NOTES ON MODERN MACHINE TOOLS.

The President said Mr. Eady in his paper had put so very much information before them that discussion was very difficult. If he had dealt with some particular tool and outlined its points there might have been more probability of discussion.

Mr. J. T. N. Anderson said it was a pity if this important subject should be closed. The mechanical engineers belonging to the Institute might possibly contribute if they kept it open to another meeting.

Discussion adjourned.

PAPER.

THE MAIN ROAD PROBLEM.

By J. T. Noble Anderson.
(Past President.)

Main roads are generally devoted to Government and other public uses, as follows:

(a) Government Uses—

(1) Rapid transit, including not only direct Government despatches, but the postal and telegraphic services, which the Government almost everywhere conduct as a trading business.

(2) Military transit and transport.

(3) The means of access to, and service of Government property and reserves, whether devoted to mining, forestry, water reserves, State or Government railways, canals, hospitals, asylums, and other such properties and factories as the Government may possess.

(b) Other Public Uses—

(1) Commercial transport of goods.

(2) Transit of passengers, whether for business or pleasure.

(3) Tourists, whether by motor or coach.

(4) Travelling stock.
(5) Drainage. This either provides for the drainage of not only the road itself, but often also of the adjoining properties.

(6) Water supply. This, along with the grazing reserves in new countries, is necessary for the use of travelling stock, but often the road is also the chief artery for the supply of water for domestic or irrigation service to the adjoining lands.

Further, the roads are to a considerable extent responsible for the maintenance of rivers and creeks in their proper courses, since the bridges and culverts are the principal, often the only, artificial obstructions in their natural channels.

All these elements enter into the main road problem, and in its development and the growth of the districts served into industrial communities, the question becomes even more complicated by the provision along the road, as far as practicable, of the ancillary services, in the shape of light railways, or canals. But clearly, excepting drainage and water service, the bulk of its service is rather to the country at large than to the immediate locality it traverses.

**Trial and Failure of Road Location.**

The author had already pointed out* that a study of the main road history of older countries shows that, as a rule, the original routes become abandoned, and new roads have to be acquired at great cost.

In his own practice in Victoria, he has let contracts within the past twelve months for no less than eight cases of road deviation, aggregating about six miles in length.

A further study of road history in older countries will reveal the fact that had a proper topographical map of the countries been in existence, and had the then road engineers a grasp of the main principles of road engineering as now understood, probably none, or at the most, one or two, of the abandoned roads would have been located where they were placed, of course always assuming that adverse private interests could have been disregarded.

**Topographical Surveys.**

This matter of topographical survey is a most important one, and it is only the engineer who has worked in military countries,

* See page 84, Vol. XI., Proceedings of the Victorian Institute of Engineers.
where the ordinance surveys are in existence, who can realise against what a heavy handicap our Australian municipal engineers are compelled to work.

Burdened with so much purely surveying work, they are unable to give such close and specialised attention to the work of construction as will secure good roads to the community.

Often, in fact in the majority of cases, the municipal engineers' works of bridges, culverts, drains, road cuttings, and river fords, along with such topographical surveys as he may make, go unrecorded, and the periodic re-issue of the land surveys of the different parish plans only record such changes in boundaries as have been gazetted in connection with land transfers, and take no cognisance of these important engineering features.

The necessity of an ordinance survey from a military point of view is a question for discussion in another place, but for the present it may be assumed as a necessity of the first importance, since every large army of modern times has not only secured the most detailed surveys of the country it is to defend, but of the lands far beyond its own frontiers that may come into the practical Kreigsspiel. But, apart from that, it is generally recognised as part of the duty of the Government to provide from time to time an up-to-date topographical survey, for the benefit of the country at large. The results of such surveys should be made freely available to all concerned, just as the annual publications of the departments are made available.

Local Authorities.

It is obviously unfair to expect the local authorities, from revenue raised within parochial bounds, to maintain these main roads. The system of making counties take over the maintenance of main roads, and raise locally the revenue, succeeded the older system of supporting these roads by tolls; and so long as the memory of the toll exactions was green, little complaint was raised against the present system.

At the present time, however, the development of the country by railways, in place of diminishing the main road traffic, has greatly added to it, and the ratepayers see all their revenue going to support main roads, which in many cases are destroyed by the heavy traffic coming from beyond their bounds, or, if
coming from within their bounds, coming from the Crown estates in mining lands or forests, and the only interest it directly benefits is the State railways. But these are not exempt from rating; but often actually impose a railway rate. At the same time they find the local authorities unable to give the necessary relief to them in the proper maintenance of branch roads, serving two or three occupiers; or, in assisting to make access to their grazing areas, which, if accessible, could be profitably taken over from the Crown and converted into freeholds.

It will be said that in this State the Government grants aid for the construction, and even maintenance of these main roads. The answer is that such assistance is entirely inadequate to meet, not only the improvements which are needed to keep pace with modern conditions, but also to reach in any effective way the immense demands of an extraordinarily rich country, which is beginning to find out how its development depends on road transport.

**Government Classification of Roads.**

But this State Government is gradually evolving useful reforms. A big move to ascertain what is the value and cost of the present service is being made. And no doubt the actions of the Government in the future, and the amount it will grant, will be largely influenced by the records which will be obtained. Another move will probably follow, to differentiate roads, with a view to providing for tourist and military requirements some up-to-date motor roads.

The State reaps a revenue from registration of motors and chauffeurs, and road fines. It would seem only fair that this should be earmarked to give a return in the shape of proper roads to the motoring public who have provided this revenue. No doubt, in time, many of our main roads will have three tracks—one the track for ordinary traffic as at present, a second track for motors and rapid transit, and a third the light railway to relieve the main road of the damaging heavy traffic.

**Desirable Extension of Departmental Assistance.**

In all these matters, however, the functions of the Government or of the State Department's engineers can be greatly extended without trenching on the proper duties of the municipal engineer. Thus, the State Department as a central board can
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provide all testing of materials, road metal, timbers, paints, cement, steel, and other materials of construction at a nominal charge. An example of two of these materials in which the wasteful test of "survival of the fittest" has worked out under the author's recent experience, are as follows:—In one shire, after years of using inferior sedimentary rocks for road metal, which cost from 4s. to 7s. per cubic yard, the experience of the present wet winter has forced the Council to the view that the only suitable material for road surface, on the main road to the railway, is igneous rock. In another shire, local red gum, a material which in most places is found to be very durable, has perished with less than twenty years' life. And the white paints used have proved useless. These are all matters which could have been determined at a nominal cost by scientific experiment, but which have entailed heavy losses.

PUBLIC ROAD PLANTS.

Another extension of departmental assistance would be, as the author suggested (see p. 90, Vol. XI., Vic. Inst. Engineers), that the Government should provide modern road plants for the use of the shires. A few of the shires, and the municipalities near the metropolis, have provided themselves with up-to-date road plants, not only graders, scoops, ploughs, and rollers, but a steam plant, with stone crusher and quarry steam drills, as well as a steam roller. In the country shires, however, where between revenue and Government assistance, there is seldom more than, say, 2,000 or 3,000 cubic yards of metal handled in any one year; and seldom more than, say, three or four miles of roads graded and formed, it is obvious that the heavy initial expense of such a plant would not be justified, and many of the shires are so poor that, though they admit the necessity of a road roller to secure a good road surface, they will not even embark in a three-horse road roller.

The author has had some experience in the joint ownership of a road plant between two ridings in the same shire, and it resulted in both ridings procuring their own independent plants, and he has no doubt but that by the Government lending road plants, and arranging to subsequently sell them on easy terms, it would be only a short time when every shire in this State would have similarly equipped itself.
THE MAIN ROAD PROBLEM

How great the saving would be can be judged from results with a grader in road formation alone. The author has made careful records in the use of three different plants, and found that forming which used to cost 15s. a chain could be done for 7s. 6d.; while road work which would have cost 21s. a chain by contract, cost 11s. by day labour with the grader. Of course, in merely trimming up private lanes, these machines will not always pay to work; but when it comes to main road work, they are indispensable, because, not only is the saving in cost to be regarded, but they make a much firmer road bed. As to steam rollers, and such plant, their saving is, of course, only found by saving in subsequent maintenance.

EASY VICTORIAN CONDITIONS.

In this main road work, so far, under the lighter traffic and drier atmosphere of this State, it has seldom been found necessary to adopt the orthodox system of mitred drains in the road bed, and of stone-paved boxing at the sides of the metal. If the Width of Tyres Act were made compulsory throughout the State, this cheaper type of road would probably suffice in 95 per cent. of our main roads. But, unfortunately, the Width of Tyres Act, though adopted by a large number of the shires, has even in them been a dead letter.

SCIENTIFIC RECORDS OF WEAR, ETC., OF ROAD SURFACES.

One final remark on assistance which the shires require to enable the municipal engineers to study their work, and so secure the best results for their councils. That is the need for three or more viagraph cars, to enable the roads in the different parts of the State to be tested. It is not within the means of a country engineer to provide such an expensive instrument, and the engineer who would ask his council to procure one would be looked on as an "eccentric," and unpractical; and yet it is impossible to study the road problem properly without frequent viagraph tests. From the rough approximate results, which are all the author could get with improvised gear, he is of opinion that few of our macadamised roads give a less tractive effort than 48 to 50 lbs. per ton; while the "dirt," or unmetalled formation, in wet weather may go far beyond 200 lbs.

It is mainly due to these vilely bad results that local authorities are so indifferent to the efforts of the Government officials
to secure easy grades. When a man is travelling on a road where the tractive effort is already on the flat equivalent to going up a grade of 1 in 10, he is not greatly concerned whether a hill is surmounted by a short length of 1 in 10 grade, or a longer length of 1 in 15 grade. In fact, there are many new deviations where the surface has not been metalled, in which the traffic persists in keeping to the old steeper route. There could be no surer or more convincing proof than this of the wastefulness of the new work, and it is not to be wondered at that in such cases the engineer is blamed by ratepayers, and it is idle for him to argue that his road has been made with a uniform grade and good curves, and is everything that it should be (so far as the funds available admit), and it would be equally folly for him to attempt to close the old shorter route to traffic. This is no fancy picture. In travelling on a main coach route, not 100 miles from Melbourne, the author asked the driver why he preferred the steeper old route, and his answer was, “I have travelled over the new one.”

The moral is obvious—all new routes should not only be rolled, but either metalled or corduroyed, and made practicable for traffic before being taken over from the contractors.

EXPLANATION.

These are a few hasty suggestions thrown out during an exceptionally busy time, not with any desire to make a complete paper, but as suggesting subjects that at the present time should elicit valuable suggestions, and the record of their own experience, from other municipal engineers.

DISCUSSION.

The President (after the vote of thanks recorded in the Proceedings had been passed), said the paper dealt with a subject of the first importance in engineering at the present time. It gave members—not only those present, but those who were municipal engineers throughout Victoria—an opportunity of recording their own experiences upon the points Mr. Anderson had broached. He trusted that their members in the country who had knowledge and experience of that work would thoroughly discuss all the points that had been raised.
DISCUSSION—THE MAIN ROAD PROBLEM.

There were those present who were more competent to discuss the paper than he was. That it would give rise to a good discussion he did not doubt. It seemed to him that the paper was a plea for general plan and for appliances. Also it raised the question of policy, with such alternatives as (a) direct government control; (b) municipal control under direct government supervision, or (c) direct municipal control of works subsidised by government funds. These were matters of importance, and expressions of opinion about the views expressed in the paper, from men who knew, might be of great advantage to the public at the present time.

Mr. Anderson had mentioned the viagraph, and it was of great advantage in road work. Recently he had seen some of the diagrams taken by that machine over very long runs in France. The accompanying comments were somewhat adverse, because depressions were found a six in. deep. He was curious to know just what sort of a diagram the viagraph would give on passing over a Gippsland road in winter, cut up into ruts two feet deep.

Topographic survey was an important matter, and this Institute had time after time pleaded for it. A good idea of how the work of the shire engineer would be simplified if they had such preliminary data at command was supplied by the topographic survey of the Federal capital site.

Mr. Anderson had dealt in several places with motor traffic. If they had money no doubt perfect motor tracks would be a matter that they might consider. But might they not pay too heavy a price for the perfect road required for a motor? Until a greater development of the country had been accomplished might it not be injudicious to spend too much upon the perfecting of roads for the benefit of quite a small class, whilst the absolute requirement of far more important producing interests remained unmet?

Mr. Anderson said he did not intend to refer to the motor car as the only form of motor traffic. In many of their districts, with a small improvement of the roads, the motor waggon would supplant the horse. That was so in years like the present, when fodder was very cheap. What would it be in lean years, when the fodder might cost twice as much?
The President said such policy would, of course, entail a separation of the traffic. The heavy traffic could not be permitted on perfect, and expensive, roads.

Mr. Anderson said that was so. Rapid traffic had a certain effect on the material that filled the interstices in the road bed. The rapid vehicular traffic, by vacuum effect, disturbed or removed it. But motor wagggon traffic at moderate speeds improved the ordinary main road, as it acted upon it somewhat as a road roller.

Mr. T. W. Fowler said the first thing they wanted to know in dealing with the main road problem was, what is a main road? And candidly he was not in a position to give a definition. He did not think Mr. Anderson had given one. It was a very difficult problem indeed to define what was a main road. For instance, many years ago a road—undoubtedly a main road—was made into the North-eastern district, and another into the Castlemaine and Bendigo districts. One was called the Sydney Road and the other the Mt. Alexander Road. Since those roads were made, railways had been constructed almost parallel with them, and had taken all the through traffic that was to travel on the roads. Would they call those roads main roads? He did not think they could legitimately apply the term main roads to such roads as those under present conditions. At least they must recognise that those roads do not now bear a part in conveying the heavy traffic to and from the interior that they used to do. To define what actually was a main road was very difficult indeed.

Then there was another point. It was very easy for them to decide what was the ideal type of construction to adopt. They could at least get into fairly close agreement upon that point. But when the municipal engineer attempted to put that construction into execution he found himself confronted with one very great difficulty, and that was the financial difficulty. Mr. Anderson at the close of his paper suggested that deviations should be made thoroughly trafficable before being thrown open for traffic. An admirable view indeed, and he wished it was always done, but was it practicable to give effect to it? If so, he would have avoided a couple of months ago a rather nasty trip through a deviation having become impracticable for traffic.
The municipal council had made an excellent deviation a couple of miles or so in length, but it had not the money to metal it, and it had become utterly untrafficable. The result was they were compelled to leave the buggy out all night, and make their way as best they could to the nearest habitation, some miles away. But he did not blame the municipal council in that case for not metalling the road, because he knew it had not the money to do it. If the councils could impose rates at the rate of 50s. in the £ and keep them up for 10 or 15 years they would have a fair chance of getting reasonably decent roads through the country! At one time he had made a computation as to how long it would take a municipality in a country district with no special difficulties to metal the whole of its roads, assuming it did not spend very much upon maintenance. He came to the conclusion that, taking the ordinary municipal revenue, with rates of 1s. in the £, in about 200 years there would be enough money to metal the whole of the roads. That was the problem municipalities had before them. Give the municipal engineer plenty of money and he would make as fine a road as could be obtained in any part of the world. But they had to remember that the municipal engineers of Australia had to work under conditions very different from those of the engineers of Europe. They had to deal with large areas; they had very small amounts of money at their disposal; and they had to pay high wages to their workmen. It was a good thing for the country that the rate of wages was high, but it necessarily diminished the amount of work that could be done for a given sum of money.

Another point was the width of tyres. He understood Mr. Anderson strongly advocated the Width of Tyres Act, and to say that the broad tyres improved the road. He heartily agreed with the author in that, where broad tyres could be used. He would go further, and say that the present provisions in the Local Government Act with reference to the width of tyres could be amended with very great advantage. He looked upon the present protection to the roads given by the Width of Tyres section of the Local Government Act as being very trifling. They might take it that an ordinary waggon would have wheels with tyres three inches in width, that was a total width of 12 inches. Under the Width of Tyres provisions it was legal to take on such a vehicle a load of 5 tons 8 cwt., including the weight of the vehicle, or,
say, about 4 tons and the vehicle. He thought they would all realise that that was a very high load indeed to impose upon any road. And if any protection was to be given to a road by bringing it under the provisions of the Width of Tyres section of the Act he certainly thought the load should be diminished. There were provisions in the Act under which attempts had been made to reduce the weight below that specified in certain cases. He had studied it very closely, and he certainly was of opinion that if those provisions were tested in a court of law they would be found to be absolutely meaningless and unworkable. In one case an attempt was made by a municipal council to reduce the load that could be taken to one-third during certain winter months. They asked the Governor-in-Council to pass a regulation reducing the load which could be taken from 4½ cwt. to 1½ cwt. That would be reducing the load which an ordinary waggon could take from 5 tons 8 cwt. to 36 cwt., or practically reducing the load so that it would be an utterly unpayable proposition to move any material on the road at all. That was attempted to be enforced during the winter months, and as the result of counsel’s opinion taken both by the municipality and by others who were interested in upsetting the regulation, it was found that the municipality dared not attempt to enforce the regulation. A reasonable reduction, say to 3½ or 4 tons, would be a very great protection to the roads. But as the result of his experience he would say that broad tyres were dangerous and utterly unworkable when they had to take traffic over unmade roads and steep sidings. When they took traffic over such roads it was found to be absolutely necessary to use comparatively narrow tyres, because if they got on a greasy siding with broad tyres the load would slide to one side, and there was a great danger of capsising. He had travelled in spring carts under such circumstances, when his own weight and that of the driver was not sufficient to load the vehicle down, and they were nearly slipping off the side altogether. The broad tyre was a great advantage where they had made roads, and roads the cross section of which was practically level. But in the case of roads with steep sidings it became very dangerous.

Mr. Wm. Calder said they were indebted to Mr. Anderson for bringing this matter before the Institute again, for although the road problem was an old problem, it was still an ever new one. He was quite in accordance with the author that some
more systematic survey should have been made in the way of topographic work, but he was afraid from the trend of things that they were still a long way from it. They could not make a thorough topographic survey without as a foundation a trigonometrical survey. Even the small amount of trigonometrical work that had been done had been allowed to drift. Mistakes were made in the laying out of the roads in the first place. They went the wrong way about it. Allotments were laid out on the draught-board principle, without reference to the topographical features, whereas the roads should be the first consideration after the trigonometrical work, and then the allotment would fall naturally in order.

A point Mr. Anderson had referred to was private interests. That held good with relation to roads and railways. Many roads had been wrongfully laid out through pressure brought to bear by interested persons.

Another good suggestion in the paper was that the Government or somebody—preferably the University—should take in hand the testing and standardisation of road materials. Very few municipal engineers had the apparatus necessary to test materials, and he did not suppose any had the time. The engineer scarcely had time to do his own every-day work, without going into experimental work or testing, and it would be of great value to shire engineers if there was a standardisation of road material. Some roads were made of local material and in a short time had to be taken up and re-made. It would very often pay municipalities to expend £50 per cent. more per cubic yard on their metal than to use the local material.

Another question was that of rolling. No macadamised road could be made thoroughly and effectively without a roller, and the municipality that could not afford a stone roller should cease to exist. Perhaps they could not all have a steam roller, but they could surely expend £50 on a horse roller, which, although not as good as the heavier roller, was better than nothing. It would be better to roll a road with a cylindrical log than not to roll it at all. In the process of setting the broken stone was rolled about under the horses' feet until all the edges were ground of it, and it would not set. The result was it was never a satisfactory road, and much of the road stone was wasted.

Reference had been made to the roads in France. That was
a country with a large history behind it. From what he had seen of the French roads he did not think they equalled the English roads, and that was the opinion of the British road engineers who attended the conference in Paris in 1908.

He was also very much in favour of the universal extension of the Width of Tyres Act. He thought it did not go far enough. He had forgotten the exact weights per half inch of tyre width which could be carried under the Act, but he remembered that on looking into the matter at the time he did not think it went far enough. There were a few circumstances under which the wide tyre was not an improvement on the other. He had read some years ago of certain tests having been made. In one case where the wide tyre was taken through a field it was found that the tractive effort there was greater. The soil had accumulated round the tyre and impeded it to a certain extent. That was the only instance in which the wide tyre was not a benefit. Generally speaking it had a rolling effect on the road.

Another consideration was the diameter of the wheel. A wheel of large diameter was not so severe on a road as one of a small diameter. And it was found that absolutely the worst form of traffic to cut up an ordinary macadamised road was 'bus traffic. There was a certain swing from the springs of a heavily laden 'bus which caused the depression to become greater. An ordinary motor car was a very good viagrap. It was astonishing how one noticed a very slight depression. On most roads there was not the width to provide separate tracks for motor cars, but it should be done where there was room. It would be better for the motors and for the general public. Supposing they had on St. Kilda road a strip up the centre for rapid through traffic up and down; then a line of tramway up one side and down the other; and the remainder available for ordinary vehicular traffic.

As Mr. Fowler had pointed out, they could not blame the municipal councils for the poor roads. In the case in question it was far better to regrade that road even though at the time they could not metal it, because in the time to come, when the necessary funds were available, the road could be permanently constructed on the improved gradient.

Mr. T. W. Fowler said they had for a portion of Victoria a very beautiful set of topographical maps in connection with the
original geological survey of Victoria, and he thought every municipal engineer who had had the pleasure of working in a district covered by that survey would agree with him in saying that the assistance he could get from those maps was enormous. They could not estimate too highly the work of the early geological surveyors in that respect. As far as he had been able to test it, it was most accurate.

Mr. J. A. Griffiths said he was very glad to hear Mr. Fowler give his testimony as to the geological maps. He had heard of them, and he believed Mr. Fowler's remarks were quite warranted. They could do very good topographical work without trigonometrical work. The trigonometrical survey was necessary where the country was fairly outlined, but in Victoria it was premature. They could not find the base line yet. It appeared to him there were many places where the Sydney main road might cross the ridge besides the Seymour gap. Take a very simple case. For 50 or 60 years the Lands Department had had surveyors measuring those lines, and many of the chess-board blocks had slopes of 1 in 1, 1 in 4, and 1 in 10. The topographical features were seldom included unless it was a watercourse, which was used as a boundary. But in only a few rare instances have any of the Governments of the States of Australia compiled what might be called proper topographical maps. The Defence force recently began to make a slight start for their military necessities, particularly in regard to their camp, by producing a contour sketch of the locality of the camp. That was small, but it was far better than nothing at all.

If every surveyor made a topographical sketch of the features of the country at the time he made the outline plan subject to the necessities of land subdivision requirements, they should have been a long way towards a topographical map of Australia.

The President said that much of the work had not been done, and much of the work that had been done had been lost, and would have to be done again.

Mr. J. T. N. Anderson, in his interim reply, referred to Mr. Fowler's remarks as to the definition of a main road. If anything, his paper would tend to show that it was impossible to say what was a main road. He thought also that was what was in Mr. Fowler's mind. It was entirely a question of judgment.
Speaking as a shire engineer, he should say that a main road was one on which the preponderance of the traffic was from outside the locality that had to support it. Another person's point of view would probably be different.

The President thought the legal definition of the main road would be one of the first things to be dealt with in the case of the operation of a policy of Government control. It would become a question in which the law would require definition.

Mr. Anderson thought they would have to follow the dictum of Dickens and say "the law is a hass."

Discussion adjourned.
But he thought that the results which he had brought forward would show that the designers of machine tools had not been asleep. He thought the trend of commercial engineering had been along the lines of the machine tool builders. As he had stated in the paper, the tremendous amount of work that was being done to provide for the benefit of the people had been the outcome of the ingenuity of the engineer; and the public at large owed a great debt to those designing heads. To a certain extent, the craftsman was being displaced by the up-to-date tools, but certainly costs were being greatly reduced.

The President said Mr. Eady had given them a great deal of material that must prove of use to them. He thought all would agree that engineering in none of its branches could stand where it stood to-day were it not for the progress made by mechanical engineers in recent years.

Discuss'on closed.

THE MAIN ROAD PROBLEM.

The discussion on the paper on "The Main Road Problem" was resumed.

The following contribution from Colonel J. Monash was read:

Both in the paper, and in the subsequent discussion, the necessity for a topographical survey of the State has been referred to; but to judge from the terms of these references, and from similar remarks in other recent discussions of this Institute, it is apparently widely believed that very little has yet been done in this direction. It is, however, within my personal knowledge that a very great deal has been, and is being, done—primarily for military purposes. Mr. Griffiths has alluded to the work recently done in the Kilmore district as a contour sketch of the locality of the camp. This is doing but scant justice to a very minute and detailed and very complete piece of topographical survey work. An area of upwards of 150 square miles at Kilmore, and another of 200 square miles at Seymour, has been very completely mapped, at a scale of 1 mile to the inch, with contours at 50 ft. vertical intervals; these maps not only show, as faithfully as can be done to so small a scale (the same scale as the British Ordnance Survey) the conformation of the ground surface, but also indicate
in detail the whole of the roads of every description, whether metalled, formed, or unformed, as well as lanes and tracks; also all bridges and important culverts; while streams, both permanent and intermittent, as well as gullies subject to storm-water flow during rain have all been indicated. In the matter of completeness of detail, these maps can fairly rank with the best standard of military tactical mapping.

The maps alluded to happen to be the only ones yet multiplied by lithography, but they by no means exhaust the work already performed by the Topographical Section of the Intelligence Corps. As to an area of nearly 2,000 square miles in the immediate neighbourhood of Melbourne, the whole of the matter mentioned, together with many other data of special military value not before alluded to, have been collected in the field, and much of it has already been brought to paper. Doubtless in due course these maps will be made available to the public, just as are the Ordnance Survey Maps of Great Britain; but the work is necessarily slow, and up to the present, although pressingly sought, practically no assistance has been rendered to the Department by the municipal engineers. Of course, it is not to be expected that municipal engineers can spare the time for a complete topographical survey, including contour data, but much help would be rendered if municipal engineers could, in such spare time as may be at their disposal, furnish the following data, taking the zin. to 1 mile parish plans, as published by the Lands Department as the groundwork:

(a) Indicate, by striking out, all roads shown which do not in fact exist as open roads.

(b) Show, approximately to scale, the actually existing road diversions, not already shown on the parish maps.

(c) As to each road, state whether metalled, or only formed, or wholly unformed.

(d) Mark the bridges and principal culverts, stating the materials of construction.

If municipal engineers would co-operate in this way, by dealing successively from time to time with the various parishes
within their shire boundaries, a body of information could be collected, which, on being collated, would form a very valuable topographical record as a basis both for military and other public purposes.

The acquisition of such maps, showing the whole of the road systems of the State, and their physical condition as they at present exist, would be of the most undoubted value in the study of the main road problem. With such maps, the question of the legal definition of a main road would be much simplified, and might indeed be met by a process of actual selection of specified roads in each municipal district, to be proclaimed main roads by an independent authority, such as a Central Road Board, vested with the responsibility of such selection.

Every one must agree with the main contentions of the author, as to the urgent necessity for greatly improving the standard of our principal traffic routes. Motor transport is one of the striking developments of the present day, but its general adoption in this country must be indefinitely delayed, unless the whole problem be grappled with in a statesmanlike spirit.

One further point I should like to allude to, which is clearly associated with the roads themselves, is that of the construction of bridges, culverts, and flood openings. Surely the time has arrived for the final abandonment of the wasteful and extravagant policy of temporary construction in perishable and combustible materials. Such structures, with a life of from 15 to 20 years as a maximum, are really the least economic of all; because on a 4 per cent. amortization basis, their first cost is less than one-half of their capitalised cost. It is profoundly true, at the present day, in most country shires in Victoria, that a large proportion of the available revenue is yearly expended in the repair and replacement of timber bridges and culverts, which have fallen into dangerous decay. If a road falls into disrepair, it does at any rate remain usable without danger to life, but when a bridge or a culvert becomes dangerous to traffic, its replacement is of imperative urgency. This factor is often the principal one in seriously reducing the shire funds available for road maintenance and construction, and it is time that a perpetuation of such an absurd policy should be put a stop to for good and all.
Mr. W. S. Strettle said he had not had an opportunity of reading the paper yet, but on hearing Colonel Monash's remarks about the topographical work, he thought it might be interesting to give his own experience. Last year he had managed to secure the salient facts in regard to about 200 square miles of country. He used the parish plans, mounted, and each plan numbered and cut up into sections of about 10 inches by 8 inches. As he went along he marked the elevations, and took a note of where all the bridges were. He took a few angles, and then it was comparatively easy to make a contour sketch. In a previous parish he found it took perhaps half-an-hour in a day's work to gain information in connection with eight or ten square miles of country. The next time he went along he checked it, and if it agreed fairly closely, he tentatively accepted it. In the course of twelve months he had in that way mapped out 200 square miles of country, so that it was an easy matter for the shire engineer to gain the military information asked for.

Mr. J. T. N. Anderson, in an interim reply, commenting on Colonel Monash's remarks, said there was one point which struck him—that was, the assistance that the shire engineer could give in the matter of a military topographical survey. As things were at present, the engineers employed by the shires had not only no incentive, but also they had very little opportunity. Colonel Monash admitted they had very little spare time.

But something might be done by associating shire engineers with the military authorities. A great deal had been done in Great Britain by associating the ordinary engineers of the country with the military as officers, without subjecting them to drill, but making use of their work. They either got some slight pay or some honour. Honour was a cheap way of paying for a thing; but without either pay or honour it was hardly to be expected that the shire engineer would sit up till midnight compiling topographical surveys.

He wished to refer to the 50ft. contours mentioned by Colonel Monash. They might suffice, but he did not think they could apply to it the words of Colonel Monash, to the effect that it would rank with the best topographical work. In work he had done he had put in 25ft. contours, and where the ground was not
precipitous he had filled it in to 5 ft., in accordance with the usual practice. Of course that was for a map equivalent to 6 inches to the mile. The British ordinance map, with few exceptions, was 6 inches to the mile. There were some cases in which it was only an inch to the mile; but these were the exceptions. Two-thirds of the British maps were to a 3 ft. contour, and France was even more minute.

Mr. R. Fennelly said he thought Mr. Anderson's remarks to the point. In connection with the camp at Seymour the authorities had made a remarkably good topographical plan. He understood from a previous communication from Colonel Monash that the authorities did not get as much assistance from the shire engineers as they were entitled to expect. He understood that it was stated that there had been no response. He was in a position to say that in his part of the country (Kilmore) the shire engineers—two of them—gave all they possibly could, and all the information that was asked of them. He himself was one who did it. He did all he possibly could for his part of the country, and his predecessor at Kilmore did the same. They were asked to supply information as to main roads, closed roads, trafficable roads, etc., and all the information that the engineers could give was given. He certainly must compliment the military authorities upon the excellent plan they had prepared.

With regard to contours, there was a great difference in a short distance in very rangy country. As to Seymour, there was a fall from the public storage reservoir of 800 ft. to the mile for a short distance; 50 ft. contours might there be quite close enough. But if they went down to where the military authorities were at work the undulation of the country was very small, and if they only took a 25 ft. contour they would have very few of them. And lower down, where it fell at the rate of but a foot to the mile, they would not get any in 25 miles. He would like to know how the contours were taken, whether with an aneroid barometer, or in what way. It would be a matter of interest if there were details of this given. He knew of a case where levels were taken on the Goulburn River with an aneroid barometer, and it was found on returning after several days to the starting point that the lower part of the river was, apparently, one foot higher than the upper part.

Further discussion was adjourned.
DISCUSSION—THE MAIN ROAD PROBLEM.

Prof. E. W. Skeats, D.Sc., F.G.S., then described in detail a number of typical examples of rocks and rock sections, illustrating his remarks by specimens, micro., and lantern slides.

Mr. H. S. Summers, M.Sc., followed, with a brief illustrated description of the mode of preparing the sections, and of the machines and methods for testing.

On the motion of the President, a hearty vote of thanks was passed by acclamation to Professor Skeats and Mr. Summers for their valuable and instructive contribution to the discussion.

On the motion of Mr. T. W. Fowler, seconded by Mr. Wm. Calder, the discussion was then adjourned until the next general meeting.

The discussion on "The Problem of the Gauge of Australian Railways," by Mr. Jas. Alex. Smith, was resumed, and at a later stage also adjourned until the next meeting.

At 10.25 p.m. the meeting closed.

DISCUSSIONS.

THE MAIN ROAD PROBLEM.

The President said the first business was the discussion of Mr. J. T. N. Anderson's paper on "The Main Road Problem," the first contribution being a written contribution from Colonel Monash, unavoidably absent, as follows:

Colonel J. Monash wrote as follows:—Mr. J. T. Noble Anderson took exception to the statement in my previous contribution that the work being done in the topographic survey of Australia would rank with the best of its kind elsewhere. This criticism was doubtless based upon a misapprehension of my meaning; for the reference both to the class of work now being done and to the British Ordnance Survey was to map production for military purposes. In this field, as in every other branch of engineering, there must be a compromise between reasonable cost and reasonable efficiency, and after a long period of diversity of view and practice, it has now been established as the settled practice of the Great Powers that for the mapping of large terri-
tories, a scale of about one inch to one mile is as large as is expedi ent or desirable.

The adoption of a vertical contour interval of 50 feet is a necessary consequence of this determination, because experience has shown that in average country any smaller interval would lead to the crowding of contour lines, and consequently to obscurity in the map. The present surveys of Canada, South Africa, Central Africa, Alaska and many other new territories are proceeding on exactly those lines. And this determination has been made with a full recognition of the fact that maps primarily prepared for purely military purposes, are nevertheless available for and are habitually employed by the engineering profession for civil services, and so the question raised is really whether my contention was justified that maps of that description are likely to be of utility to the road engineer.

While no one will deny that a map of two inches to the mile with 20ft. or 25ft. vertical intervals would be still more serviceable, yet the cost of its preparation would be more nearly four times than twice as great, and it would still fall far short of any requirement that the map could be used exclusively, and without local survey, for the final location and final design of engineering works.

I venture to reaffirm, however, what I intended to imply in my former remarks, that the 1in. to one mile map, faithfully prepared, will be a powerful aid to the engineer. Such a map will suffice to determine, with only a small percentage of error, such important matters as catchment areas, positions of valley lines and of ridge lines, location and grading of roads, railways, and water conduits, besides giving valuable information as to the afforestation, cultural features, and distribution of settlement over the area in question. For these reasons the present activities of the Defence Department in the direction indicated are to be welcomed by the profession, and encouraged by their co-operation, as being the best that the State is likely to achieve in Australia for at least a generation to come.

I am glad of the opportunity of saying, in connection with the remarks of Mr. Fennelly, that I regret having in my previous communication omitted to acknowledge the splendid assistance which the shire engineers in the Kilmore district rendered in the preparation of the Manoeuvre map of that area.
The President invited Colonel Owen to speak to the discussion.

Colonel P. T. Owen said he had not given the subject very careful thought, but upon hearing Colonel Monash’s remarks it struck him that for general military requirements, the scale of one inch to the mile did not quite fill the bill. When going into military engineering questions, one required a map of not less than four inches to the mile.

As to the contours, a map of one inch to the mile, with anything less than 50 feet vertical intervals, would be too much covered with the contour lines. He thought that for military purposes one inch to the mile, to give a general indication of the whole country covered, was too small a scale, and the map for military engineers should be to a much larger scale. If the map were four inches to the mile, they could work on 25 ft. contours.

The President said he proposed to depart somewhat from the usual procedure in conducting the discussion, as there were present Professor Skeats, Professor of Geology, and Mr. Summers, Lecturer in Geology at the Melbourne University, who would each deliver a short lecture on the various road metals used locally. They would show something of the petrological and geological states of the materials that were being used in road building. He need not point out to them the great importance to the engineer of that knowledge in the search for economical construction. The pioneer time was passing when materials could be adopted without scientific examination. Now they required exact data.

He would call attention, in passing, to some very interesting information that was appearing in the current “Engineering.” That newly-formed municipal form of control—the Road Board—was laying down lengths of three or four miles of road, constructed by various methods and of various materials—experimental roads. They were recording exactly the performances of those roads, and were expressing the wear of the road in units, based upon the wear per square yard per ton carried. In time, this promised to furnish a record of the very greatest importance.

It seemed to him that the time had perhaps arrived when shire engineers here might, with advantage, make a closer examination of the materials used. Professor Skeats would show them some of the modes that evening.

[Continued under “Lectures,” p. 152.]
DISCUSSIONS.

THE MAIN ROAD PROBLEM.

The President declared the discussion on Mr. Anderson's paper open. He asked if Prof. Skeats had anything to add to his previous contribution to the discussion.

Prof. E. W. Skeats said he had nothing further to say. He had come in the hope that there might be material for him to reply to.

The President said the position was a little difficult. It would seem that the discussion was exhausted, therefore if there were no further contributions the matter must, under the rules, lapse, subject to the Author's right of reply, except upon a direct motion for adjournment. He did not think that Professor Skeats's contribution to the discussion had elicited the comment it was entitled to. It had been only a few days in members' hands. If they considered it as a separate lecture, then it could be discussed at the next meeting.

Mr. W. Calder asked whether Professor Skeats's contribution would be taken as a separate matter.

The President said he thought that could be done.

Mr. F. W. Temple said he had noticed in that morning's paper a reference in the Premier's speech dealing with the main road problem. It was proposed to advance to the municipalities £1,000,000 for the purpose of constructing main roads. It was also proposed to establish a central road board, and divide Victoria up into districts under district road boards. The constitution of the Central Road Board was still to be decided, whilst the district road board would be appointed by the municipalities. The district road board would report to the municipalities and advise them as to how the work in connection with the main roads should be carried out.

He thought the Institute should take the matter into consideration. For instance, the question of the main road boards and the expenditure of the money. They should watch the interests of the engineers, and see that the powers existing at the present time were not encroached upon.
No doubt it would be very nice to have £1,000,000 to spend, and taking the cost of construction at about £10 per chain it would give about 1,200 miles of roads. Taking the net annual value of all the properties in Victoria at the end of September, 1910, if a penny rate were struck it would realise £52,500; the cities in the Melbourne area would realise about £19,247; the cities and boroughs outside Melbourne area, £3,453; and the shires £29,320. The total net annual value of all the properties in Victoria was £12,600,331. This was just a guide to show what possibilities there were with regard to the maintenance of the main roads and the striking of a rate. There was no doubt that was the method they would have to adopt at no very distant future date.

Then there was the question of powers. He thought that it should be taken into consideration.

These were simply a few points suggested to him while reading the report of the Premier’s speech, and he thought it would be well to bring it before the Institute, as others might be led to express an opinion on the subject. He thought they should be very grateful to Mr. Anderson for having introduced the subject.

He considered (in reference to the matter he had mentioned) it would be advisable to appoint a committee to discuss the question and bring up recommendations which might be a guide in the preparation of the scheme. Theirs was a large Institution, and they had members whose experience would be invaluable to the board. For instance, what was the definition of a main road? Take Sydney Road. What portion of that road would they define as a main road? Would they start in Elizabeth Street, or in Coburg, or where? Personally he did not think any road in a city should be considered a main road. If a municipality rose to the dignity of a city it should be called upon to maintain its own roads. These were questions which a sub-committee could deal with very much better than a large meeting, such as the general meeting of the Institute. And they could bring forward recommendations which could be discussed in turn, and each item thrashed out on its merits.

The President said there was a great deal in Mr. Temple’s remarks worthy of consideration. There were a great number
of engineering questions upon which they should be prepared to speak, and possibly if they spoke with united voice they might render very real assistance to the public, and to those who had to carry out the work. If Mr. Temple would either propose the names of a committee to deal with the matter, or move that the Council be requested to consider it, that would be something definite. No doubt action would be taken. Even if Mr. Temple went no further in the matter the Council might take the initiative.

Mr. Temple said he would be very pleased to move that the Council be requested to take into consideration the advisability of submitting a set of questions for discussion. At the present time it seemed that they were not discussing the matter on any direct lines. That, of course, was due to the modesty of the members. Some of the country engineers were not accustomed to speaking much to meetings such as these, and their modesty was keeping them in the background, to a great extent, on account of the magnitude of the question. But he thought if the various items were submitted, and discussed separately, they would elicit some practical information that would be of great value to the municipalities and also to the Institute.

Mr. T. Hill asked if Mr. Temple would add to his motion "with power to act." The Council might feel that they should not act on the motion.

The President said they would not be able to act without submitting proposals to the general meeting.

Mr. Hill suggested the addition "that the Council be not enforced to act."

Mr. Temple said he would leave it optional with the Council. He did not wish it to go forward as an absolute instruction that the Council bring forward recommendations.

The President said he understood that there was a motion that the Council be authorised to consider the matter and draft recommendations. He understood that Mr. Hill suggested that the motion be extended in its scope.

Mr. Hill said he did not wish it extended. He would have it go forward subject to that limitation.

The President said Mr. Temple's motion was "that the
matter be referred to the Council for consideration and report to
the general meeting."

Mr. T. Hill seconded

Mr. Temple said unless there was something definite brought
before the meeting the subject was likely to lapse. The matter
was not receiving the consideration that it deserved. If the
Council brought forward a set of proposals each subject could be
discussed in its turn, and would elicit a far better discussion than
by going about it in the conversational manner that they had been
doing.

Mr. Hill said the point was the question whether they should
spend £1,000,000 on roads or railways. He wanted to bring the
matter forcibly before the Institute, and was supporting the pro-
posal to place it before the Council. But if it meant they were
to support the spending of £1,000,000 on roads as against rail-
ways he was against it.

The President said the proposal was that the question be
submitted to the Council for consideration, and, if the Council
so decided, for report to the general meeting.

Mr. W. S. Strettles thought it would be advisable to get the
opinions of members generally either by circular or through the
Proceedings.

Mr. Hill asked if that closed the discussion on the main
road problem.

The President said that was a separate question. They
would deal with the motion first, and then the other question
would be in order.

The motion was then put and carried.

The President said that it was to be hoped that individual
members would convey their views to the Council. It would be
of very great advantage.

Mr. Hill would now be in order in submitting a motion either
to continue the general discussion on the Main Roads Problem,
or to terminate it subject to the Author's right of reply.

Mr. T. Hill moved, and Mr. W. S. Strettles seconded, a
motion that the discussion be postponed until the next meeting.
Carried.
DISCUSSION—THE MAIN ROAD PROBLEM.

COMMONWEALTH OF AUSTRALIA.

Department of Home Affairs,
Melbourne, 18th December, 1911.

Sir,—

I am considering the appointment of assessors in connection with the Competitive Designs for the Federal Capital city which have been invited returnable not later than 31st January next. It is proposed that the Board shall consist of an Engineer, an Architect, and a Surveyor, and I shall be glad if your Institute will be good enough to suggest the name of an Engineer, a non-competitor whose nomination to the Board would be acceptable to the profession and who has not been in any way connected with any competitor.

I enclose a copy of the printed conditions in connection with the competition, and would invite attention to clauses 12, 13, and 14 thereof.

Yours faithfully,

(Signed) KING O’MALLEY,
Minister for Home Affairs.

The President,
Victorian Institute of Engineers,
57 Swanston Street,
Melbourne.

Received after date of meeting.

DISCUSSIONS.

THE MAIN ROAD PROBLEM.

The President declared the discussion upon Mr. J. T. N. Anderson’s paper open.

Mr. A. C. Mountain said he had not had time to carefully read the paper, but the general impression he had received from the paper was one of pleasure. He thought it was a very admirable paper, and dealt with matters very much in advance of those of a previous paper read by the same author.

There being no further contribution, the discussion was declared closed, subject to the author’s right of reply.

Mr. J. T. N. Anderson’s reply has been received, as follows:—

Since replying hurriedly and verbally to Mr. Fowler’s query, “What is a Main Road?” the Author has given the matter more consideration, and is confirmed in the view then expressed that no satisfactory definition can be given either in statute or by any court—and consequently the solution of the difficulty will best be met by an authoritative classification, just as shires are now
classed as first-class, second-class, etc. Such classification would naturally follow a census of the traffic on the principal roads.

In cities such census is sometimes made by the police. Clearly in any serious attempt to solve the main roads problem it is a factor of the utmost importance, and will require careful collating of information which must be supplied in a very minute and detailed manner, just as merely an enumeration of vehicles under two or three different headings would give unsatisfactory results.

This road census, however, will only touch half of the problem —namely, the relative importance of the roads at the time it is taken. To determine what will be permanent main roads, as has been argued in this place almost "ad nauseum," it is necessary to have a far more detailed topographical map of the State than any now existing. The excellent topographical maps of the Mines Department have been referred to by Mr. Griffiths, and Mr. Fowler mentioned how valuable they are for the shire engineer. It is evident from what Colonel Monash has said, that we will not get the type of map we want from the military authorities. Consequently we are thrown back entirely on the State. If the Agricultural Department would do for the agricultural areas what the Mines have done for the mining areas, another step would be taken in the right direction. Clearly, yet another step which is most urgently needed is a large increase of the Survey Department to enable topographical surveying to precede the alienation of all Crown lands.

These things should be put in hand at once, and gone on with vigorously, and in time it will be possible to definitely fix the routes of the permanent main roads for this State. In the meantime the present Government promise a Main Road Scheme to cover an expenditure of £1,000,000, and statistics are being prepared to show how such money will be best spent. At first the Author was aghast at the utter inadequacy of the sum named. No doubt, when completed, the statistics now being prepared will show that the shires estimate three (3) or four (4) times this sum to be required for urgent works. And it will be in the memory of many here that twenty years ago the Government of the day gave an annual municipal subsidy of nearly half-a-million (£450,000), and most of this was sunk in temporary works, such as wooden culverts, and too lightly metalled roads, and the danger now, as then, is that with so inadequate a sum as one
million made available for so vast a need, it will be largely spent in the same manner. On further thought, however, there is great comfort in the moderation of the proposal, because, assume that five millions instead of one were mentioned, then the position would be that which has proved so wasteful in the past, many roads would be made in haste, which would, within say twenty years, have to be abandoned for new routes.

For instance, in one place the Author has just completed, at a cost of over £600, a deviation, which is the third relocation of an important main road. This means a terrible waste of effort due largely to the pioneer engineers not having had a topographical survey before the work was put in hand.

It is to be hoped that a fair share of the £1,000,000 to be spent on main roads will go to the provision of proper road-making plants, and more especially road rollers. The number of shires which, according to Mr. Calder, should be wiped out of existence because they are too mean to provide even a horse-drawn roller, is great; in fact, probably the majority of the shires persist, in spite of the advice of their engineers, in worrying along without a road roller of any kind. Then, too, a great deal can be done by the Government to test the quarries, and facilitate the reserving of really useful quarry sites, in addition to, or in some cases in exchange for, existing quarry sites.

One consequence of the unsatisfactory method of road-making is that a great amount of blinding has to be put on the roads, by the maintenance men, and in many cases that excess of greasy mud so much complained of by Professor Skeats and Mr. H. S. Summers is largely due to the unsuitable material used for blinding. This is a fact that would not readily be noticed by a chemical or physical test, because it is a common thing to find the surface soils of almost identical chemical constituents to the rocks beneath or adjoining.

As to the objection to wide wheels, that they are liable to side skidding to a dangerous extent this difficulty can be removed by lowering the centre of gravity of the load. This will of course mean smaller wheels, but the objections to these, that they require more traction, and are damaging to the roads, will be found to be less in effect than a mathematical consideration of the problem would lead one to expect. This, because no mathematical theory has yet been brought into the shape of a
formula of which the distribution of the stresses in the road bed itself is a factor.

Motor Traffic.

The Author verbally said that shires can at a slight increase in the cost of their works make the roads attractive for motor traffic. The following are a few of the headings under which these improvements are needed:

1. The abolition of open water crossings.
2. The introduction of wider curves, with as level a grade as possible.
3. Where curves exceed 1½ chains radius the introduction of the saucer track (cant) principle, as advocated by the Author in his paper (May, 1910); for sharp curves, see figures 2 and 3.
4. The proper rolling of the metal, and the abandonment of all materials except rotten rock or tarred sand as a blinding; the tar being forced in after the final rolling of the metal, and again after the first rolling of the blinding.

There are several remarks which were made in the discussion which are pregnant with meaning, and deserve following out if time were available. For instance, Mr. Fowler’s calculation that the revenue available would about make the existing roads good in two hundred years. On investigation it will be found that in many shires the rate of deterioration exceeds the rate of improvement, at least during the past dozen years, and consequently the roads are in the aggregate getting worse instead of better.

Another instance was Colonel Monash’s reference to the need for more permanent works. This is a subject worthy of many separate papers. But some mention should be made to the yeoman service done by the last Surveyor-General, Mr. Wm. Davidson, in the introduction of permanent concrete or Monier structures in place of wood, wherever practicable. The officers of the Department seem still as anxious as ever to push this policy, but they are, like the shire engineers, powerless before a short-sighted wave of public opinion.

In conclusion, the Author is eagerly looking forward to the testing laboratory which Professor Payne has promised, and ventures to suggest that a printed form be supplied to the shire
engineers to return with the rock they may submit, which will set out all the particulars of the sample, and the quarry whence it came.

Discussion closed.

THE PROBLEM OF THE GAUGE OF AUSTRALIAN RAILWAYS.

The discussion on the President's paper was resumed.

Mr. A. C. Mountain said he was afraid that nothing approaching an impartial and just decision on that important matter could be hoped for until some assurance was given by the Commonwealth Government that the particular State which would have to undertake the alteration would not be at the loss of such alteration, because that would mean a very cruel tax on that particular State. Until that assurance was given he doubted very much if the professional officers—the men to whom they would look as experts—would be able to give an unbiased opinion as to what was the best thing to do. Whereas supposing they knew that it was a matter the cost of which would be borne by the Commonwealth, they would be free to give an opinion, even though it might be adverse to the State which employed them. They could not expect an engineer who had been engaged for a number of years by a State to immediately say that the gauge adopted by that State should be abandoned, and the gauge adopted by another State taken up. All that would be removed if it were explicitly stated that the expense of the alteration would be a national one, instead of being left in uncertainty. It was essential that they should get the best expert opinion in the matter, as it affected not only the present but the prospects and prosperity of the whole country. Therefore it would be foolish to start without getting an unbiased opinion.

The President, in replying to the discussion, said it was within his knowledge that it had been put forward that a condition precedent to the adoption of any particular gauge should be the laying of the foundation for the subsequent adjustment of the cost of that gauge. That course had not met with the approval of the powers that be. But such a course would be necessary to secure an impartial and a just decision from Departmental officers.
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Anderson, Joshua Thomas Noble

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The main road problem (Paper & Discussion)

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