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Developmental Work in the Wheat-growing Areas of New South Wales.

An analysis of the results of expenditure on railways and roads in the wheat-growing districts during the past twenty years, with suggestions for further developmental works if found on other investigation to be economically desirable.

By A. G. Close, L.S.,

Investigations Officer.

INVESTIGATIONS have been carried out and are now proceeding in regard to the influence of the Board's operations on the development of the State, the object being to ascertain to what extent and under what circumstances the construction of developmental roads can be undertaken to the best advantage. In pursuance of this object, past operations have been reviewed to ascertain, if possible, the effect on development of construction works carried out from Developmental Roads Funds. Consideration of this matter must necessarily take into account first of all the conditions obtaining in the areas affected at the date when a definite policy of road construction to assist development was first entered upon; and secondly, the extent to which other factors have operated to bring about the amount of expansion that may be found to have taken place.

A very brief examination of the position is sufficient to show that it will be a matter of the greatest difficulty, if not altogether impossible, to discover how much of the development of a district is due to the improvement of road access and road transport facilities over a given period in individual cases. Probably the only case where this could be approximated would be the case of an area of country which, owing to the total absence of means of access, was non-productive. In this instance the whole of the development following on the provision of road access could perhaps be attributed to such provision, so long as all other surrounding conditions remained unaltered. It need hardly be said that such a case does not exist, and it is instanced only to illustrate how different are the actual conditions with which it is necessary to deal. Although a few cases in which developmental road construction has been carried out may have approximated the conditions mentioned, in so far that production was near the minimum, other conditions, such as ownership and occupation, means of transport and markets, have all influenced the development of these areas in different and varying degrees. In every

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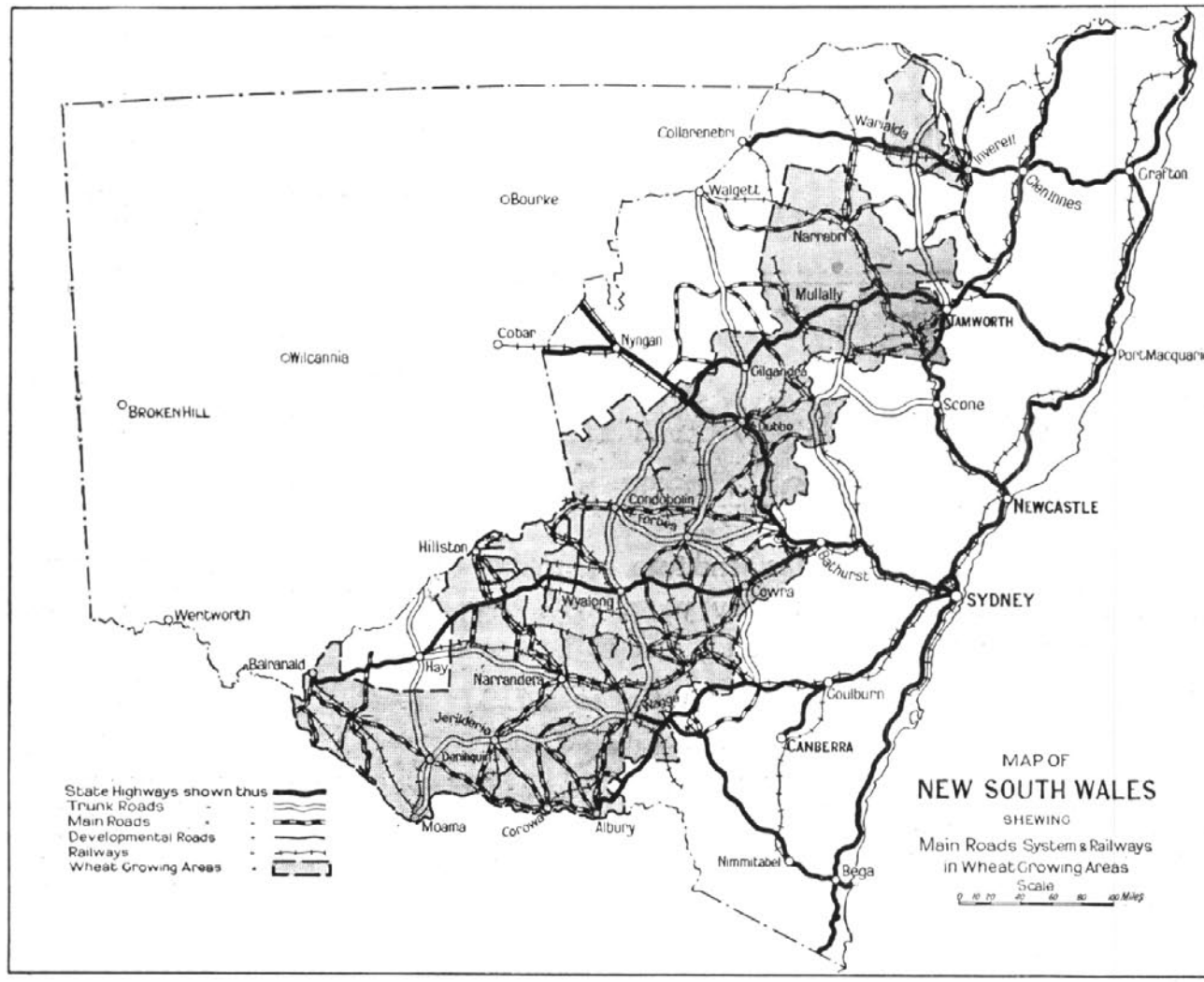
case the area served, at date of proclamation of the road, was already provided with access of a kind, and the holdings were already developed to a greater or less degree. In these circumstances it is apparent that a measure of the influence of the road improvement on subsequent development could only be obtained after the most exhaustive investigation over a very wide field, embracing the many contributing factors, or a searching personal inquiry into the reasons actuating the various individual landholders in the operations undertaken by them.



Notwithstanding the difficulty of obtaining concrete and tangible information from inquiries along these lines, it is still possible, by comparing present conditions with those previously obtaining, to gauge something of the effect of developmental road construction in certain cases, and information in respect of these is now being compiled and analysed.

Developmental road construction has only been carried out as a settled policy for about five years, and, in view of the influence of other factors, such as markets, seasonal conditions, &c., sufficient time has not elapsed for the full results of the road improvements to become evident. It was considered desirable, therefore, as a preliminary to consideration of the effect of developmental road construction, to review the general position in regard to development over a longer period. With this object, investigations have been carried out to ascertain what expansion has followed public expenditure on developmental works generally during the past twenty years. The accompanying diagrams have been prepared from information contained in the Statistical Register, to show graphically the position in regard to the wheat and wool industries.

Expenditure on Developmental Works in Wheat-growing Areas.—Very little public expenditure has been incurred with the direct object of developing the sheep and wool industry. The wheat-growing industry, on the other hand, has been specially selected for development by means of new railway lines to open up suitable country. Figure 1 shows the amount of public expenditure on developmental works in wheat-growing areas only, i.e., within the

area indicated in the accompanying map, during the twenty years ending 30th June, 1929. Such works include railways and roads (and bridges) only. Expenditure on works such as water conservation and irrigation, which have not a direct influence on the production of wheat, or on any works outside the wheat-growing areas, has been excluded. The total expenditure incurred within the area under review for the twenty years was approximately £13,677,700. Of this total, the cost of railway construction amounted to about £7,494,000. The remainder, £6,183,700, is made up of the combined amounts expended by Shire Councils (including Government grants), by the Public Works Department, and latterly the Main Roads Board also. The

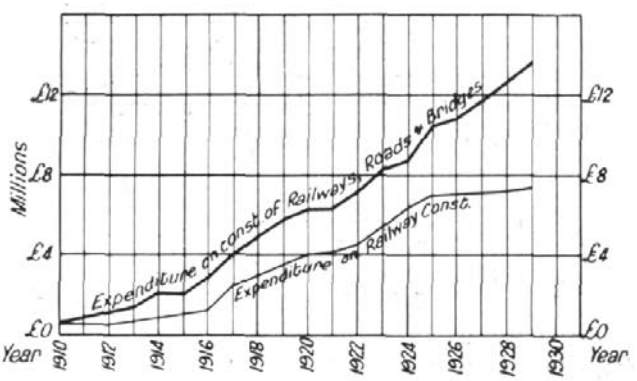


Fig. 1. Graph showing public expenditure on developmental works in wheat-growing areas. Data relating to years previous to 1910 are not available.

amount expended on railways is the construction cost of new lines only, while the expenditure on roads and bridges is the total for construction and maintenance on all roads, including those in areas served by railways constructed previous to 1910.

Wheat Production.—The yearly area under wheat, i.e., the area harvested for grain, excluding areas cut for hay, is shown in Figure 2. In this diagram the influence of the periodical droughts to which the wheat-growing areas are subject is very clearly indicated. The area harvested in the year ending 30th June, 1910, was 1,990,180 acres, and for the year ending 30th June, 1930, the area was 3,902,200 acres, a nett gain of 1,912,020 acres, or nearly 100 per cent. It will be observed, however, that from 1910 to 1916, during which period an amount of £2,809,770 was expended, there was a very decided increase in the area sown. From 1916 onwards, allowing for seasonal conditions, while expenditure was incurred at an ever increasing rate, the area cultivated dropped again, and remained stationary about the 1914 level until the year 1928. Subsequent to that year a very marked upward tendency is again evident, culminating in this current season's record of about 5,000,000 acres under wheat.

After making due allowance for the fact that the area placed under crop in 1915 was abnormally large, owing to a special war effort, the position still remains that, with the facilities then existing, an area of 4,188,865 acres was harvested, and it is reasonable to suppose that that did not represent the ultimate limit of production in the areas then opened up. Although the upward curve representing expenditure subsequent to 1916, is influenced by the decreased purchasing power of money as compared with preceding years, the diagram shows that the works carried out, mainly with the object of bringing an increased area under wheat, failed—up to this present season—to produce that result. It is of interest, however, to observe that the average yields show a more sustained increase during recent years. It is difficult to determine the extent to which seasonal conditions have contributed to this

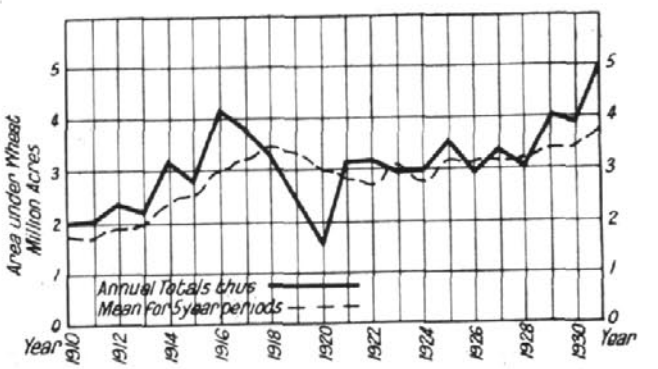


Fig. 2. Graph showing area under wheat, i.e., the area harvested for grain, excluding areas cut for hay.

result, but the fact may be taken to indicate something of the beneficial influence of the Agricultural Department's activities in the direction of improving the individual and aggregate yields per acre.

It is certainly true that many areas, which formerly were without the transport facilities necessary for the production of wheat, are now being used for that purpose. It is also true that, by reason of the expenditure on developmental railway construction, the State has been enabled to dispose of a considerable portion of the Crown estate, and thereby assist the revenue; but, so far as the community is concerned, the practical benefit resulting from these operations does not appear to be commensurate with the expenditure and liabilities incurred.

In face of the fact that new land has been brought under cultivation, that new communities have come into existence, and new towns, which are almost entirely dependent on wheat-growing, have been established, the position can only be accounted for by a cessation of wheat-growing on areas adjacent to the older railway lines. The question arises then—To what use have these former wheat areas been put, and has some other form of production been carried on that would compensate for the transference of wheat-growing to more remote parts? As a general rule the only other industry that could be carried on in a large way on such areas is the

sheep and wool industry, and figures relating to wool should form a fairly reliable guide as to any compensating increase in that form of production.

An examination of Figure 3, showing the number of sheep, and Figure 4, showing the weight of wool produced for each year since 1910, indicates that, while there was a downward tendency in the number of sheep and in the wool produced during the years 1910-1916, corresponding with the marked increase in wheat production during those years, there is no evidence of an increase in wool production during subsequent years that could account for the low wheat production. The failure of developmental works to bring about the desired increase in wheat production cannot be attributed to unsuitability of the land, or to adverse climatic conditions in the new areas. In every case where developmental railway lines have been constructed, the areas served have commenced almost immediately to produce wheat. This gain, however, has been accompanied by a loss elsewhere. The

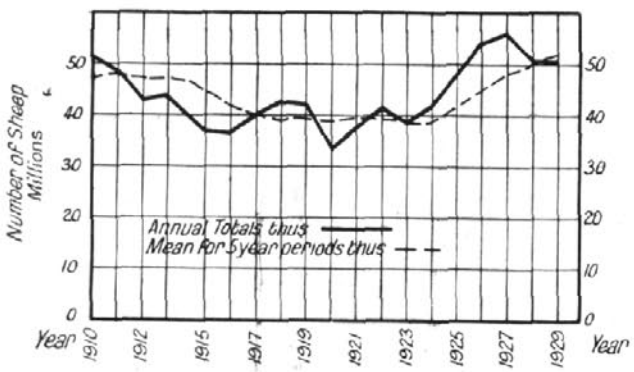


Fig. 3. Graph showing number of sheep in New South Wales.

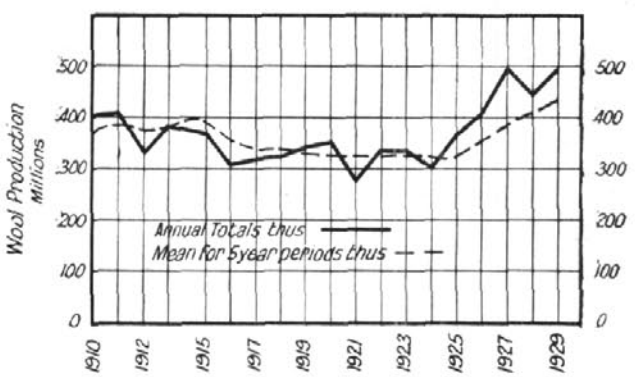


Fig. 4. Graph showing quantity of wool (in millions of pounds) produced annually.

inevitable conclusion, which is borne out by observation, is that wheat-growing is carried on, both in the old and the new areas, only in the most favoured situations. That is to say, only the best of the land, and that most favourably situated in respect of access to rail, is used regularly and continuously for this purpose.

Hence, it may be said that, since 1916, the position has altered only to the extent that the State's wheat crop is now gathered over a much wider field at greatly increased cost. In effect, the State has provided a greatly enlarged system of transportation for the conveyance of the same (or less) quantity of produce; and, at the same time, has added greatly to its obligations to provide other services and instrumentalities necessary for the settlements newly established.

Various reasons have been assigned for the non-expansion of the wheat industry. It is safe to say that it is not due to any single cause, but to a combination of adverse conditions under which the returns from wheat-growing have not been sufficiently attractive to encourage expansion. The construction of new railway lines, while making wheat-growing practicable on new areas, does, not, ordinarily, improve the conditions under which wheat is produced, and by itself the railway does not meet all requirements for the transport of wheat. The feeder road is also essential.

If reference is again made to Figures 1 and 2, it will be seen that in the period 1910-1916, during which a steady and considerable increase in the area under wheat is observed to have taken place, the expenditure on the railways completed during the 7 years (£1,547,300) was little more than half the total expenditure. That is to say, an almost equivalent amount (£1,262,000) was expended in providing or improving the roads of access and intercommunication. The length of railway constructed during this period was 332 miles. From 1916 to 1925, about 854 miles of new railway was provided at a cost of about £5,465,200, while only £2,587,200 was expended on the roads of access, &c., including expenditure in areas adjacent to the older railways. During this time no further expansion occurred. From 1925 to 1929 the cost of the new railways opened was only about £481,500, while the amount spent on roads, bridges, &c., was £2,562,600. Although no material change occurred during the first two years of this period, a very considerable expansion has taken place since 1928, the area under wheat having increased from about 3,000,000 acres to 5,000,000 acres.

It need not be concluded that this increase is the direct result of the increased expenditure on road improvements. It may be due in part to an attempt by many wheat-growers to overtake arrears resulting from the previous sequence of bad seasons, and partly to a variety of other causes. The fact, however, that the increase has followed so closely and in such marked manner on the carrying out of a definite policy of road construction and improvement is certainly very significant. It has been stated that the construction of developmental railways does not by itself improve the conditions under which wheat is produced. The road, however, has a very direct influence on those conditions where railways have been provided, and more so now than in earlier days. Previous to 1916, conditions affect-

ing wheat-growing, though worse in many respects than in following years, compared more favourably with conditions affecting other occupations and industries than has since been the case. The greater expenditure on road improvement in recent years has improved the conditions in two important respects—by providing better and cheaper facilities for the carriage of wheat, and by improving the social conditions of the people engaging in the industry. There does not appear to have been any notable improvement in the conditions other than those mentioned. *It, therefore, seems to be a reasonable conclusion that a considerable proportion of the recent gain is due directly or indirectly to road improvement, and that developmental road works generally have played a very important part in bringing about the development that has taken place during the past few years.*

Developmental Road Works undertaken since 1925.—A definite policy of developmental road construction was entered upon in the year 1925. In pursuance of that policy, the Board has recommended for proclamation as developmental roads only those acting as direct feeders to the railways. This will be seen on reference to the accompanying map. Up to 30th September, 1930, a total amount of approximately £435,060 had been allocated to Councils for expenditure on proclaimed developmental roads in wheat-growing areas. A length of 366 miles of clearing has been done on roads which formerly were in their virgin state or nearly so, thus providing that modicum of accessibility essential for the carriage of wheat. A length of 354 miles, including parts of the length last mentioned, has been formed and for the most part gravelled. Altogether clearing and/or forming and gravelling has been carried out on a length of about 575 miles of road, and it is estimated that with the lengths constructed previous to 1925, about 800 miles of these roads have been placed in a condition suitable for the requirements of traffic. This length is distributed over seventy-eight proclaimed developmental roads.

In considering these figures it must be borne in mind that they relate to roads specially singled out for their developmental significance; and it is reasonable to suppose, therefore, that the expenditure thereon has contributed in no small measure to the increased production. The effect of developmental road construction is not limited to the areas served by these roads. As a result of such works, and expenditure by the Board on main roads, the Councils concerned have been relieved of certain expenditure on the roads affected, and in many cases have thus been enabled to effect greater improvements on ordinary shire roads with considerable additional benefit. Further, while the chief stimulus to production has been to wheat, other forms of agriculture, as well as wool growing and fat lamb raising, have also benefited.

To What Extent is Further Developmental Road Construction Warranted in Wheat-producing Areas.—Public expenditure on developmental works can only be justified on the basis of anticipated profitable return to the community either directly or indirectly. The foregoing review of the effect of developmental works carried out in wheat-producing areas shows fairly conclusively that while expenditure in those areas was mainly confined to railway construction, it was not fully effective, but when supplemented by the necessary means of road access and intercommunication the position improved greatly. Developmental railway construction, in the past, has not been accompanied by any deliberate or orderly improvement in the roads giving access to the railways, and notwithstanding the substantial improvement effected during the past five years, the feeder roads generally are still totally inadequate to the needs of settlement in many districts. In the year ending 30th June, 1929, there were 121 railway stations in the area under review at which more than 20,000 bags of wheat were loaded. There were thirty-eight railway stations or sidings at which only from 5,000 to 20,000 bags were loaded. Allowing that at least two roads of access 10 miles long on the average are required for each of these 159 railway stations, 318 roads of a total length of about 3,200 miles would be needed for the carriage of wheat. The actual mileage is undoubtedly greater, but allowing for a length of about 800 miles of developmental road placed in good trafficable condition, and probably about 800 miles of ordinary shire roads in fair to good trafficable condition, there is a length of not less than 1,600 miles in more or less urgent need of improvement. *Provided, therefore, broad economic considerations, involving the questions of profitable marketing and the ability of the State to finance works, indicate that it is desirable in the national interest that the present rate of wheat production shall be increased, or perhaps merely maintained, and that this can best be secured by additional developmental works, the beneficial effect of developmental road construction so far carried out would appear to warrant an extension of the policy along the same lines.* It cannot be too strongly emphasised that, before coming to any decision in regard to any developmental programme, it is of the greatest importance to determine firstly, whether, in view of the prevailing depression and the apparent over-production of wheat, an increase of wheat production is warranted, and secondly, if this is so, what form of encouragement, if any, is necessary. This is fundamental to the national welfare, and can only be decided upon considerations outside the Board's purview. The most that this analysis can be said to demonstrate is that, *should it be proved that improved road facilities are an essential factor in the economic solution of the wheat-growers' difficulties, then this can best be brought about by the extension of the developmental road programme.*

Future Developmental Road Work.—Presuming for the moment that further improvement of developmental roads is necessary, the question then arises as to how this may best be achieved. In order that the maximum immediate benefit may result from the expenditure of any funds that may be provided, it will be necessary to make such

moneys go even further than previously, and to adopt either a modified standard of construction or a modified method of achieving the ultimate standard. This is apart from the efforts that are continually being made to provide suitable types of roads at lower and lower cost. In other words, the works to be carried out should, I suggest, be limited to the minimum necessary for present requirements, subject to the condition that all works below the standard of ultimate requirements should be in the nature of stage construction, and on the permanent location of the road. In the wheat-growing districts the average annual rainfall ranges from about 13 inches to 27 inches, and the average number of days on which rainfall is registered ranges from about sixty to eighty-five. The months of lowest rainfall are from November to February inclusive. It is unlikely, therefore, that the carriage of wheat would be seriously interfered with as a result of wet weather alone. In these districts, particularly on the red soil (which comprises by far the greater part) an earth formation, properly constructed and maintained would probably meet the essential requirements, in the case of a great many roads, for many years to come. Where gravel is necessary, its thickness should be the smallest possible compatible with the loads to be carried. Causeways also might be generally adopted in place of large culverts. In many cases a variety of conditions will be met with on a particular length of road, and in such cases different classes of work might be applied to the different conditions as they occur, even though this should result in, say, short lengths of gravelled road separated by lengths of earth formation or clearing only. In the case of every class of work maintenance would have to be insisted upon. In such ways an endeavour could be made to reduce the average cost of construction to not more than £500 per mile. Such low cost work as that contemplated would, it is thought, need to be financed from revenue rather than loan, as it would be difficult to guarantee such maintenance subsequently as to ensure that the work undertaken would not, in some cases at least, be dissipated before any loan so used was repaid.

Although these methods would not be the most economic methods of construction, considered solely from the point of view of the ultimate cost of the road—since the total cost of additional forming or gravelling on broken lengths would exceed the cost of complete initial construction—they appear to present the only means whereby an attempt could be made to deal with the position under the present difficult conditions in regard to finance. This would make practicable a very great increase in the area under wheat, without the need for breaking any new ground by means of further railway construction, and would consolidate the position by making the roads of access to existing railways reasonably trafficable. Then, as development takes place, the land, or the produce thereof, should provide the means for additional improvements as they become necessary.

Present conditions in wheat-growing areas seem to require that a fairly liberal interpretation should be placed on the term "developmental" as applied to road construction. It is not now so much a matter of providing for new settlement as of preserving the settlement already in existence; and the availability of new land suitable for wheat-growing, in my opinion, should not be an essential requirement to render a road eligible for proclamation. In present circumstances the test should be the condition of the means of access; and where this is below requirements, and beyond the power of the local Council to improve, the road, or certain parts of it, might with advantage be proclaimed or otherwise rendered eligible for assistance from developmental road funds. It is also suggested that any improvements, beyond those necessary for the minimum requirements of the area, should only be undertaken on a contributory basis—a proportion of the cost being provided by the benefited landowners.

Another aspect of the matter which calls for consideration is the distance from rail to which developmental road construction should be extended. In this regard there is something to be learned from experience in connection with developmental railway construction carried out in the past. Statistics, as has been demonstrated, indicate that an extension of the railway lines into new territory does not result in an aggregate increase in production unless it is supplemented by additional facilities for access. It is very probable that somewhat similar results would follow an undue extension of road construction. As with the railways, the best results should be obtained from developmental road construction if the subsidiary feeders receive attention at the same time. In wheat-growing districts, as a rule, this would require nothing more than clearing, and it should be a condition precedent to any extension of developmental road construction that the minor feeders to the length already constructed should be rendered trafficable by the Council; otherwise, except in special cases, the extension should be regarded as premature. Under any circumstances, it does not appear to be advisable, for the time being, to carry the construction of developmental roads beyond 10 or 12 miles from the railway, unless they act also as connecting links in the general road system. Cases have been noted where wheat has been carried 26 miles to rail by motor lorry for £1 a ton. It is not likely however, that the market price will permit of 6d. a bushel being paid for road transport. The position is influenced, of course, by the land values, but as a general rule 3d. a bushel road carriage is about as much as can be paid as a regular thing unless prices improve considerably. It would appear preferable, then, to give attention to another road rather than extend construction beyond about 12 miles from rail on ordinary developmental roads. Future conditions will probably warrant extensions beyond that distance, but at present such extensions would be made at the expense of some other locality where the prospects of success are more certain.

The Construction of the Hume Highway between Cross Roads and Narellan.

By G. Hall, B.A. (Oxon.),

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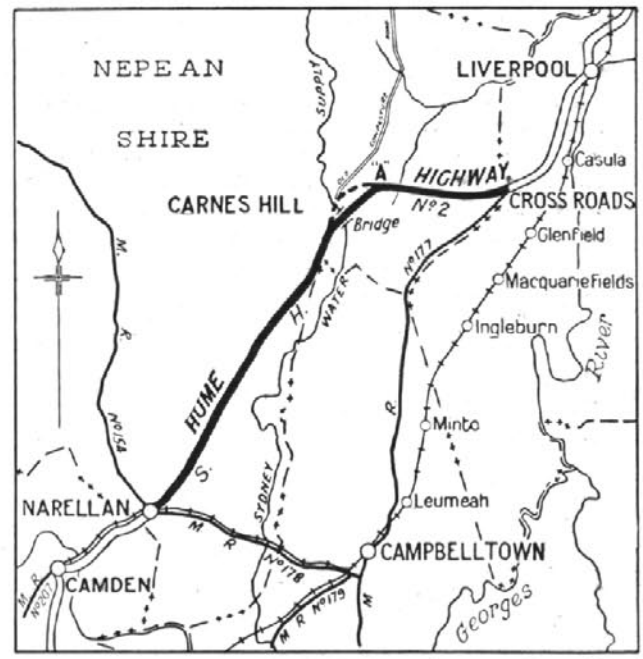
THE chance discovery in 1795 of sixty head of wild cattle grazing in the peaceful valleys on the west side of the Nepean, near where Camden now stands, and their subsequent rapid increase to as many as 5,000 in 1812—the descendants of those first seven which were brought to the colony with the first fleet in 1788 and promptly strayed into the unknown—drew attention to the possibilities of this quarter of the new land as pastoral country. Many early settlers, therefore, who received grants of land turned their steps in this direction and selected their holdings in the vicinity of the "Cowpastures," as the 15,000-acre Government reserve was called. This part of the colony thus became associated with the names of the Macarthurs of Camden Park, with their Merino sheep, the Rileys of Raby with their Saxons, and many others who played a prominent part in the early development of the pastoral industry in New South Wales.

One may note, too, that Naralling, from which the neighbouring village of Narellan takes its name, was granted in 1821 to William Hovell, who in 1824 accompanied Hume (after whom the Great Southern Highway has now been named) when he set out from Appin on that first memorable overland journey to Port Phillip.

The wild cattle on the Cowpastures figure frequently in the despatches of successive Governors—Hunter, King, Bligh, and Macquarie—for these rapidly increasing herds appeared to represent a considerable asset to the colony. They were, however, exceedingly wild, and required elaborately organised efforts to tame them, resulting in the establishment of a series of taming stations, of which the chief was at Cawdor. Moreover, they were not an unmixed blessing, as they provided ready sustenance for escaped prisoners who took refuge in the locality.

In the first years of the colony, the main southern route from Sydney Cove and Parramatta ran by way of Prospect, Carne's Hill, and Narellan to Camden, as those localities came to be called, and took its name from the Cowpastures. While the road between Carne's Hill and Narellan remained a portion of the main southern route, after a comparatively brief era the importance of the portion between Prospect and Carne's Hill waned with the discovery of what appeared to be more inviting lands west and north, and with the adoption of the southern route through Liverpool, Cross Roads, and Carne's Hill. This then remained the chief avenue for traffic southward till the reconstruction of the longer route via Campbelltown, shortly before the passing of the Main Roads Act.

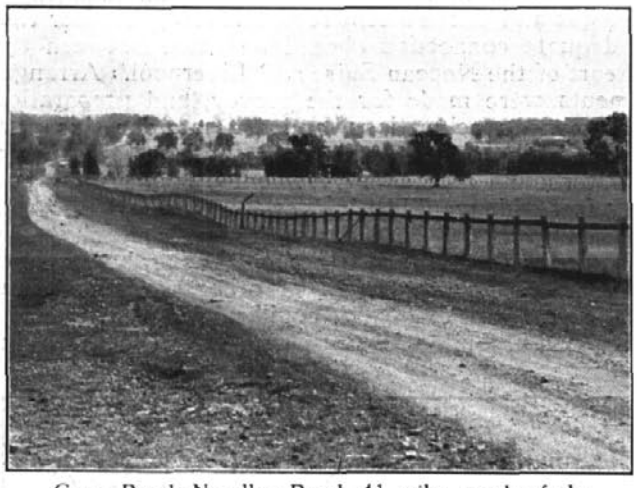
In April, 1925, representations were made to the Board by the Nepean Shire Council to have that section of the Great Southern road between Cross Roads and Carne's Hill reconstructed, in order that adequate connection should be made between the heart of the Nepean Shire and Liverpool. Arrangements were made for the survey, and preparation of plans, specifications, and estimate for this purpose. The original proposals contemplated that a waterbound macadam pavement 9 inches thick and 15 feet wide would be laid, as this was considered to be sufficient for the needs of the traffic which it was immediately designed to serve. Owing, however, to the more urgent claims of other works, a commencement of this work could not be authorised at that date, and assistance was confined to maintenance.



Locality sketch of the Hume Highway between Cross Roads and Narellan. The old road at Carne's Hill deviation is shown dotted at "A."

At a conference of Interstate Road Authorities held in Melbourne in February, 1926, it was decided, as reported on page 59 of the Board's First Annual Report, that, with a view to the adoption of common principles and standards on main road works throughout the Commonwealth, the width of metalling or gravelling on the great trunk highways throughout the Commonwealth should be 20 feet. The road which had been constructed prior to the commencement of the Main Roads Act, via Campbelltown, and round which the southern

traffic was being by-passed, had a width of pavement of only 18 feet, and would have required to be widened to conform to the standard. As the Great Southern road proper was also 3 miles shorter than the road via Campbelltown, the Board decided on the 27th May, 1926, that, instead of confining the construction of the pavement on the Cross Roads-Carne's Hill road to that which would be suited to farm traffic, it should be built to a width of 20 feet and in a class of construction suited to carry main highway traffic. This would allow the



Cross Roads-Narellan Road, 4½ miles south of the water-race, before re-construction.

road, when the construction extended to Narellan, to resume its proper position as part of the Great Southern road, while the early construction of the length between the Cross Roads and Carne's Hill—irrespective of any extension to Narellan—would give the relief which the residents of Nepean Shire were urging should be afforded them. The saving to through traffic in operating costs to road users, when the whole section from the Cross Roads to Narellan was completed, promised to be large, due to the reduction in distance of 3 miles from the longer route via Campbelltown. For example, if the through traffic between Camden and Sydney using the shorter route was 400 vehicles per day, the annual saving to traffic at 6d. per vehicle mile would be £30 per day, or £10,950 per year. In actual fact, however, the traffic on all the main roads was then increasing rapidly, and the through traffic between Sydney and Camden—neglecting that which proceeds to Appin and Bulli—had by 1929 reached an average of nearly 600 vehicles per day.

A commencement of the work was made at the Cross Roads on 10th November, 1926, the class of construction adopted being a Telford foundation of sandstone 8 inches thick, covered by a wearing course of 3 inches of premixed bituminous macadam. Timber edge pieces were added at a later stage to reduce the cost of edge maintenance.

Up to the stage when New South Wales entered into the Federal Aid Roads Agreement with the Commonwealth, it was possible to consider the construction of only the section between Carne's Hill and the Cross Roads, i.e., the length of which the reconstruction was demanded (although not to such a high standard as was being laid) for local purposes. With the signing by the State of the agreement on the 17th June, 1927, a new phase was entered upon. The emphasis laid in the agreement on the development of a scheme of road improvement that would be national in character, and serve not only the State but the Commonwealth, indicated that the completion of the work between the Cross Roads and Narellan via Carne's Hill was one of the projects that would come under this category.

Accordingly proposals were submitted to the Commonwealth for this purpose, and the project approved as a Federal Aid road work. The national character of the work also suggested that an endeavour should be made to overcome the obstacle of Carne's Hill (maximum grade of 1 in 13), and as this was possible by the adoption of a deviation which reduced the grade to 1 in 21 and shortened the route by 1,200 feet, this deviation was adopted. This has involved the building of a small reinforced concrete bridge over the Upper Canal of the Metropolitan Water, Sewerage and Drainage Board conveying water from Cataract Reservoir to Prospect Reservoir.

As a premixing plant was not available at the time when the deviation was sufficiently consolidated to be paved, a bitumen penetration macadam course was laid on Telford pitching on the deviation.

The section from the Cross Roads to the point where the deviation commenced was completed on 23rd March, 1928, and for a while work was suspended owing to the funds provided becoming exhausted. After the approval by the Federal Authorities of the 1928-29 programme, work was resumed on the 17th August, 1928, and the deviation, including the bridge over the water channel, completed on 11th January, 1929.

Road formed in readiness for construction of concrete pavement on Carne's Hill deviation, looking south.

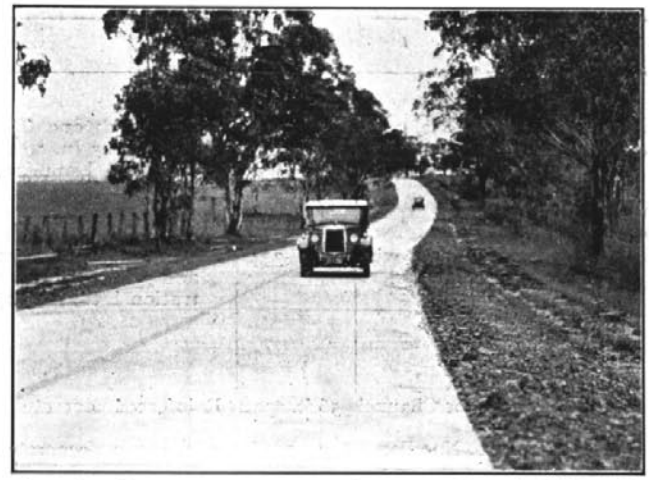
Operations were then again suspended awaiting provision of further funds under the 1929–30 Federal Aid Roads programme. Following such provision, work was again resumed on 1st May, 1929.

The country which had been passed through from the Cross Roads, and which is similar to that extending to Narellan, consists of clay of the Wianamatta series, and is of a particularly plastic nature. Difficulty had been experienced with it in wet weather on this and other roads owing to its unstable character. The Board therefore decided that, notwithstanding the higher initial cost, it would be preferable to continue the pavement to Narellan in some form of construction which would form a raft and spread the load as widely as possible. The ideal pavement for this purpose was cement concrete, which was therefore adopted.

During the collection of the materials for this pavement, the unstable character of the clay was demonstrated. While dry weather prevailed no serious difficulty was experienced, but after heavy rains, during which the subgrade became saturated, portion of the completed bituminous pavement yielded, due to the failure of the foundation. This was specially marked on the deviation, which had had less time to consolidate than the earlier section. Repairs were effected at a cost of £1,331, and the road has since given satisfactory service. The failure was purely a subgrade failure, and was in no sense due to faulty workmanship. This experience further demonstrated the importance of tests being made of subgrade soils to assist in determining the class and thickness of pavement to be adopted. Prior to the establishment of the Board's testing laboratory it had not been possible to do this, but this is now an important phase of the laboratory work.

In making provision for the construction by day labour of the concrete pavement between the Water Race and Narellan, a distance of 7 miles 3,118 feet, depots were established for the stock piling of materials for the pavement at three points in turn, one at the Water Race, one at Raby Lane 3¼ miles along the road, and one half a mile from Narellan. The main camp was located at the second depot. Seven thousand two hundred tons of materials, sufficient for 1½ miles, were hauled to the first depot from Liverpool: 11,900 tons, sufficient for 2¾ miles, to the second depot via Narellan; and 15,344 tons, sufficient for the remaining 3¼ miles, to the third depot.

The locality between Carne's Hill and Narellan is not served by any system of water mains, but, as the road runs in fairly close proximity to the main supply channel from Cataract Dam to Prospect, it was possible by arrangement with the Metropolitan Water, Sewerage and Drainage Board to draw water direct from the water channel and to pipe it along the road, a system of 3-inch pipes with the necessary gravitation tanks being adopted for the purpose. Thus an ample supply of good water, so essential in connection with concrete pavement construction, was available. The most convenient point for tapping the supply channel existed where this crosses Raby Lane, about half a mile from the main road, and convenient to the second depot site and camp. At this point the level of the supply channel, relative to the main road, was such that water could be syphoned from the channel and gravitated through 3-inch pipes along Raby Lane to the pump, which could thus be conveniently situated at the depot. This location had the added advantage of being approximately at the centre of the length for which the system was required (since for the last half-mile, approaching Narellan, water could be drawn from a Water Board main). Only about 3½ miles of pipe were therefore required for the 7 miles of road, the length of 3¼ miles from the Carne's Hill end to the pump being laid first, taken up in sections as the road work progressed from that end, and relaid to extend the line from the pump towards Narellan in preparation for succeeding operations. The cost of the material for the pipe lines was thus



Completed concrete pavement between Carne's Hill and Narellan, 1½ miles south of the water-race.

kept to a minimum. The pumping unit, working against a constant pressure of 210 lb. per square inch, was capable of delivering 3,000 gallons per hour, the prime mover being a 10-h.p. oil engine. The total cost of the complete system was £3,198, while the salvage value of the material, which was dismantled and sold on completion of the work, was approximately £1,000, making the net cost of the installation approximately £2,198.

The construction work consisted of a central cement concrete pavement 20 feet wide, flanked by 4 feet shoulders. The pavement was 7 inches thick, with edges thickened to 9 inches, the mix being 1-2-3½. Crushed gravel was used for 4¼ miles and round gravel for the remaining 3¼ miles. The mixer used was Rex paver No. 4 of 27 cubic feet capacity. The pavement was reinforced with edge bars throughout and with bar mat on the fills, the area reinforced with bar mat being about 18,000 square yards of a total area of concrete laid of 89,093 square yards.

Barber Greene loaders were used for loading the 1½-inch and ¾-inch metal into batches. The sand for the concrete batches was hand loaded into the lorries for haulage to the mixer, as a mechanical loader could not be made available for the purpose.

Owing to the nature of the ground and the need for providing some facilities for traffic, it was not considered desirable to complete the earthworks too far in advance of the paving operations, and it was

not practicable to maintain the same rate of advance with the earthworks as could be kept up with the paver. The working of the latter was therefore necessarily somewhat intermittent.

The average output of the concrete paver per available working day throughout the work was 326 square yards. Some very high "peak" outputs, however, were obtained, viz., 2,334, 2,000, 1,999, 2,001, 1,900, 1,888, 1,889 and 1,880 square yards per day, and the average per day worked was maintained at a high level, viz., 1,451 square yards.

The following table sets out the lengths and the cost of the various sections of work between the Cross Roads and Narellan:—

The higher costs of the earlier section of the bituminous macadam work compared with those later attained were due in a large measure to the early difficulties of obtaining skilled road workmen, the permanent gang having to be trained. This same gang afterwards carried out work on the Prince's Highway at a cost greatly below the prices obtained by public tender. In judging the costs of this section of work, therefore, the substantial benefits which have accrued from it as a training ground for other works should not be lost sight of. A contributory factor to the cost was, however, the long haul of materials from Liverpool and Glenfield railway stations, which added over £1,200 per mile

Section.	Length.	Class of Construction.	Cost.		Remarks.
	mls. ft.			£	
Cross Roads to the commencement of the Deviation.	2 3935	8 in. sandstone Telford foundation and 3 in. wearing course of premixed bituminous macadam.	Earthworks	8,437	Commenced 10th November, 1926; completed 28th March, 1928.
			Culverts	2,564	
			Pavement	26,688	
				37,689	
Commencement of Deviation to Water Channel.	1 334	8 in. sandstone Telford foundation and 3 in. wearing course of penetration bituminous macadam.	Earthworks, Fencing and Culverts.	3,854	Commenced 17th August, 1928; completed 11th January, 1929.
			Resumption ...	145	
			Pavement	8,954	
				12,953	
Bridge over Water Channel	56 ft. span	Reinforced concrete	.....	1,495	
Water channel to Narellan...	7 3118	7 in. cement concrete pavement ...	Earthworks	18,950*	Commenced July, 1929; completed 16th January, 1931.
			Culverts	6,180*	
			Pavement	70,370*	
				95,500	
Totals	11 2107			£147,637	

* This part of the work having just been completed, the exact final cost is not yet available, but it is anticipated that it will approximate closely to the figures given.

The concrete pavement complete (including edge bars and dowel bars) was laid at a cost of 13s. 7d. per square yard.

The total earthworks amounted to 31,875 cubic yards, of which approximately 40 per cent. was carried out by the Board's skimmer shovel; 1,800 cubic yards were in rock, requiring the use of explosives, and the balance was taken out by tractor and plough, back filler and Barber Greene loaders. The unit cost throughout the work was 6s. 4d. per cubic yard.

Considerable work was carried out in the renewal of culverts and small bridges, the cost of these being approximately £6,180.

Excavation was begun in July, 1929, and the pavement was completed and opened to traffic by the 16th December, 1930.

The costs per mile of the various parts of the work were therefore:—

(a) Earthworks, culverts, fencing, and bridges, i.e., all work other than pavement, of which one-third represents the cost of providing culverts and bridges £3,630
(b) Pavement of Telford foundation and premixed bituminous wearing course 9,721
(c) Pavement of Telford foundation and penetration bitumen wearing course 8,421
(d) Cement concrete pavement 9,271

to the pavement cost. Again, for the greater portion of the length from the Cross Roads to the commencement of the deviation, the ballast was obtained under contract from Parramatta at a cost of 12s. 4d. per ton delivered to the road. For the remainder of the work, ballast was obtained from a local quarry and landed on the road at a cost of 9s. 9d. per ton.

The work on the concrete pavement was carried out with a fully-trained crew, and resulted in a great saving (£31,530) on the estimated cost (£127,030) previously published in the Board's Fourth Annual Report.

New South Head Road.

The regrading of the junction of Ocean-street and New South Head road has been undertaken by Woollahra Municipal Council by day labour. This intersection was a difficult one for traffic to negotiate, mainly on account of the high crown on the old pavement in Ocean-street. This will be reduced to the extent of approximately 1 foot 6 inches. The cost of the work is being borne jointly by the Board and Woollahra and Paddington Councils.

Traffic at Peat's Ferry.

THE motor vessel "George Peat," built by Messrs. Poole and Steel, of Balmain, for the Hawkesbury River crossing on the Great Northern Highway, was delivered to Peat's Ferry on the 26th May, 1930. The sister vessel, the "Frances Peat," was delivered on the 11th July. On arrival at the Hawkesbury River the "George Peat" was put into operation, using the single docks which had been completed at that time on each side of the river at Kangaroo and Mooney Mooney Points. Immediately difficulties were experienced in the docking of the vessel, owing to the complexity of the strong tidal currents, to the effects of wind, and to the unfamiliarity of the ferry masters with the river conditions. After a fortnight's trial, during which valuable information in the handling of the vessel under the continually varying conditions was obtained, and the initial difficulties were to a large extent overcome, the service was temporarily suspended to allow certain of the dock walls to be extended and pile dolphins to be provided. This would permit of the vessels approaching the entrance of the docks at greater speed. When this work was completed, the service was re-opened on 13th August, 1930, and has since been in continuous operation, the measures just described having proved entirely effective for their purpose even under very adverse weather conditions.

TABLE I.— TOTAL MONTHLY TRAFFIC.

Month. ...	...	Aug. (part).	Sept.	Oct.	Nov.	Dec.	Jan. (part).	Total.
No. of days running	...	19	30	31	30	31	11	152
Class of Traffic.	Rate of Toll.	No.	No.	No.	No.	No.	No.	No.
*Passengers.**	s. d.							
Children, 4–14 years	0 2	2,423	6,777	5,405	4,638	8,905	4,765	32,913
Over 14 years ...	0 4	15,379	34,116	34,698	27,904	40,645	18,870	171,612
		17,802	40,893	40,103	32,542	49,550	23,635	204,525
Bicycles	0 6	211	341	188	126	201	66	1,133
Horse-drawn vehicles.	0 8 and 1 0	10	13	35	49	60	20	187
		221	354	223	175	261	86	1,320
Motor Vehicles.†								
Motor cycles ...	0 8	407	652	598	574	982	410	3,626
Motor cars, cycle and side car ...	1 0	6,729	15,295	15,510	12,692	18,663	8,660	77,549
Motor lorries under 3 tons	2 6	389	988	1,085	1,192	1,754	515	5,923
Motor lorries—								
3–4 tons ...	4 6	25	70	87	116	162	26	486
4–5 tons ...	6 6	5	27	15	36	66	8	157
5–6 tons ...	9 0	8	14	13	10	82	3	130
6–7 tons ...	11 6	1	8	5	6	86	4	110
7–8 tons ...	14 6	...	1	4	8	63	1	77
8–9 tons ...	18 0	...	2	1	...	29	...	32
9–10 tons ...	22 0	...	1	...	...	26	...	27
Motor omnibuses to 12 persons ...	15 0	...	1	2	1	1	...	5
Motor omnibuses, 13–20 persons ...	30 0	2	1	3	...	1	...	7
Motor omnibuses over 20 persons ...	40 0	2	1	2	1	2	1	9
Total motor vheicles ...		7,568	17,061	17,325	14,636	21,917	9,628	88,138
Daily average number of motor vehicles		398	569	558	487	707	875	579
Total, all vehicles		7,789	17,415	17,548	14,811	22,178	9,714	89,458

* Does not include drivers of vehicles.
† Rate of toll includes driver of vehicle.

TABLE II.—PASSENGERS.

Week ending.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Public holiday	Total.
1930.									
17 Aug. ...	...	...	106	117	219	301	1,283	...	2,026
24 ,, ...	563	1,093	827	676	657	1,380	2,672	...	7,868
31 ,, ...	499	524	629	613	736	1,277	3,630	...	7,908
7 Sept. ...	815	859	765	922	1,276	2,167	3,866	...	10,670
14 ,, ...	1,158	1,567	1,040	1,119	1,047	1,892	4,312	...	12,135
21 ,, ...	1,494	679	645	588	721	1,254	3,624	...	9,005
28 ,, ...	702	534	500	584	611	1,477	3,073	...	7,481
5 Oct. ...	686	916	579	578	1,246	4,760	4,427	...	13,192
12 ,, ...	...	1,057	539	538	572	835	1,623	8,499*	13,663
19 ,, ...	595	937	455	537	749	1,168	2,144	...	6,585
26 ,, ...	656	697	398	475	443	904	1,749	...	5,322
2 Nov. ...	668	456	588	527	704	1,402	2,678	...	7,023
9 ,, ...	730	469	559	516	687	1,301	2,541	...	6,803
16 ,, ...	1,137	914	546	515	678	1,372	2,406	...	7,568
23 ,, ...	758	541	613	570	735	1,325	2,512	...	7,054
30 ,, ...	642	925	519	508	631	1,357	2,455	...	7,037
7 Dec. ...	642	565	555	643	700	1,341	2,628	...	7,074
14 ,, ...	725	578	620	568	720	1,165	2,361	...	6,737
21 ,, ...	669	693	552	574	915	2,037	2,259	...	7,699
28 ,, ...	1,250	1,406	3,421	...	...	...	4,718	13,012†	23,807
1931.									
4 Jan. ...	1,423	1,252	1,558	...	1,843	3,078	4,318	2,747‡	16,219
11 ,, ...	1,482	1,453	1,322	1,008	1,188	2,278	2,918	...	11,649
Totals ...	17,294	18,115	17,336	12,176	17,078	34,071	64,197	24,258	204,525
Daily Average...	864	862	788	608	813	1,622	2,918	4,851	1,345

* Eight Hour Day. † Christmas Day, 4,976; Boxing Day, 5,104; Saturday, 27th December, 1930, 2,932. ‡ New Year's Day.

TABLE III. - VEHICLES.

Week ending.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Public holiday.	Total.
1930.									
17 Aug. ...	...	...	61	74	91	147	411	...	784
24 ,, ...	295	497	391	352	375	574	931	...	3,415
31 ,, ...	276	270	346	335	373	590	1,400	...	3,590
7 Sept. ...	400	380	367	404	567	816	1,453	...	4,387
14 ,, ...	518	645	406	467	493	814	1,651	...	4,994
21 ,, ...	643	344	329	321	377	565	1,232	...	3,811
28 ,, ...	371	298	302	312	371	643	1,068	...	3,365
5 Oct. ...	409	449	344	321	610	1,862	1,456	...	5,451
12 ,, ...	...	507	314	315	376	406	617	2,966*	5,501
19 ,, ...	366	464	226	307	385	535	776	...	3,059
26 ,, ...	372	415	205	266	287	449	674	...	2,668
2 Nov. ...	382	288	362	322	376	621	938	...	3,289
9 ,, ...	416	300	328	330	380	559	863	...	3,176
16 ,, ...	541	437	316	304	397	594	892	...	3,481
23 ,, ...	404	348	381	348	386	562	876	...	3,305
30 ,, ...	396	455	303	324	375	590	847	...	3,290
7 Dec. ...	371	355	349	360	370	593	934	...	3,332
14 ,, ...	411	333	351	325	403	527	846	...	3,196
21 ,, ...	486	487	426	443	608	884	880	...	4,214
28 ,, ...	667	722	1,503	...	...	...	1,797	4,731†	9,420
1931.									
4 Jan. ...	676	594	746	...	794	1,182	1,653	991‡	6,636
11 ,, ...	752	645	589	477	568	960	1,103	...	5,094
Totals ...	9,152	9,233	8,945	6,707	8,962	14,473	23,298	8,688	89,458
Daily Average...	457	439	406	335	426	689	1,059	1,737	588

* Eight Hour Day. † Christmas Day, 1,828; Boxing Day, 1,770; Saturday, 27th December, 1930, 1,133. ‡ New Year's Day.

The total monthly traffic, with details of the numbers of the various classes of traffic for the period 13th August, 1930, to 11th January, 1931, is shown in Table I. The distribution of traffic throughout each week is shown in Tables II and III.

In order to test the demands of traffic and for reasons of economy, the service up to 22nd December 1930, was limited to the period between the hours of 6.30 a.m. and 9.30 p.m. each day, except on holidays, when all-night running was adopted. On ordinary week-days (Mondays to Fridays inclusive) one vessel was sufficient to deal with the traffic, and only one vessel was therefore used, but on special occasions, such as on race days and during Saturdays and Sundays and holiday periods, when the traffic was heavy, both vessels were called into operation as required. Since 22nd December, 1930, up to the present (19th January) a continuous all-night service has been operated—for the period 22nd December, 1930, to 5th January, 1931, with a view to giving special assistance to holiday traffic, and from 5th January, 1931, to date, with the object of ascertaining the normal demands between 9.30 p.m. each night and 6.30 a.m. the following morning.

was reached. With the Eight Hour Day holiday week-end and fine weather, a greatly increased volume of traffic was recorded for the two weeks ending 5th and 12th October. On the holiday (6th October) a total number of 2,966 vehicles (of which 2,747 were cars and motor cycles and side cars) was transported during the day, the great proportion (2,000 approximately) of this total comprising vehicles whose occupants all decided to return to Sydney during the late afternoon and evening. This traffic, which was the most intense experienced to date, was almost exclusively in one direction, and was handled by the ferry staffs with excellent expedition. During the peak period, trips were made at 9 minute intervals on occasions, and over a period of ten hours the average interval between the trips was approximately 12 minutes. The corresponding numbers of vehicles transported per hour were 240 during the peak period, and approximately

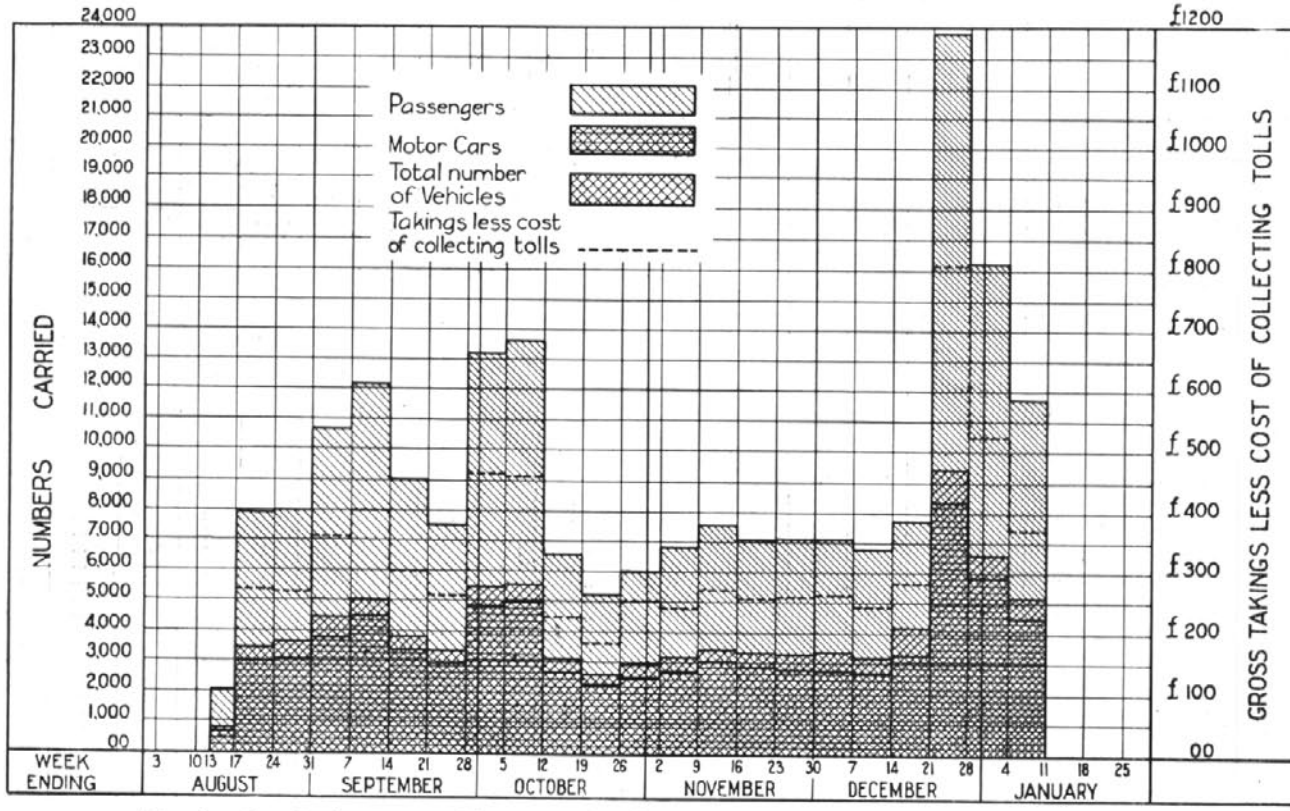


Fig. 1. Graph showing weekly variations of traffic and nett toll takings at Peat's Ferry.

The weekly variations, together with the nett toll takings, are shown graphically in Figure 1.

From this it will be seen that the traffic rapidly increased each week until the 14th September, largely on account of the desire of many travellers to inspect the new route and enjoy the scenery, which had not till that time been available to road traffic since the cessation of the original Peat's Ferry service forty-one years ago. Following this, a decrease set in until the 28th September, when what the figures available to date indicate to be the normal weekly spring and summer traffic of (in round figures) 3,500 vehicles and 7,500 passengers

200 over ten hours. These figures may therefore be taken as a direct and practical measure of the capacity of the ferry service with two vessels for transporting traffic across the river when it is predominatingly in one direction. Had the traffic been in both directions longer intervals would have been necessary between trips, although as both backward and forward trips would have carried loads, a greater number of vehicles would have been carried each hour.

The intense concentration of traffic on this occasion resulted in a queue forming on the northern side of the river, which reached a maximum length

of 5 miles, and involved a corresponding wait for those at the extreme end of this length of about five hours. This experience was not repeated by the Christmas and New Year traffic, and must therefore be regarded as abnormal. When the duplicate docks now under construction are completed, it may be practicable to augment the service during holidays with a third (hired) ferry, and thus reduce the delay on such occasions.

Due possibly to the widely circulated and somewhat exaggerated reports of the period of waiting on the afternoon and evening of Eight Hour Day, and consequential also on less favourable weather, traffic fell off considerably during the next fortnight, after which it again commenced to rise, and reached normal volume in the week ending 16th November. From this date, it remained practically constant until the commencement of the Christmas and New Year traffic, when it reached its greatest volume to date, as many as 9,420 vehicles and 23,807 passengers being transported in a single week. Instead of a concentrated rush occurring, such as was experienced on the evening of the Eight Hour Day holiday, a high daily average was maintained throughout this period.

Figure 2 depicts the hourly variation of traffic—

(a) For an average week day (during the period 10th November to 7th December) with the service operating from 6 a.m. to 10 p.m.

(b) For an average Saturday and Sunday (during the same period and under the same conditions as (a)).

(c) For an average week day, exclusive of actual holidays during the summer holiday season (20th December, 1930, to 11th January, 1931), with the service operating throughout twenty-four hours of each day.

(d) For an average holiday (Saturdays, Sundays, and public holidays) during the same period and under the same conditions as (c).

These graphs reveal no unexpected characteristics. They show:—

(1) That under summer conditions and on ordinary week days the substantial demand for the service commences between 6 a.m. and 7 a.m. (compare graphs (a) and (c)), and ceases about 11 p.m. The continuous service was only availed of to any appreciable extent on the night of December 24-25 (see graph (d)) and on the night of January 1-2 following the New Year holiday, which had been favoured with ideal weather, only twenty-four cars crossed in the eight hours from 10 p.m. to 6 a.m. The total volume of the vehicular traffic using the ferry between 10 p.m. and 6 a.m. throughout the Christmas and New Year holiday period amounted to only 3.4 per cent. of the total traffic carried in the twenty-four hours. As a result of this, the Board has decided to terminate the all-night service immediately after Anniversary Day (26th January, 1931), and after this

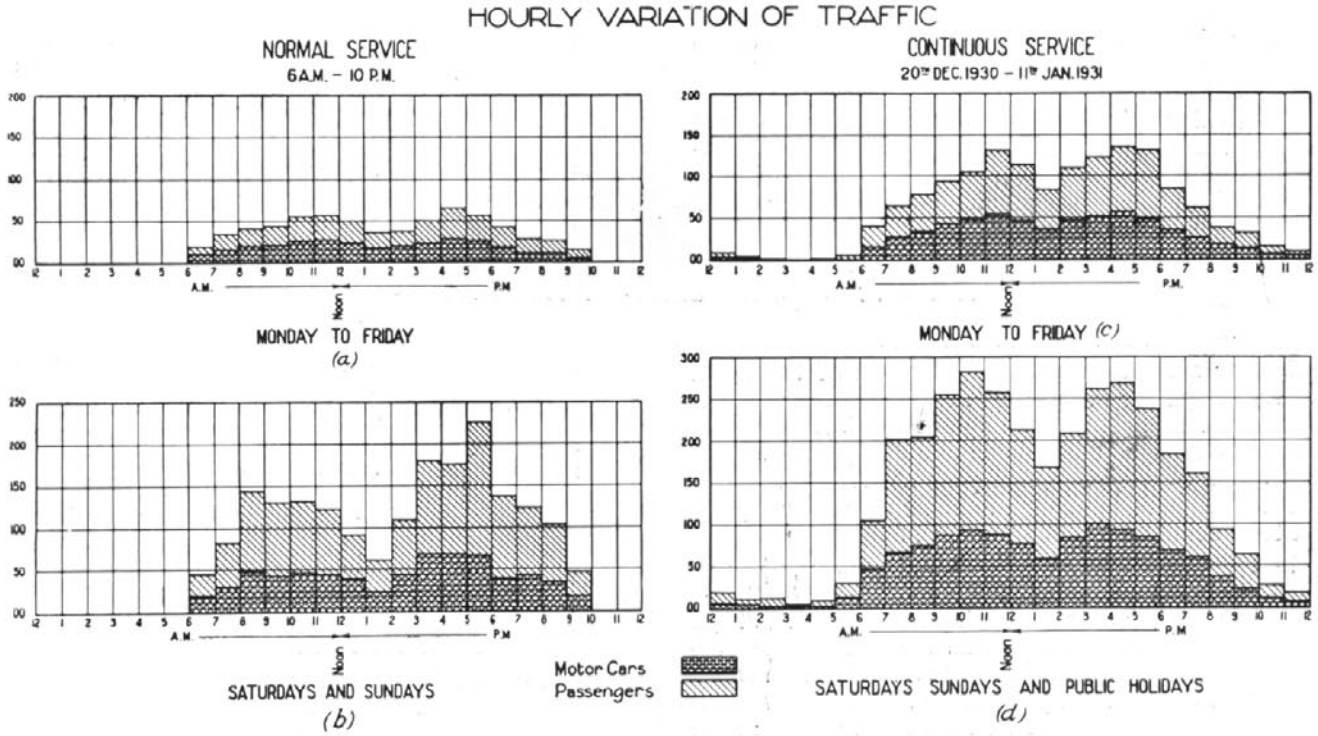


Fig. 2. Graph showing the hourly variations of traffic at Peat's Ferry.

to extend the hours of running from 10 p.m. to midnight, until the end of March, when further consideration will be given to the matter.

(2) That on ordinary occasions and during any but the briefest holiday periods the traffic is reasonably well distributed throughout the day between 6 a.m. and 10 p.m.

(3) That as the capacity of the service has been demonstrated to be up to 240 vehicles per hour with two vessels, or 140 vehicles per hour with one vessel, and as under normal operation one vessel only is used from Mondays to Fridays, and two vessels, as required, on Saturdays, Sundays, and holidays, the service is capable of dealing with the traffic without unduly long periods of waiting, except on occasions of great concentration of traffic.

As a guide to the earning capacity of the ferries, or of any alternative form of crossing that may be considered at any time and financed on a toll basis, the particulars given in Figure 1 of the toll takings less cost of collection will be of interest. Altogether the toll receipts to 31st December, 1930, have amounted to £7,870, and the corresponding costs of collection £905 1s. 11d. The difference, or £6,965, represents the sum available to pay the wages of masters and crew, fuel, family endowment, stores and materials, watching, insurance, maintenance of vessels and docks, and interest and sinking fund on the sum invested in the vessels and docks. Divided by the total number of vehicles that have used the ferries up to 31st December, 1931, this works out, on a traffic averaging 545 vehicles per day, at 1s. 9d. nett return per vehicle (including passengers). This figure can be used as a definite guide to the prospects of financing, on a sound basis, at the same rates of toll as the present ferry, any high-level bridge in substitution of the ferry.

For each £100,000 of capital cost of a bridge with a life of, say, sixty years, an annual revenue of £6,188 is required to pay interest on the capital expenditure at 6 per cent. and to extinguish the debt at the end of the life of the bridge. Allowing a further annual amount equal to ½ per cent. of the capital cost for maintenance, the total figure of £6,688 is arrived at as the minimum revenue required per annum per £100,000 of first cost to make any bridge a financially sound investment. This is equivalent to an average traffic of 208 vehicles per day on the present toll basis.

News of the Month.

Metropolitan Division.

Tar surfacing is in progress on parts of the Great Western Highway in the Blue Mountains district. Before the tar is applied, any slight irregularities which have developed in the old surface are planed off by means of a heavily weighted planer. Where the surface is broken or too rough to allow a satisfactory result to be achieved by such methods, a new surface coat of premixed material is laid. The riding qualities of the road are considerably improved by these processes.

Baulkham Hills Shire Council has completed a length of over 1 mile of metalling and tar surfacing on the Great Northern road (Main Road No. 160) from Dural Junction in a northerly direction. This work has greatly improved conditions on the road, which, as the result of grader work carried out last year by the Shire Council, is now in good order as far as Glenorie Post Office.

The widening of sections of the concrete pavement of the Great Northern Highway, between Longueville-road, Artarmon, and Boundary-street, Roseville, has been completed. The work was carried out on behalf of the Board by Willoughby Council by day labour.

Outer Metropolitan Division.

The reconstruction in penetration macadam of the North Coast Highway from 8 miles 4,300 feet to 14 miles 3,180 feet, between Raymond Terrace and Stroud in Port Stephens Shire, which was carried out under contract in two sections by Messrs. W. B. Carr Construction Ltd., and Messrs. Bryant and Buchanan Ltd., respectively, is complete and has been opened to traffic.

The tar re-surfacing of the Newcastle-Maitland road (Great Northern Highway) between Ironbark Creek bridge and Hexham railway station was completed by Messrs. B.H.P. By-Products Pty. Ltd. just prior to the Christmas holidays. To minimise inconvenience to the travelling public, the work was carried out at night.

The paving of the Oak Flats-Shellharbour deviation on the Prince's Highway, in the Municipality of Shellharbour, has been completed in premixed bituminous macadam, and the deviation is now open to traffic.

Upper Northern Division.

Messrs. M. R. Hornibrook and Co. have completed and opened to traffic the steel plate girder bridge over Maryland River, on the Great Northern Highway, approximately 50 miles north of Tenterfield. This bridge was described and illustrated in the April, 1930, number of *Main Roads*.

A further step towards making the Great Northern Highway between Amosfield and Mount Lindesay suitable for interstate traffic has been made by the completion of a length of waterbound macadam commencing at Old Koreelah and extending 2 miles towards Woodenbong.

On the Murwillumbah-Nimbin road (No. 142), in the Shire of Tweed, a two-cell 10 feet by 6 feet reinforced concrete culvert and approaches has been constructed by Contractor Ryan.

In the Shire of Bannockburn a grant of £1,750 for the relief of unemployment has been expended in the construction of 4,580 feet of gravelled roadway on the Inverell-Auburn Vale developmental road (No. 1,119).

Expenditure from 1st July to 31st December, 1930.

	Expenditure from 1st July to 31st November, 1930.	Expenditure for month of Dec., 1930.	Expenditure from 1st July to 31st December, 1930.
	£ s. d.	£ s. d.	£ s. d.
COUNTY OF CUMBERLAND MAIN ROADS FUND—			
Construction of Roads and Bridges	132,598 13 2	22,105 18 3	154,704 11 5
Cost of Land Resumptions	51,977 6 9	15,750 10 5	67,727 17 2
Maintenance of Roads and Bridges	75,110 16 5	24,187 9 8	99,304 6 1
Repayment of Loans	51,014 8 2	12,685 2 3	63,699 10 5
Survey, Design, Supervision and Administration	21,112 1 5	2,462 19 2	23,575 0 7
Miscellaneous	23,178 1 9	1,788 6 11	24,966 8 8
Totals	354,997 7 8	78,980 6 8	433,977 14 4
COUNTRY MAIN ROADS FUND—			
Construction of Roads and Bridges, including Resumptions ...	210,571 17 4	53,034 2 0	263,605 19 4
Maintenance of Roads and Bridges	344,904 11 0	62,020 16 5	406,925 7 5
Repayment of Loans	15,715 6 4	4,046 11 9	19,761 18 1
Cost of Survey, Design, Supervision and Administration ...	51,123 13 5	9,321 7 6	60,445 0 11
Miscellaneous	30,652 3 0	898 19 1*	29,753 3 11
Totals	652,967 11 1	127,523 18 7	780,491 9 8
FEDERAL AID ROADS FUND—			
Construction of Roads and Bridges, including Resumptions ...	286,517 18 9	67,009 19 7	353,527 18 4
Miscellaneous	11,876 13 6	1,343 19 11	13,220 13 5
Totals	298,394 12 3	68,353 19 6	366,748 11 9
DEVELOPMENTAL ROADS FUND—			
Construction of Roads and Bridges	107,848 15 11	25,778 18 7	133,627 14 6
Survey, Design, Supervision and Administration	3,330 5 10	642 16 3	3,973 2 1
Miscellaneous	10,703 17 3	83 14 8*	10,620 2 7
Totals	121,882 19 0	26,338 0 2	148,220 19 2
SUMMARY, ALL FUNDS.			
Construction of Roads and Bridges, including Resumptions ...	789,514 11 11	183,679 8 10	973,194 0 9
Maintenance of Roads and Bridges	420,021 7 5	86,208 6 1	506,229 13 6
Repayment of Loans	66,729 14 6	16,731 14 0	83,461 8 6
Survey, Design, Supervision and Administration	75,566 0 8	12,427 2 11	87,993 3 7
Miscellaneous	76,410 15 6	2,149 13 1	78,560 8 7
Grand Totals	**1,428,242 10 0**	**301,196 4 11**	**1,729,438 14 11**

* Credits.

Lower Northern Division.

Narrabri Municipal Council has tar-surfaced Maitland-street, between Bowen and Lloyd streets. The Board is sharing the cost of the central 20-foot strip, and the Council is financing the work over the remainder of the width between kerbs. The surfaced section comprises half a mile of the main business street of the town.

In the Shire of Bellingen, on the Thora-Brinerville developmental road (No. 1,154), two new timber low-level bridges, with approaches, have been constructed at 12¾ and 14½ miles and opened to traffic. The work was carried out under contract to the Bellingen Shire Council. Higher up the valley, between 22 and 25 miles, funds provided for unemployment relief work have been expended in widening the existing formation in narrow places.

In Manning Shire, on the Brown's Creek developmental road (No. 1,044), a four-span timber beam bridge, with approaches, has been constructed over Brown's Creek and opened to traffic.

Central Western Division.

Contractors Gam Bros. and Jenkins have commenced the construction of 2 miles 1,400 feet gravel pavement and fourteen concrete box culverts between 5 miles and 8 miles from Yeoval, on the Wellington-Parkes road (No. 233), in Amaroo Shire.

Messrs. Model Homes Ltd. have commenced the construction of 2 miles 40 feet of tar penetration pavement, with concrete pipe and box culverts, between Cowra and Holmwood, on the Mid-western Highway in Waugoola Shire.

The Divisional bridge maintenance gang is effecting repairs to the bridge over the Macquarie River at Dubbo. Fourteen foot-way girders, 7 piles in the approach spans, one approach span girder and 34,000 ft. super. of decking are being replaced.

Southern Division.

On the portions of the Yass-Cowra trunk road (No. 56) and the Gunning-Boorowa-Young road (No. 241),

which traverse the main streets of Boorowa, the Municipal Council has constructed 4,100 feet of penetration macadam pavement.

The Mount Darragh-Wyndham developmental road (No. 1041) has been completed and opened to traffic. There is a short by-track in use at the concrete bridge over Jones Creek near Wyndham, which is not quite complete. The works involved in the construction of this road were described in the April, 1930, number of *Main Roads*.

Riverina Division.

On the Mid-western Highway, between Wyalong and West Wyalong, 1 mile 1,580 feet of tar surfacing is being carried out by the Bland Shire Council on behalf of the Wyalong Municipal Council.

Two miles of gravelled roadway, with culverts, were recently completed and opened to traffic on the Ganmain-Dullah developmental road (No. 1,060) in Coolamon Shire. The construction was carried out as unemployment relief.

Tenders and Quotations Accepted.

The following Tenders and Quotations were accepted by the Board during the month of December, 1930:—

Tenders.

Work.			Name of Successful Tenderer.	Amount of Accepted Tender.
Municipality or Shire.	Road No.	Description.		£ s. d.
Erina and Lake Macquarie.	9	Surfacing between Wyong and Swansea:—(*a*) Silicate of soda treatment and tar surfacing, ¼ mile; (*b*) Bituminous or tar surfacing, 5¼ miles; (*c*) Mixed-in-place pavement, ½ mile.	Bryant and Buchanan, 14 Martin Place, Sydney.	3,932 18 6
Young	239	Construction of 3-span concrete bridge and approaches over Burrangong Creek, in Short-street.	Burns Bros., Trafalgar-street, Petersham.	3,200 3 0
Yass	56	Construction of reinforced concrete arch bridge over Walker's Creek.	Chas. Hardy Contracting Co., Wagga Wagga.	2,457 0 0
Tarro and Port Stephens.	10	Overhaul and repair of Hexham vehicular ferry	Walsh Island Dockyard, Newcastle.	550 0 0
Sutherland and Bulli.	1	Haulage of 5,500 tons of materials from Waterfall railway station to the Board's local depot.	M. Gilroy, Gilroy-road, Turramurra.	1s. per ton.

Quotations.

No. of Quotation.	Description of Article.	Name of Successful Tenderer.	Amount of Accepted Quotation.
			£ s. d.
975	No. 3 tar, sprayed between Blaxland and Blackheath, 18,500 gallons.	Australian Gaslight Company	1,079 3 4
977	Blue metal, 1,200 tons 1½-in., 1,500 tons ¾-in., 1,400 tons 5/16-in.	State Metal Quarries	820 0 0
978	Bitumen, 60/70 penetration grade, 100 tons	Shell Company of Australia, Ltd. ...	775 0 0
	Bitumen, 60/70 penetration grade, 65 tons	Atlantic Union Oil Co.	503 15 0
	Bitumen, 60/70 penetration grade, 75 tons	Vacuum Oil Co.	581 5 0
980	Concrete pipes—16 ft. x 24-in. dia, 24 ft. x 18-in. dia., 8 ft. x 15-in. dia.	State Monier Pipe Works	13 4 10
982	Metal—300 tons 5/16-in., 300 tons ¾-in.	Emu and Prospect Gravel Co.	319 2 10

The acceptance by the respective Councils of the following Tenders has been approved by the Board during the month of December, 1930:—

Work.			Name of Recommended Tenderer.	Amount of Recommended Tender.
Municipality or Shire.	Road No.	Description.		£ s. d.
Patrick Plains ...	1,052	Gravel construction	W. Webber	295 3 6
Patrick Plains ...	1,052	Gravel construction	W. Tierney	337 0 0
Bowral	260	Tar penetration, 2,761 feet	Worner and McFarlane	2,351 9 0
Wallarobba ...	1,128	Formation and culverts, 1 mile 2,720 ft.	J. A. Croll and Sons ...	2,002 4 7
Yallaroi	12	Gwydir River bridge, fencing	Manuel Bros.	257 0 0

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