,310. The revenue for the North Island Railways (exclusive of six subsidised branches) is £3,678 per annum.

On the Orawia branch line, for every £100 earned, £427 is spent for working expenses and £677 for interest charges, or a total of £1,104. After making allowance for feeder value it still costs £550 to earn £100.

Railway goods revenue is also likely to suffer because the tariff has been based on what traffic can bear rather than on what it costs. This was a sound method when the railways had a monopoly, but is very vulnerable to competition. The only sound way to prevent loss of traffic is to lower the rates on those articles which pay exceptionally high rates.

Developmental Value.—Where there is an alternative method of transport, such as the motor vehicle, the developmental value of a railway is limited to the difference between the costs of transport by rail and by road. "Cost" by rail may be ten times the amount actually charged.

If the cost by rail is greater than by road the railway has no developmental

value. In an extreme case in which the railway charges 3d per ton mile for what really costs 18d per ton mile, if the goods could be carried for 9d a ton mile by motor vehicle there is a loss to the country of 9d per ton mile, caused through using a less economical method of transport. It would be better for the State to run the goods by road at the same charge and lose only 6d a ton mile instead of 15d. Railway transport costs diminish rapidly with increase of traffic because the heavy fixed charges are spread over a wider surface. Conversely, loss of traffic leads to an increase in the cost of the traffic, but a rise in the charges to meet the rise in the costs may lead only to further losses of traffic.

TAXATION OF MOTOR TRANSPORT.

Since railways bear the cost of maintaining their permanent way, motor transport should pay for its share of maintaining the roads. Its share is difficult to estimate closely, but should be equal at least to the difference between the cost of the roads now and their cost, say, ten years ago, increased in proportion to growth of population. Contrary to general belief, the taxation at present is approximately equal to this difference.

County rates per head have increased 80% in the last eight years, while borough rates per head have remained practically stationary. Most of the increase in county

rates is due to increased roading costs, but this in itself does not prove that motor taxation is inadequate.

For many years past the amount of Customs duties on imported motor vehicles has exceeded one million pounds annually. This goes to the Consolidated Fund, but if it were spent on the roads it would be more than sufficient to balance the increase in country rates

The income of the county ratepayer is determined mainly by world prices, hence an internal adjustment to his disadvantage, such as the above, cannot be met by commercial methods but requires correction by legislation such as "derating" of farm lands.

Cost of Road Improvements. — Any improvement in the surface, grading, or alignment of a road reduces the cost of motor transport. Hence it should be possible to compare the cost of the improvement with the saving in running costs. No expenditure on a road should then be made which is not balanced by an equivalent saving in the running costs of the traffic using it.

As an example of the economy of improving a road, the Great North Road, six miles from the Auckland Post Office, gave a traffic tally last year of 2,400 vehicles daily. The saving per vehicle which resulted when the old macadam road was paved in concrete is estimated to average

one penny per vehicle mile, i.e., £10 per day and £3,650 per annum. The vehicles are paying in tax about $\frac{3}{4}$d per mile, i.e., a total of approximately £2,500 per annum. The cost of the road (interest, sinking fund, and maintenance) is about £800 per annum, so that there is a balance available for roads with little traffic where savings and payments in taxation are insufficient to provide for improvements.

The taxation may be estimated as follows: 540 lorries and buses at 1 1-3d equals 720d; 1380 cars at 2-3d equals 920d; 320 motor-cycles at $\frac{1}{8}$d equals 40d; 185 unclassified (horse vehicles, etc.), nil. Total per diem, 1,680d (£7), i.e., £2,555 per annum.

CONSTRUCTION AND MAINTENANCE OF ROADS.

The life of any road depends partly on natural causes and partly on traffic.

Natural causes (sun, wind, rain, floods, vegetation) produce least effect on the most expensive, most used road, and most effect on the cheapest road.

Traffic causes *wear* of a road varying with the surface of the road and the weight, speed, and nature of tyre of the vehicle, while it causes *damage* by impact which varies with the same factors. The damage done by one heavy vehicle with solid tyres travelling fast on a cheap road may be much greater than that done by a

thousand vehicles on an expensive road.

Solid rubber tyres cause so much more damage than pneumatic tyres that vehicles using them should be restricted drastically as regards both load and speed, while there are strong arguments for the total prohibition of their use.

As traffic increases the engineering problem becomes more difficult but the economic problem becomes easier. For every motor per diem using a road an average taxation of over £1 per mile per annum is paid, and an expenditure of that amount is justitified. But whereas £750 per mile per annum is more than sufficient to pay the whole costs of a road carrying 750 vehicles a day, for a road carrying 10 vehicles a day the amount paid in taxation may be quite inadequate to maintain the road in a passable condition.

Petrol consumption on macadam roads is over 50% more than on paved roads, while tyre wear may be four times as great. The user of the rough road pays in taxation up to twice as much per mile travelled as the user of the smooth road, but even this may not strike a balance for the little used road.

Traffic Tallies.—The number and kind of vehicles using a road must be known before any intelligent discussion can be made of proposed expenditure on the road. Traffic tallies should be taken of every road at regular intervals. On little used roads

intervals of five or ten years may suffice.

The difficulties of the road with little traffic will be eased by limiting the allowable load and speed, particularly of solid-tyred vehicles, while the solution of the problem will be assisted by the use of the British Army invention, the six-wheeler. This vehicle will carry a heavy load on a light road without causing damage, it will travel across country, and it makes practically any road an all-weather road.

COMPARATIVE VALUE OF TRANSPORT BY ROAD AND RAIL.

The cost of transport per ton mile is not the only criterion in comparing road and rail. The ability to deliver in small quantities, to deliver direct to door or site, to avoid delays while trainloads are being shunted and sorted, and to deliver at any required time are all definite advantages for which it may be worth while to pay the difference between road costs and rail costs. On a short haul the elimination of one or two handlings may make the road costs lower, apart from any other consideration.

Railways have already lost much of their passenger traffic to the touring car. They are likely to lose an increasing amount both to the touring car and the service car. They might be expected to retain their long-distance express passenger traffic if there were no likelihood of

air services ever starting. The competition of motor-cars for short trips and the potential competition of airways for longer trips make a dark outlook for the future of railway passenger services.

The ability of the motor lorry to compete with the railway for high grade goods transport under existing circumstances cannot be disputed. Any handicap to the lorry imposed by increased taxation is likely to be outweighed by a lowering of costs resulting from improvements to the roads. It is therefore likely that unregulated competition would lead to the railways losing more and more; the high grade goods going first, their loss leading to a rise in charges which would lead to the next grade being lost, and so on.

The advantages of the railway for low grade long distance goods transport are too great to justify the unregulated policy of survival of the fittest. On the other hand, to stifle motor transport would be definitely retrograde. The newly formed Transport Department look to co-ordination and co-operation as the solution; they realise that regulations in themselves have no creative value, and are worthless even for restriction without cordial general support.

THE USE OF THE MOTOR CAR.

It is not many years since the opinion was frequently expressed that our economic troubles were due to the purchasing of motor cars by farmers, but the world-wide slump in prices has proceeded so far and so fast that the hardiest exponent of that view has hesitated before giving voice to it recently.

Even when the complaint was made, the steady increase in the amount of production from farming, which continued in spite of the drift to the towns, should have suggested that the farmer was not spending any appreciable amount of his time in "joy-riding." Between 1922 and 1929 the national production per head of population increased 18 per cent., while the production of farmers per head increased 30 per cent. in the same period.

The farmer's time is worth money to him, as to any other busy man, and a car used only once or twice a week may well pay for its keep, apart from its indirect value in easing the lot of the farmer and his wife.

The uneconomic purchase of motor cars is most frequent among office-working city dwellers, for their travelling could be done by rail, tram, or bus during the week,

by taxi at the week-end, and by hired car on annual leave, more cheaply than in a privately owned car not used in working hours. In the case of a family or party of four or five it may be cheaper and it is certainly more convenient to travel by car to and from work.

For commercial travellers, doctors, engineers, surveyors, builders and contractors the car may double or treble the capacity for work, while the use of the car or lorry for parties of workmen reduces the cost of work off the beaten track almost to the level of that which is conveniently situated.

There are many individual cases of the unjustified purchase of a car, but there is such a large proportion of the population to whom the possession of a car is a real asset that the inroads of the private car on the railway passenger traffic are certain continually to increase.

Last year, before the crash on the Wall Street Stock Exchange, American motor manufacturers were sounding the slogan "Two or more cars to every household," a cry which was premature even for the country that "won the war" by selling munitions at high prices. We have merely reached the stage of one car to eleven people or one car to every three households, but in spite of wars and slumps, production is increasing so much more rapidly than population that the standard

of living rises every decade. And a rising standard of living is more likely to lead to increasing travelling by motor than to a return to travelling by railway.

Statisticians estimate that the standard of living in England is four times as high now as it was 120 years ago. They also estimate that world production is increasing about three per cent. annually, while world population is increasing only about one per cent. annually. This would lead, given peace and stability of prices, to doubling the standard of living in thirty to thirty-five years. The rise in the standard would not necessarily lead to every household possessing a car, but it would certainly lead to a very large increase in the number in use.

Some years ago an English manufacturer advertised the budget of a fortnight's holiday trip of 1,000 miles, made by four people in a motor car, in which, after making fair allowance for all costs, the travelling proved to be cheaper than at third-class railway fares. When one considers the attractiveness on a holiday of independence of time-table and freedom as to destination, the conclusion is unavoidable that the railways cannot hope to win back such business.

On any railway, travelling by express for distances of 200 miles and over is more rapid and less tiring than travelling by car, and in this country trips such as that

from Auckland to Wellington by road are not likely to compete with the railway. But the comforts of the Main Trunk train are not so pronounced that passengers will ignore the third alternative of travel by air. Commercial air services may develop rapidly here as they have elsewhere, and their development can only lead to the railways losing long distance passenger traffic.

The Transport Department Report gives the following figures for railway passenger services:—

	Ordinary Passengers	Season Ticket Holders	Total	Revenue
1921-2	14,262,000	473,000	28,122,000	£2,418,000
1928-9	9,046,000	656,000	25,575,000	£2,125,000

THE DIFFICULTIES OF THE RAILWAYS.

Apart altogether from the loss of business to motor transport, the New Zealand Railways have difficulties to face, some of which are shared with every railway system, and some of which are more or less peculiar to this country.

A steady rise in the ratio of working costs to revenue has occurred practically everywhere. In England the ratio rose from 48% in 1870, to 51% in 1880, to 62% in 1900, to over 85% at the present time. Whether the original wage rates were unjustifiably low or not, it is quite clear that the margin for allowing reductions in fares and freights has been seriously affected.

As regards costs of construction, New Zealand avoided the difficulties experienced by English Railways in buying the land for their permanent way. The huge capital of the English Railways (£1,400,000,000, i.e., more than double the pre-war National Debt) was more than half due to Parliamentary expenses and payment of fictitious prices for land; half the capital had no tangible asset resulting from its outlay.

On the other hand, the political control of railways in this country not only constructed lines where there was little justi-

fication for them, but has been responsible for their cost being unnecessarily high. So few lines have been built by private enterprise in this country that there are few comparable figures, but the opinion is commonly held that the cost has been raised to a serious extent by "political" methods. It is quite certain that in some cases construction has been so long drawn out that interest and maintenance charges on unproductive outlay have gone a long way in themselves in raising the cost. (*See note at end of Chapter*).

New Zealand is not the right shape for a good railway system, as it resembles too closely the geometrical line which has length without breadth. The division into two islands is another weakness. Empty trucks have much longer journeys to refilling stations, and more trucks are required than on a system of equal mileage arranged in a square or rectangular grid.

Policy Rate.—A good deal of confusion has arisen owing to the use of the term "policy rate" of interest to represent some figure lower than the actual rate paid, the difference being intended to represent developmental value. It has been pointed out already that developmental value cannot exceed the difference between the true cost of transport by rail and by road, and that if the latter is cheaper, the developmental value of the railway is less than nothing. It must also be remem-

bered when discussing "policy rate" of interest that the actual rates paid between 1870 and 1900 varied from 3% to 4%, and the loans that were not provided with sinking funds (the majority) have had to be renewed at a higher rate.

It should also be noted that one of the main reasons for the continuance of high rates of interest is the continued high level of expenditure on public works, including railways. From 1880 to 1920 the average expenditure on public works was about £2 per annum per head of population, whereas during the last ten years the expenditure has exceeded £5 per annum per head.

Continuing the comparison with English railways, our own suffer definitely from the fact that our country is more hilly and mountainous, with the result that our grades are necessarily steeper. George Stephenson, the first, greatest and most far-sighted of railway engineers, always insisted that the great advantage in traction possessed by the railway over the road was and is largely dependent on grade. The pull of the engine is limited by the friction grip of the smooth wheels on the smooth rails, dependent upon the weight of the engine, and while a pull of ten pounds will move a load of one ton on a level railway, double that pull is required to draw the ton up a grade of 1 in 200 and treble the pull is required to draw it up

a grade of 1 in 100, so that the maximum load for an engine on a level railway is halved for the same engine on a railway with a grade of 1 in 200 and divided by three on a railway with a grade of 1 in 100.

Stephenson aimed at a maximum grade of 1 in 120 if possible and at the worst 1 in 100, and opposed new railways intending to use grades of 1 in 70 or 1 in 80. In New Zealand there are many grades steeper than 1 in 40 on which the load is about one sixth of that which could be drawn by the same engine on the level. The main lines from both Auckland and Wellington have been handicapped in this way till quite recently.

On the other hand, with road transport, the tractive power of an engine on the level is less than on rails but the effect of grade is almost limited to slowing down the rate of travel. The friction grip is normally so great that the risk of slipping wheels may be ignored.

There was an old estimate "that on a good wagon road a single horse power will draw about 3,000 lbs. at the rate of 3 feet per second and, on a railway, about 30,000 lbs. at the same rate". This estimate refers to a level way in each case, and, while the load on a railway at a grade of 1 in 40 would be reduced to about 5,000 lbs., the load on the road would hardly need to be reduced.

The absence of level ground in this

country is of course one of the main reasons accounting for the extraordinary rise in the cost of construction. The country immediately surrounding three of the four main centres led to steep grades alongside the main stations limiting the weight of trains, but once away from the main centres, railways naturally followed the level ground where possible, so that many of the earliest lines were built in easy country, while most of those recently constructed have had difficult ground to traverse. The Oxford and Eyreton Branches cost only £2,300 per mile, Rakaia-Methven £3,300 and the Morrinsville-Rotorua branch £5,600 per mile, while more recently the Kaikohe-Okaihau extension cost £24,000, Ranganui - Portland £41,300 and the Waiotira-Kirikopuni cost just under £80,000 per mile.

Even if all motor transport were prohibited in the nighbourhood of these last named lines, they must either charge such rates as would probably defeat their own purpose by strangling traffic, or create a heavy charge on the community, most of which is transferred to the primary producer. The assistance of uneconomic transport to one section of the farming community is made largely at the cost of the remainder of the farming community.

The Waiotira-Kirikopuni branch, 13 miles long, cost just over £1,000,000. The

writer finds it hard to believe that the district would not have benefited more from the same expenditure made on roads in the neighbourhood. The expenditure of one million borrowed at 5½ per cent. is equivalent to the expenditure of £55,000 per annum in perpetuity. The Transport Department Report gives the cost of a water-bound macadam road capable of carrying up to 300 vehicles per day as £1,500 to £2,500, and the cost of maintenance as £125 per mile per annum. The latter figure may be too low for 300 vehicles per day, but in the district under discussion the traffic is very much less. At the figure of £125 the amount of £55,000 annually would provide for maintaining 440 miles of metal roads, if they were in existence, while it would suffice to construct and afterwards maintain about 150 miles of the same type of road. The case is admittedly an extreme one, but some of the lines now under construction will be little if any better.

Of course the losses on the railway are borne by the whole country, while the cost of the roads is borne by local rates. The railway charges are low but the costs are low only on busy lines cheaply constructed. The distinction between charges and costs cannot appeal much to the farmer who sees cheap transport for manure benefiting himself and the country at large as well. Raising the

charges would injure everybody by reducing the traffic, but an alternative method is available by which the primary producer can receive some assistance towards cheap transport without the necessity of building uneconomic railways.

The proposal to "derate" farm land and to provide the funds for constructing and maintaining the roads from motor taxation has justification in the exposure of the farmer to world competition, the dependence of the whole country on the farmer, and the fact that the farmer would be contributing to the motor taxation in proportion to his use of the roads, at a higher rate than the town dweller because of higher running cost on country roads.

Criterion for Closing Branch Lines.

The "Feeder" value of branch lines is recognised in considering their financial position. A branch line may barely pay working expenses, but if it brings in a good volume of traffic to the main line, which would not otherwise reach it, then it is reasonable to credit the branch line with a portion of the main line revenue. If the branch line then shows revenue greater than working expenses it is making some contribution towards meeting the interest bill, which must be paid whether the line is kept working or not.

If the branch line, after being credited

with "feeder value" cannot pay working expenses it may still be more economical to keep it working, for the additional cost of transport by road may be more than the loss on the railway. But if the traffic is very small the working expenses of the railway may be much greater than the revenue, and it may be economical to shut down the railway, even if the transport by road were subsidised to run at railway rates. These considerations apply to railways that have already been built and must be paid for. When it is a question of constructing a new line however, the interest and sinking fund must be put in the balance at every step, for it is still possible to avoid that payment if there is not sufficient traffic to meet all charges.

It has been shown that a railway costing £32,000 per mile to build, with interest at 5% and ratio of working expenses to revenue of 80% requires a revenue of £8,000 per annum to enable it to meet all charges. Compare this figure with the revenue from the six subsidised North Island lines, £325 per annum, and the twenty-two subsidised South Island lines of £392 per annum. The discrepancy shows that no possible allowance for feeder or developmental value could justify construction under such conditions.

Railway Tariff.

Another difficulty under which the railways work is the tariff, made when they

had a practical monopoly, charging what traffic can bear rather than what it costs. Butter worth £100 to £150 a ton can fairly pay a higher rate than coal worth £1 a ton, for a rate that would make a crippling addition to the price of coal would have no appreciable affect on the price of butter. The charge is based on value of service rather than cost of service.

But the high tariff charged for butter may make it possible for motor transport to compete for that work, in which case the railways would lose their most profitable freight. The motor transport would be accused of robbing the railways of the "cream" of their business, both literally and metaphorically. But the action of the motor transport would be perfectly natural. Nor would the railways be to blame. Through no fault of their own a system which worked well a generation ago is found to be unworkable now. If the railways are to keep the traffic they must either use restrictive legislation, a dangerous weapon, or reduce their charges on such freight as butter more nearly to what it costs. Throughout the world railways are adjusting their tariffs in the direction of reducing the higher rates.

Potential Competition of Motor Transport.

The fact that the total freight carried by the railways in this country is increas-

ing steadily, if not rapidly, would suggest that motor transport of goods has not seriously injured the railways as yet. Motor transport has probably brought more goods to the railways than it has taken away. But the potential competition in transport of goods will increase not only in proportion to the improvement of road surfaces, but also in proportion to the increase of motor transport feeding the railways. Costs reduce with increase of business for motor transport just as they do for railway transport. Motor transport has shown that it can make its way in the face of an existing monopoly, on roads which in England would not be considered roads at all.

The effectiveness of motor transport is bound to increase enormously in the absence of unreasonably restrictive regulation.

Such legislation as the appointment of a Tramway Board to be the licensing authority of its competitor motor buses is repugnant to common sense as well as to fair play; while the prohibition of new methods of transport is not attractive in view of the history of those towns in England which refused to allow railways to approach them and which stagnated while others flourished.

Motor transport is making its way now in the face of opposition similar to, though

not so bitter as, the opposition faced by the railways a hundred years ago.

The Waipa Colleries Line, privately owned, six miles long, cost £7,700 per mile, while the Waiuku Branch Line, 13 miles long, built by the State, cost approximately £16,000 per mile. On the Colleries Line the cost of Station Platforms, Buildings and Signallings was very light, but the bridging was unusually heavy; the Waiuku Line runs through rolling country and should have cost about the same per mile as the Waipa Line, but actually cost more than double.

On the Napier-Gisborne line at 31st March, 1924, according to the Public Works Statement, there were 11m. 73ch. open from the Napier end, and 14m. 51ch. under formation. At 31st March, 1929, there were still only 11m. 73ch. open. On the Stratford-Main Trunk line in 1924 between Matiere and Okahukura there were 10m. 23ch. under plate-laying, while in 1929 the same length was still under plate-laying.

Of 88m. 47ch. under formation and 171m. 30ch. under plate-laying in the North Island in 1924 only 185m 37ch. were open for use in 1929.

THE LESSON FROM CANALS.

A hundred years ago in England the canals were working at full strength. Their record was a remarkable one. In the seventy years from 1760 to 1830 England had developed industrially from negligible beginnings to the foremost place as manufacturer for the world. This advance was due to mechanical inventions and improved methods, but their effect depended directly on the provision of cheap transport by the canals which replaced the pack-horse and the wagon.

Not only were the canals in possession of the trade; they had flourished and paid off their cost of construction. Furthermore the cost of transport along a level canal was much less than along a level railway. The same horse-power that was estimated to draw 3000lbs. along a good wagon road at 3ft. per second, and 30.000 lbs. along a railway at the same rate, was estimated to draw as much as 200,000lbs. in water. Yet in spite of all these advantages the canals were unable to prevent the railways from forging ahead and absorbing most of the business offering.

It is frequently said that this was brought about by the railways buying up the canals and closing them. But according to Kirkaldy and Evans (History and

Economics of Transport) this view is not supported by the facts. It is true that about a third of the canals of England are owned by the railways, but in many cases the railways were persuaded to make the purchase, while in other cases the railway companies, when seeking legislative authority for their work, were threatened with opposition from the canals unless the latter were bought out. The traffic on the canals did not cease at once or on all lines; in 1905 they transported 43 million tons as against the railways' 460 million tons, and as a further answer to the argument quoted above, the busiest of the canals still in use were among those owned by the railways.

The reasons why the railways beat the canals are of historical interest in any case, but when it is seen that most of the same reasons serve to explain the progress of the motor vehicle against the railway, an examination of them assumes new importance.

Comparison between Canals, Railways and Roads.

The advantage the canal possessed over the railway in smaller resistance to traction was set off by the inability of the canal to negotiate grades—the necessity of using locks to obtain a variation of level was a distinct drawback. Similarly the advantage of the railway over the motor in tractive power required is set off by the

capacity of the latter to climb hills. The railway is more flexible than the canal in that sidings can be run into factories, warehouses and docks more easily than can canals. The advantage of motor transport in flexibility over railways is still greater than that of railways over canals. The railway gave much more rapid delivery than the canal, and the motor by eliminating time spent in handling and making up train loads gives more rapid delivery than the railway. The railway can handle small lots and separate articles better than the canal, and the motor better than the railway. The similarity between the cases cannot be ignored. The passenger transport of the canals faded rapidly, although their goods traffic continued to increase for a generation after railways were first built.

When Smiles was writing his Lives of the Engineers (published 1857) canal goods traffic was still increasing. But Smiles described how railway passenger traffic had exceeded the most sanguine expectations. Even Stephenson's foresight and confidence in the railways had not prepared him to set much store by revenue from passenger traffic, whereas almost from the first the receipts from this branch exceeded those from transport of goods.

Travelling for passengers by canal was cheap but very slow, while travelling by coach, though fast in the eyes of that generation, was too expensive for the general

public. Mr. Porter in "Progress of the Nation," estimated that 30 million passengers travelled by coach in Great Britain in 1834, an average distance of 12 miles for an average fare of five shillings, i.e., 5d per mile. Smiles gives the figures for railways in 1873 as 448 million passengers, an average of $8\frac{1}{2}$ miles for 1/1, i.e., $1\frac{1}{2}$d per mile.

The railways increased the total amount of travelling by leaps and bounds then, just as motor transport is doing now.

RUNNING COSTS OF MOTOR VEHICLES.

The charge is often levelled against motor transport that it is being carried on by people who have no idea of the true costs, who work at ruinous rates until their vehicles are worn out and who then find themselves with no reserve for purchasing new ones. Such people are found both in the transport business and in most other callings, but not in numbers large enough to affect seriously the concern which is paying its way on a sound basis.

On the other hand private owners of cars quite commonly make no attempt to find out what their car is costing them, and some talk cheerfully as if the benzine bill were the main item of cost.

The buyer of a new car often waits till he trades it in for a second one before he realises what he has spent. To any one who has not owned a car there are a hundred reasons why he should become a buyer, not the least amongst them being the astonishing value in the average car at the price. The car to be bought is of sturdy build, it will stand very rough usage, it will climb anything in top gear (or if not in top, then in second or third), it will make the owner a proud possessor, and so on. The cash is paid over and there is

another victim to mechanisation. Then after a year or two, while the machine is still giving every satisfaction it requires a coat of paint. While it is being painted the accumulator is examined, and it is decided that it will be cheaper to buy a new one than to recondition the old; some wiring may want replacing, the engine had better be taken down, and valves reground or cylinder head cleaned. A new set of tyres has just been purchased, so no more need be spent there, but the brakes need relining, a few bearings require renewal, and so on until the owner is convinced that it will be very foolish not to trade it in and buy a new one with all the latest improvements. If the old car were an open one he would be told that driving in an open car simply isn't done, so he looks at all the new gadgets and buys a new closed car.

Cost of Depreciation and Interest.

The owner of a car lives at the "Hand in Pocket" Inn, and if the purchaser of a new car be suddenly smitten with a desire to return to economical habits, depreciation is the cord which binds him. With a £500 car depreciation proceeds for some three or four years at the rate of about £2 per week, whether the car is used or not, and interest on the money spent represents another ten or twelve shillings a week. On a private car which travels only 1,000 miles in the year, depreciation and interest

alone cost 2/6 per mile, i.e., four to five times the price charged by some taxis.

Even on a car running 5,000 miles a year an owner may well be spending four or five pounds a week in reality, while imagining that he is spending only twenty or thirty shillings.

With a new car it is only possible to obtain a low rate per mile if a big mileage is being run, hence for any one who needs a car but is not travelling long distances regularly, and is not able to spare four or five pounds a week, a cheap car must be bought. There is a lower limit to the price of new cars, but "used" cars may be had at almost any price, depending on the kind of "use" it has had. A cheap "used" car may turn out to be a very expensive one, but when its appearance is not a vital matter, and when the car has not had rough or ignorant usage, the items interest, depreciation and maintenance may be brought down to a low level.

Every year roads improve and the number of ignorant and incompetent drivers diminishes, so that the quality of the "used" car for sale improves, while the younger generation are developing a capacity for maintaining and repairing the motor vehicle that is almost incomprehensible to the older generation, to whom the jargon of carburettors, differentials, commutators and gear boxes represents a dark and greasy mystery.

TAXATION OF MOTOR TRANSPORT.

It will probably be admitted by most motorists that motor taxation should be sufficient to balance the difference between the cost of the roads now and their cost before motor transport became common. It is also reasonable that improvements to a road which cost less than the saving produced in the running costs of the transport on the road should be paid for entirely by that transport. A third rule, which is equally sound, but which might not be admitted by motorists so readily as the two just quoted, is that improvements to roads should not be made unless their cost will be balanced by an equal saving in running costs.

The first contribution to any criticism of road transport usually consists of the statement that the roads are provided nearly free of charge for motor transport to make use of while railways are required to provide and maintain their own permanent way. Not many years ago the statement was substantially correct, and the rise in county rates of 80% per head during the last eight years would suggest that it still holds good. The county ratepayer is undoubtedly being penalised in the endeavour to improve long mileages

of roads rapidly, but the largest single item of motor taxation (customs duties) is not available for the Main Highways Fund. Nevertheless, the customs duties are a tax paid by motor transport, and must be credited to it when estimating its total payments in taxation and comparing them with the roading costs legitimately debited to motor transport.

Contributions to Taxation at Present Rates.

In the Transport Department's Report the question is discussed as follows:—

"It is believed by a number of authorities that the measure of special motor taxation should be the difference between what may be regarded as the normal aggregate of road expenditure, as judged by pre-motor days, when the State and local authorities provided the annual maintenance and capital charges, and the construction money was generally, as now, found out of loans, and the present expenditure.

"Applying the average expenditure for the decade 1910-20, due allowance being made for fluctuations in the value of money, it would appear that the normal expenditure, excluding the increase due to motor transport, would be in the vicinity of £2,800,000. Excluding loan expenditure, the road expenditure during the year ended 31st March, 1929, amounted to ap-

proximately £5,700,000, leaving approximately £2,900,000 as an estimate of the additional expenditure due to motor traffic. Special motor taxation in the form of license fees, fines, petrol tax, tyre tax and heavy traffic fees amounted to approximately £1,470,000 in 1928-9 and to £1,780,000 in 1929-30. Customs duties and primage on motor vehicles and parts aggregated £1,332,000 in 1929-30."

Motor Transport Not Being Subsidised.

From this it would appear that the taxation of motor transport, including customs duties which have exceeded £1,000,000 annually for many years, is now approximately equal to their share of the costs of roads. If this is so, the argument that motor transport is being subsidised by being provided with free permanent way no longer holds good, although the division of the taxation is unfair to the county ratepayer.

The fact that motor transport is able to make use of existing roadways constitutes a natural advantage for that form of transport, in just the same way as the free use of the sea and of the air constitute advantages to shipping and aircraft respectively.

So long as motor transport pays for the wear and tear of the roads and for the improvements made to meet its require-

ments it is not scoring an unfair advantage over the railways.

The position in England may again be quoted to provide an interesting comparison. In the Economist of Feb. 8th, 1930, figures are given which show that until the last couple of years motor transport was not paying fully for the additional cost of the roads fairly attributable to it, but that last year the total proceeds of motor taxation was in excess of the difference between the present cost of the roads and the pre-war costs, adjusted for variation in the value of money. Justice requires that the taxation of motor vehicles should be in excess of current requirements until the deficits of the post-war period are made up, and other figures quoted in the Economist suggest that this should follow easily without increasing rates. The figures show that the total number of motor vehicles more than doubled in the last six years, the yield of the motor taxes more than trebled, but the total expenditure on the roads increased only by one-third. It is reasonable to expect a continued increase, even if not at such a rapid rate, in both number of vehicles and yield of taxation, while the increase in the cost of the roads is becoming stabilised, hence there should be an ample margin available for balancing past deficits. On side roads in England the expenditure is still in excess of the contributions to taxation made by

the motor transport using them, but taxation from the main roads is sufficiently in excess of the expenditure to provide a margin on the totals.

The explanation of these figures lies in the well-known fact that the cost of a road varies with the amount of traffic using it, but not directly as the amount. Cost of roading varies so much from county to county that it is impossible to work out the exact relation between amount of traffic and cost of road, but the following may be given as a rough approximation:—

Traffic. Vehicles/day.	Type of road.	Cost per annum (interest, sinking fund and maintenance.)
10	earth	£50
100	metal	£150
1,000	bitumen	£500
10,000	concrete	£1,500

These figures indicate that the cost of a road varies somewhat as the square root of the number of vehicles using it, so that, if the number of vehicles using a road is multiplied by 100, the cost of the road will be multiplied only by about 10.

In England the mileage of highways, as given by Sir Henry Maybury in his "James Forrest" Lecture last year, was 177,000 in 1914 and 179,000 in 1928, of which 96,000 miles were receiving financial assist-

ance from the Road Fund, while the number of motor vehicles licensed in 1928 was just over two million, giving 11 per mile of all highways, or 21 per mile of subsidised highways.

In New Zealand the total mileage of roads, 69,500, includes 20,600 miles of unformed roads which may be excluded from consideration, 15,500 miles of formed but unsurfaced, i.e., earth roads, which provide an exceedingly difficult problem. 31,600 miles of metal or gravel roads and 1,700 miles of paved roads, half of which are urban and half rural. The total mileage of formed roads is therefore 48,800 miles, while the number of motor vehicles is 172,000, i.e., 3.5 vehicles per mile of formed road, or 5 vehicles per mile of surfaced road. The basic fact that the economic problem of a road becomes more difficult the less traffic there is on the road, would be sufficient to make New Zealand's road problem a much more difficult one than is England's, apart altogether from the fundamental difference in the value of the roads in existence before the advent of the motor. English roads were brought to a high standard over a hundred years ago by Telford, Macadam and their successors. How high the standard was may be illustrated by the story in "Coaching Days and Coaching Ways" of the driver remarking to the passenger on the box, after crossing a narrow bridge, "Not so

bad for a team with only one eye between us." A tall story, indicating confidence in the highways. This confidence is said to be exemplified now by the week-end joy-rider who has a gramophone playing on the back seat while travelling 40 to 50 miles an hour.

Unfair Burden on the County Ratepayer.

In England an appreciable proportion of motor taxation has been diverted to general purposes since Mr. Winston Churchill first "raided the Road Fund," but the burden thrown on the farming lands has been removed by "derating."

In this country the total of motor taxation has not balanced the additional cost of the roads until recently, while a large proportion has been paid into the Consolidated Fund, not into the Highways Fund. The county ratepayer has suffered and is naturally looking for relief to the same reform "derating" as has been applied in England.

If we assume that "derating" will come in the near future, the intrinsic difficulty of maintaining side roads without spending an amount out of proportion to the traffic will still await solution.

For, assuming for the moment that the average tax paid by a motor vehicle in this country is three farthings per mile, and accepting the Iowa figures quoted in the Transport Dept. Report giving the run-

ning cost on low type roads as fifty per cent. higher than on high type roads, it appears that the tax "paid" on a good road would be about two-thirds of a penny per mile and on a bad road one penny per mile. In other words, on a good road carrying a thousand vehicles a day (365,000 per annum) the tax "paid" per annum per mile would be approximately £1,000, while on a bad road carrying ten vehicles a day (3,650 per annum) the tax "paid" per annum per mile would be about £15.

The White Queen of "Alice in Wonderland" lived in a district which moved so fast that she had to run as hard as she could to keep where she was. And the spectre in every county is the feeling that motor traffic is increasing so rapidly that the roads are going back in condition. But while this may be true of some roads, the standard of the motorist in a young country rises so rapidly that impressions are liable to be misleading.

It is not disputed, of course, that the Main Highways have improved steadily in the last five years. In fact, it may be said that one can drive, say, from Auckland to Hamilton at 35 miles per hour now with as little discomfort as at 25 miles per hour three years ago and with less discomfort than at 18 miles an hour five years ago. But a side road, which was as smooth or rather as rough as the main

road five years ago and is in the same condition to-day, causes a most unpleasant surprise to the motorist who has been driving for some time on better roads.

It is admitted that roads should not be allowed to deteriorate, but it is usually forgotten by the motorist that the amount of traffic on most of our roads, even among the highways, is not sufficient to justify an expensive form of construction.

Taxation Paid by Individual Vehicles.

In the Transport Dept. Report the annual taxation for a private car running 4,500 miles in the year at 18 miles to the gallon is given as £9/15/-. This would presumably be made up of:—Car license £2, driver's license 5/-, petrol tax (6d. per gal.) £6/5/-, and tyre tax £1/5/-. This apparently omits the tax paid in customs duties, which would probably increase it by about 50%. For the minimum amount paid by a motor car is about £25; £100 is quite a common figure, and £50 may be accepted as not far from an average figure. The mileage of the car which pays £50 in customs duties probably does not exceed 50,000, in which case the car would pay £4/10/- in customs duties on 4,500 miles. Even so the total amount is much less than the average paid by a private car in England (£23/13/4), while the taxation in the Australian States, though not so high as this last figure, is nearly 50

per cent. higher than ours. The Report quoted above shows that taxation for trucks and buses here is about equal to that in England or Australia, hence if it were desired to make our scale correspond more nearly throughout, the simplest way would be to increase the amount of the annual license fee for the private car. An additional £3 per private car (raising the license fee from £2 to £5) would bring in an additional £420,000 (£1,780,000 was collected in fees and taxes, and £1,332,000 collected as customs duties in 1929-30).

Balance between Taxation and Road Costs.

With taxation at its present figure the amount paid per mile by motor transport may be worked out more closely from the figures given in the Transport Dept. Report. Taking their figures for the private car of 4,500 miles annually, paying £9/15/- in fees and taxes, and adding £4/10/- to this for customs duties, the amount paid per mile works out at three farthings, while for a truck with a 3-ton pay-load travelling 10,000 miles annually, paying £60/9/- in taxation, the amount per mile works out at just under 1½d. Hence on a road carrying 80 cars and 20 trucks the average motor taxation per mile would amount to £135 per annum. This amount should be sufficient without any assistance from rates to maintain a metal

road that was in existence before motor traffic began, but would probably not be sufficient in most counties to pay for the first metalling in addition to maintaining it.

It may be said with more confidence that a road carrying 200 vehicles a day which contribute £270 annually in taxation should be capable of being financed entirely out of that taxation, and improved as traffic increases, without assistance from rates.

On the other hand, a road carrying 50 vehicles a day, which contribute £67/10/- in taxation annually, in most cases could not be financed out of motor taxation at its present level.

It should be possible to compute the number of vehicles (varying somewhat with the locality, price of metal, etc.) for which motor taxation is sufficient to finance the road it uses. Below this number the same rate of taxation would not provide sufficient funds, but above this number the taxation would provide a margin. At the present time the number of vehicles per day for which motor taxation is sufficient to finance the road it uses probably lies between 50 and 150.

Of necessity the busy roads must, to some extent, "carry" the less used roads. For even allowing that running costs, and therefore payments in taxation, are higher on poorly maintained roads, even

double the average rate of £135 for 100 vehicles, i.e., £13/10/- for 10 vehicles, may not provide enough for the latter road.

The average number of vehicles per day on each mile of road in New Zealand may be worked out from the Transport Dept. Report as follows:—

Car mileage	142,000	×	4,500	= 640	million miles
Truck „	28,000	×	10,000	= 280	„ „
Bus „	1,270	×	30,000	= 40	„ „
				960	„ „

Taking the mileage of formed roads as 48,000, this gives 20,000 vehicles per mile per annum or 55 vehicles per mile per day. The traffic on some of the 1,700 miles of paved road amounts to many thousands of vehicles daily, while the traffic on long stretches of unsurfaced road would not average ten daily.

COST OF IMPROVEMENTS TO ROADS SHOULD BE BALANCED BY SAVING IN RUNNING COSTS.

The total annual amount spent on Road Transport is given by the Transport Dept. Report as £32,000,000, of which £4,000,000 is for maintaining roads and £28,000,000 for operating vehicles. These figures will increase as the number of vehicles increases, but for a constant number of vehicles the total should remain constant or decrease, any increase in the cost of the roads being at least balanced by the decrease in the running costs of the vehicles. Total running costs are fairly easily obtained, but each car normally travels on such a variety of roads that it is difficult to obtain comparative figures for different types of road, and also difficult to define the type. Good roads such as concrete and bitumen roads made to a standard specification are reasonably constant in quality, but macadam roads in a fair state of repair and still more, macadam, gravel and earth roads in a bad state of repair will vary widely in their effect on running costs. Conditions here bear a general resemblance to those in the United States of America where tests have been made showing that on "low-type" roads compared with "high-type" roads the pet-

rol consumption may be increased 50%, wear of tyres be three times as great, maintenance 50%, and depreciation 25% greater,, giving a total increase of about 50%. The running costs are given as 5½ cents or 2¾d. on good roads, and 7½ cents or 3¾d, on bad roads.

COMPARATIVE RUNNING COSTS ON VARIOUS TYPES OF ROADS.

(Data prepared by Iowa University, U.S.A., published in Transport Dept. Report.)
(Approximate Cost of Operation in Cents per mile.)

	High Type Roads. Cents.	Inter-mediate Roads. Cents.	Low Type Roads. Cents.
Gasoline	1.09	1.31	1.61
Oil	0.22	0.22	0.22
Tyres and Tubes ..	0.29	0.64	0.84
Maintenance	1.43	1.72	2.11
Depreciation	1.26	1.39	1.57
License	0.14	0.14	0.14
Garage	0.44	0.44	0.44
Interest at 6%	0.36	0.36	0.36
Insurance	0.21	0.21	0.21
Totals ..	5.44	6.43	7.50

Other tests have shown petrol consumption on earth roads as high as 2½ times the consumption on concrete roads. Now running costs in New Zealand are nearly double those in the United States; in fact, 5½d. a mile on good roads and 7½d. on bad roads are probably fair average figures for this country.

In the case of an earth road with light traffic there can be no question of paving it, but only of improving it by better

drainage, use of grader, etc. Even this may be quite sufficient to produce a saving of one penny a mile, which for ten vehicles a day amounts to £15 per annum. The taxation paid by the ten vehicles would be from £15 to £20 per annum, which should be spent in any case, while the additional £15 per annum, justified by saving in running costs, could come from the excess taxation of a road carrying, say, 500 vehicles daily, producing £675 annually in taxation, and costing only about two-thirds that amount.

Traffic Tallies.—Reference has already been made to the necessity of obtaining definite information as to number, kind and weight of vehicles using a road before planning improvements. A building is designed to suit the load it will be asked to carry, and a hall to hold a certain number of people. In the same way the traffic a road surface is to carry should be known before the design of the road surface is decided on.

Justifiable Expenditure.

Costs vary so much from place to place even in the same county that no hard and fast rules can be made, but once the principle is recognised and general figures are available the choice of programme for any road can be quickly limited to its feasible alternatives. Thus for a macadam road with a traffic density of 300 vehicles

a day, expected to double in five years' time and quadruple in ten years' time, the case may be stated as follows:—

Assume present costs to be £375 per mile per annum, made up of £75 interest and sinking fund on old loan with 20 years to run, and £300 for maintenance, and note that the maintenance costs are rising rapidly while the surface of the road is barely being maintained. The stage has obviously been reached at which a more expensive type of construction is justified. Most people in Auckland will recommend concreting the road as soon as possible, and if the increase of traffic occurs as expected, concreting will be justified in the near future. But for some years to come the costs of the road will be increased very considerably. Taking the cost of the concrete road at £7,500 per mile and its life to be 20 years, the charges for interest (6%) and sinking fund ($2\frac{3}{4}$%) would be about £650, to which must be added maintenance of shoulders and joints, say £50, and the £75 still to pay on the original loan—total £775. Now the cost would probably reach this amount if the macadam were maintained till the traffic reached 600 vehicles a day. But there are alternative intermediate roads which may give better financial results. The cement penetration road, of which experimental stretches have recently been laid by the Waitemata County Council,

has not yet been fully tried out, but appears likely to offer a reduction in the first cost.

Sealing the surface with bitumen or tar of suitable quality should not be considered if the macadam has been allowed to wear too thin, but some reconstruction and sealing could be carried out at a cost of, say, £2,500 per mile. Allowing this road a life of ten years the annual charges for interest at 6% and sinking fund at 7½% would be about £340. Maintenance would commence at about £75 per annum and would increase somewhat as traffic increased. The annual cost would therefore commence at £340 plus £75 plus £75, i.e., £490 as against £775 for the concrete road. So that even if maintenance increased from £75 annually to £350 annually this road would still be cheaper than the concrete.

Now examine the saving in running costs obtained by paving the road either with bitumen or concrete. The saving in either case may be reckoned as at least one penny per vehicle mile, amounting to £450 per annum for 300 vehicles. Thus an addition of £115 to the annual expenditure on the road entailed by tar or bitumen sealing produces a saving of £450, while the additional expenditure involved in concreting the road saves in running costs £50 over and above the added cost of the road. Obviously an expenditure of this

sort should be met entirely out of motor taxation available from the Highway Board Funds. There is no justification for calling on county rates to contribute towards improvements which reduce running costs by more than the cost of the improvements.

REGULATION & CO-ORDINATION.

Taxation of Motor Transport is designed or should be designed to pay for fair wear and tear of the roads, but regulation is required not only to prevent damage to roads as distinct from wear, but to safeguard life and property and perhaps to control competition between motor transport and railways.

It is not proposed to discuss regulations intended to promote safety on the roads, although many of the regulations which aim at preventing damage to roads must also be useful in leading to slower and usually safer driving.

Damage to roads as distinguished from fair wear and tear is caused at excessive speed by the "ripping" effect of pneumatic tyres and by the impact of solid rubber tyres. With pneumatic tyres impact effect is negligible, but on a metal or gravel road the release of the extended rubber fibre as the tread loses contact with the road tends to catapult small particles from the surface, at high speed the air currents disperse these particles, while at corners centrifugal force, unless balanced by cant in the road corresponding with the speed, leads to the tyres dragging sideways and loosening the road surface. It may be said with some justification that these

effects come under the head of fair wear and tear and that the speed limit should be fixed only from the point of view of safety of life.

But there is no question that on macadam roads a touring car travelling unduly fast may, by the effects described above, cause more damage than a motor lorry complying with reasonable standards of load and speed. It might be suggested that the best cure for this practice would be to allow the road to remain rough and "pot-holed," but such a method leads to rapid deterioration and even destruction of the road, costs of running and maintenance both are increased, while the innocent are penalised to exactly the same extent as the offenders. It appears that regulations may be necessary, and if so means must be provided for enforcing them. Regulations which depend on notice boards only are not likely to be carefully observed.

Solid Rubber Tyres.—Much the most potent cause of damage to roads, however, is the solid rubber tyre. Whereas with pneumatic tyres impact effect may be ignored, except for total loads on wooden bridges, with solid rubber tyres impact increases the effect of the load enormously. Experiments carried out by the Bureau of Public Roads, Washington, showed the extent to which the effect of the load increased with the speed and with the reduction in thickness of the rubber tyre. The

tests showed that, for a solid rubber tyre slightly worn the effect of the load on the road was increased by 1½ times its own amount for every ten miles an hour increase in the speed. A two-ton wheel load produced when travelling 10 miles an hour the effect of a stationary 5-ton wheel load, at 20 miles an hour it produced the effect of a stationary 8-ton wheel load, and so on. Badly worn tyres and pot-holes both increase the impact effect still further, until the only limit is the resistance of the framework of the vehicle to destruction. And a tough vehicle unrestrained may do an incalculable amount of damage.

Even on a concrete road the unregulated passage of vehicles with solid rubber tyres travelling fast may shorten the life of the pavement appreciably. The bearing capacity of the earth below a concrete road is commonly about 30lbs. to the square inch, hence an 8-ton wheel load must be spread over an area of about 600 square inches. A load on a concrete slab 6 inches thick is spread 6 inches outwards by the concrete in transferring the load to the foundation, without introducing beam action or bending. Thus a load on an area 8 inches by 4 inches on top of the slab is spread over an area 20 inches by 16 inches of the foundation without introducing beam action in the slab. Similarly to transfer a load on top of the slab to an area of 600 square inches (say 20 by 30)

beneath the slab, the load on top should be spread over an area 8 inches by 18 inches. The area of contact of a solid rubber tyre, particularly when worn, falls very far short of this amount. Hence beam action and bending stresses are induced in the concrete slab, which, if repeated, are likely to lead to fracture. The fact that a five-ton wheel load on a solid rubber tyre may, under some conditions, produce the effect of a stationary twenty or thirty-ton wheel load points to the advisabiliy of limiting drastically both loads and speeds for solid rubber tyres.

Thus for a road capable of carrying a ten-ton axle load on pneumatic tyres at 20 miles an hour, for solid tyres the limit should be a four-ton axle load and 10 miles an hour. The difference between the two types of tyre is so fundamental that the propriety of prohibiting the import of vehicles which use solid rubber should receive serious consideration from the Transport Dept.

The Six-wheeler.—When considering the relations between the vehicle and the road the advantages of the rigid-frame three-axle lorry merits much more attention than they have received in this country so far. The Transport Dept. in their Report recommend that their use should be encouraged by framing regulations in recognition of their advantages, and quote tests which show that the im-

pact from a five-ton pay load on a three-axle lorry is less than that from a two-ton pay load on a two-axle lorry. In addition to these tests others have shown that the tyre bill for the six-wheeler three-axle lorry is often less than for the four-wheeler two-axle lorry. The explanation appears to be that there is much less spinning of driving wheels when the load rises during vertical swaying of vehicle; in the two-axle lorry uneven ground may lead to a driving wheel bouncing off the road, spinning at high speed and grinding on the road after its return, but with the three-axled vehicle the wheel is not so likely to bounce in the first case, while if it does bounce it is not free to spin; hence the wear of the tyre is less. And if the wear of the tyre is less the wear of the road must be reduced also. The three-axled chassis has become very popular for buses in England, while the same type of frame with some modifications in the way of clearance, gives a vehicle whose "cross-country" performance vies with that of the tank. The six-wheeler is one of the products of an outburst of invention in the British Army applied to the mechanisation of warfare, and while it cannot traverse swamp or bush it can fairly be described as being independent of roads or tracks.

The bearing capacity of earth has been referred to in discussing the effect of vehicles with solid rubber tyres on concrete

roads. With earth roads and roads with a light coat of metal or gravel the load per square inch is a matter of very great importance. In dry weather a tyre whose air pressure does not exceed 30lbs. per square inch should travel over most earth roads without leaving a track, while use of the road in wet weather would probably be feasible with care. A two-axle vehicle with tyres inflated to 30lbs. will not carry a heavy load, nor for that matter will a three-axled vehicle with similar tyres, but the latter will carry more than double the former pay load, while it will require the use of chains very much less frequently.

In the Transport Dept. Report reference is made to a new tyre so fat and flexible that its working pressure is only ten pounds per square inch. Such a tyre would obviously not carry a big load, but it would carry its load with ease on sand or soft ground. The writer believes that the use of an "all weather" vehicle may well be more economical than the construction of "all weather" roads.

Of the 15,500 miles of earth road in this country many thousands of miles are likely to remain unmetalled for many years. It is therefore a matter of importance that vehicles should be used which will cause them the least amount of damage. Solid rubber tyres should not be allowed on such roads at all, and it is probable that the three-axle lorry will give more satisfaction

to both road user and road maintainer than the two-axle vehicle.

Regulation.

Regulation of load, speed and tyre, inspection of passenger vehicles, and levying of taxation to pay for use of road have all been partially or wholly enforced in this country with common consent and support. Regulation of the business which motor transport shall be allowed to transact, however, is a more thorny problem.

In a sister Dominion a Commission on Road Motor Competition recommended, inter alia, that "The use of goods lorries for the conveyance of persons should not be permitted." The recommendation may have been qualified in the original, but as it stands it appears to impose a restriction which would seriously hamper the work of local authorities, builders and contractors, merely for the sake of restriction.

Reference has already been made to the railway tariff in which rates per ton mile vary widely between different classes of goods.

Road rates for Classes A, B, C and D for short hauls and for Classes A, B and C for hauls up to 100 miles are lower than rail rates, or so near the same level as to offer serious competition.

The writer believes that it is unwise to attempt restriction by way of prohibition. Motor vehicles must, of course, be taxed

to pay for the use of the road, and for some years the taxation should be in excess to make good the deficiencies of the decade just past, but prohibition of the use of an economical form of transport is a dangerous weapon.

The alternative method of meeting the competition consists in reducing the rail charges near enough to the level of the road charges to prevent loss of business. This would probably increase the railway deficit, but would certainly provide cheaper transport, while in some cases the increase of business would compensate for the lower rates.

New Zealand must have efficient transport. It would be a short-sighted policy to exclude by legislation a more efficient system of transport, although it may be almost as unwise to allow it to starve out the older and less efficient system too rapidly.

APPENDIX.

Sinking Funds.

Construction work on roads is usually carried out by loan money, but even when it is carried out from revenue it is desirable to compare it with other work paid for by loan money. In either case a sinking fund should be allowed which will wipe out the loan within the life of the work done.

Much of the earthwork carried out on roads and many of the culverts and bridges built have a life exceeding fifty years; a sinking fund of £1 per £100 set aside annually will, at 5 per cent. compound interest, equal the £100 in 36¼ years; hence a sinking fund of 1 per cent. is ample for such work.

But metalling or tar sealing on a road on which the traffic is increasing rapidly, may, if neglected, have a very short life. With proper maintenance (not necessarily costly maintenance), such work may be kept in good condition indefinitely, although it may be difficult to believe that much of the original work has survived.

In cases such as these a life of eight, ten or fifteen years may be allowed, with corresponding sinking funds at 5 per cent. of £10/9/5, £7/19/-, £4/12/8; while with better class bitumen roads or with con-

crete roads a life of twenty or twenty-five years may be allowed with sinking funds of £3/0/6 and £2/1/11 respectively.

The life of a road depends partly on weather and partly on traffic, and in estimating the life, the latter point, strange as it may appear, is frequently ignored. The Local Body Loans Board has in many cases required large sinking funds to be provided on cheap construction for roads with little traffic, with the result that the construction is made very expensive until the loan has been paid off. Local Bodies are naturally tempted to construct costly roads in many places where the traffic is quite insufficient to justify them. For a busy road, of course, the type whose cost of construction is greatest may well be the cheapest on the whole. Thus on a road carrying, say, 2,000 vehicles a day a concrete road costing £7,500 a mile to construct and having a life of 25 years would cost annually at 5 per cent., £375 for interest, £157/10/- for sinking fund and, say, £50 for maintenance: total £582/10/- per annum.

On the other hand a bituminous sealed road costing £3,500 a mile to construct, and having a life of eight years, would cost annually £175 for interest, £367/10/- for sinking fund and, say, £150 for maintenance: total £687/10/- per annum.

Now, if the same sinking fund is required irrespective of the traffic, we are

forced into the anomalous position in which the £3,500 a mile road which, given reasonable maintenance, with 100 vehicles a day, should last twenty or twenty-five years, and be paid off by a sinking fund of £106 or £78/10/-, is required to provide a sinking fund of £367/10/- and therefore to appear more costly than the £7,500 a mile road.

RECOMMENDATIONS.

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(1) Cessation of construction of railway extensions.

(2) Any variation in railway rates or fares to be downward.

(3) Vehicles with solid rubber tyres to be limited drastically as regards load and speed; no more such vehicles to be imported, or alternatively taxation of solid rubber tyres to be raised to a much higher level.

(4) Registration fee for motor cars to be raised from £2 to £5.

(5) County ratepayers to be assisted by "de-rating," or by subsidy from Highway Board Funds for all roads.

(6) No capital expenditure on roads without traffic tally being taken.

(7) Use of multi-axled vehicles to be encouraged.

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