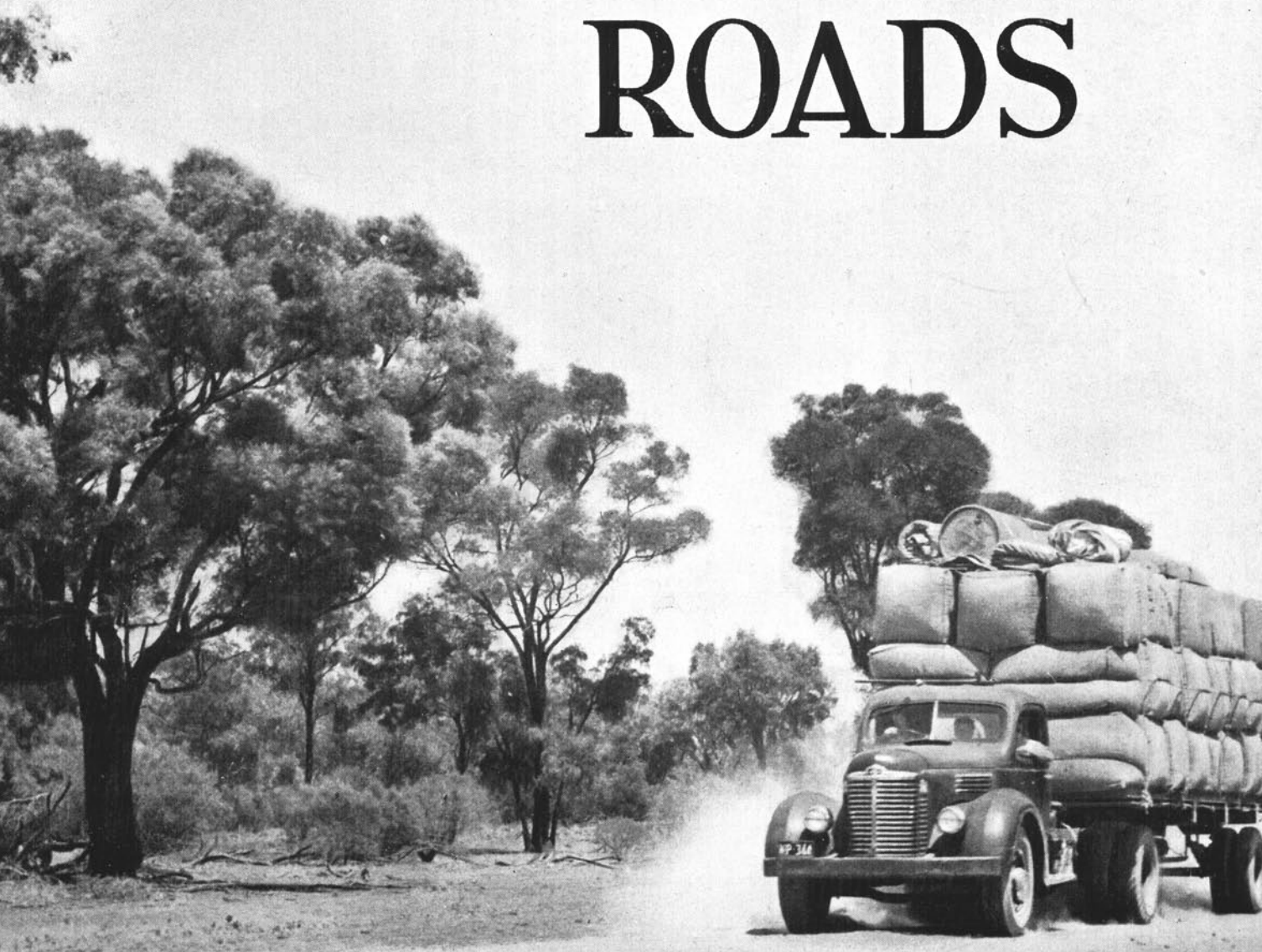
MAIN ROADS



June 1951

MAIN ROADS.

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Cover Page.

Transport of Wool on the Bourke-Wanaaring Main Road in the Western Division ***(see article, page 126)******.***

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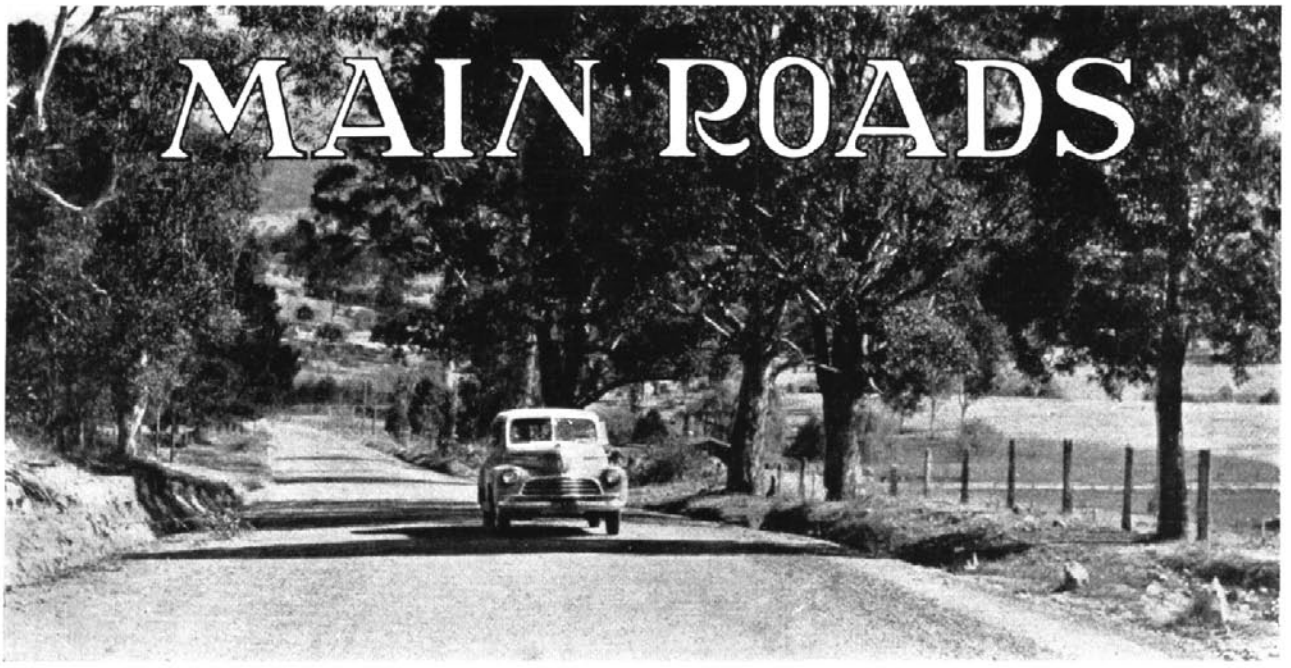


Vol. XVI. No. 4. *Sydney, June, 1951.*

New South Wales Main Roads Since Federation

As 1951 marks the 50th anniversary of the Federation of the Australian States to form the Commonwealth of Australia, it is fitting at this time to review the development of Federal Aid for roads, with particular reference to Main Roads in New South Wales.

In 1905, the New South Wales Parliament passed the Shires Act, subsequently incorporated into the Local Government Act of 1906. Under this Act the Eastern and Central Divisions of the State, outside existing municipalities, were divided into shires. The shire councils were vested with authority to levy rates on the unimproved capital value of land for the purpose of providing funds for road construction and other works and services. A minimum Government endowment of £150,000 per annum was provided also for the shires. The State Government retained the control of and responsibility for the whole of the area of the Western Division outside municipalities. About 250 of the more important bridges in the Eastern and Central Divisions, as well as ten ferries, were also retained by the State Government and proclaimed to be "National Works."

Under the 1906 Act the Minister was empowered to classify roads as "main" roads, and these roads were required to be kept in repair by the new councils. One hundred and fifty-four roads were classified on the 31st December, 1906.

The Act of 1906 did not make provision for the amendment of the list of roads gazetted in 1906, but when distributions of funds voted by Parliament for main roads were made, additional roads which, for departmental purposes, were regarded as main roads, received grants as well as those which had been gazetted. This situation continued until 1920, when an amendment of the Local Government Act made it possible to add to, alter, or repeal the proclaimed list of main roads. In January, 1924, a complete list of 219 main roads was gazetted. The realisation of the need for special attention to the main roads was considered by the Government as early as 1909 when a Main Roads Bill was prepared, though it was not until 1912 that such a Bill was placed before Parliament. Neither that Bill, however, nor Bills prepared by various Governments in subsequent years were translated into legislation until 1924 when the Main Roads Act was passed.

The Main Roads Act of 1924 provided for the establishment of a Board whose prime responsibility was to join with the local governing authorities in

improving and maintaining the main roads of the State. Taxation imposed on motor vehicles was the principal source of funds available to the Board at that time for the purpose of assisting municipal and shire councils. In the metropolitan area provision was made for these funds to be supplemented by statutory contributions by councils, whereas in the country the Board subsidised approved works proposed by the councils.

Mileages of Roads.—An appreciation of the growth which has taken place in the lengths of main roads in the State and improved road surfaces may be gained from Table A below.

Finance.—The principal sources of revenues for works on main roads at the present time are the proceeds of taxes levied by the State Government on motor vehicles and by the Commonwealth Government on petrol.

In 1923 the Commonwealth Government commenced granting assistance to the States for road purposes. However, a definite scheme of subsidy commenced regularly in 1926, when under the Federal Aid Roads Agreement a sum of £2,000,000 per annum was made available, and divided between the States on a population-area basis, population being given a weighting of three-fifths and area a weighting of two-fifths. The New South Wales share of this annual grant was £552,000.

In 1931 the agreement was amended to provide that the total amount made available on the basis of 2½d. per gallon on imported petrol and 1½d. per gallon on locally-refined petrol should fluctuate according to total petrol consumption, and the population-area method of distribution between States remained unchanged.

A further agreement current from 1st July, 1937, to 30th June, 1947, operated much along the lines of the old agreement, except that the payments were increased to 3d. per gallon on imported petrol and 2d. per gallon on locally refined petrol, and the distribution to the States was made after payment of 5 per cent. of the amount available for distribution to Tasmania. The new agreement also provided that portion of the money paid to the States might be spent on roads or other works connected with transport.

In 1947 the Commonwealth Aid Roads and Works Act, 1947, was passed. This, which applied for a period of three years, provided for a continuation of the payment to the States of the proceeds of a gallonage tax of 3d. per gallon on imported petrol and 2d. per gallon on locally refined petrol. The principal change made to the expired agreement was that in addition to the gallonage payment a fixed amount of £1,000,000 per annum was to be distributed to the States for expenditure on roads through sparsely populated areas, timber country and rural areas, and the purchase of road-making plant for use in areas where the purchase of such plant was beyond the resources of the local authorities provided that the money was not to be spent on proclaimed main roads without the approval of the Commonwealth Minister. This amount was subsequently increased to £2,000,000 in 1948-49 and £3,000,000 in 1949-50.

The current scheme which operates for the period of five years ending in 1954-55 follows the passage of the Commonwealth Aid Roads Act, 1950. The features in the previous scheme are to be continued, with the exception that:—

(*a*) All payments to the States are to be based on the proceeds of a petrol tax of 6d. per gallon on imported petrol and 3½d. per gallon on locally refined petrol.

(*b*) Of the amounts payable to the States (after payment of 5 per cent. to Tasmania):—

(i) 65 per cent., less £600,000 per annum expendable directly by the Commonwealth Government on strategic roads, roads of access to Commonwealth properties and the promotion of road safety practices, is available for expenditure on roads generally, and

(ii) 35 per cent. is available for expenditure on rural roads, including developmental roads, feeder roads, roads in sparsely populated areas and in soldier settlement areas (but excluding proclaimed Main Roads); also for the purchase of road-making plant for use on the rural roads thus defined.

Table B on page 99 shows the amounts received from the Commonwealth expended on Main Roads in New South Wales since 1926. Comparable expenditures from State and Local Government sources on Main Roads are also shown.

TABLE A.

Year.	Bituminous and other dustless pavements.		Gravel, stone and sandy loam.		Earth.		Total miles.
	miles.	per cent.	miles.	per cent.	miles.	per cent.	
1931 (*a*) and (*b*)	992	7	8,540	62	4,290	31	13,822
1950 (*a*)	4,379	25	12,010	69	951	6	17,340

(*a*) Figures prior to 1931 are not available. (*b*) Western Division roads are excluded.

TABLE B.

Commonwealth Act under which moneys made available.	Terms of Operation of the Act.		Commonwealth Government Contributions.		Expenditure from State and Local Government sources.	
	Years.	Dates.	Total.	Annual Average Amount.	Total.	Annual Average Amount.
			£	£	£	£
Federal Aid Roads Act, 1926 —						
(*a*) Up to 1931	5	1st July, 1926, to 30th June, 1931.	2,393,000	479,000	14,305,000	2,861,000
(*b*) Under the Act as amended in 1931	6	1st July, 1931, to 30th June, 1937.	3,762,000	627,000	12,072,000	2,162,000
Federal Aid Roads Act, 1937	10	1st July, 1937, to 30th June, 1947.	8,807,000	881,000	30,780,000	3,078,000
Commonwealth Aid Roads and Works Act, 1947.	3	1st July, 1947, to 30th June, 1950.	4,370,000	1,457,000	11,196,000	3,732,000
		£	19,332,000	805,000	69,253,000	2,886,000

Note.—This statement deals with expenditure on Main Roads only, and excludes expenditure on Developmental roads and roads in sparsely populated areas by the Department of Main Roads and Department of Public Works respectively from moneys provided by the Commonwealth Government and the Government of New South Wales.

PAYMENTS FROM THE ROAD FUNDS FOR PERIOD 1st JULY, 1950, to 31st MARCH, 1951.

	Amount Paid. £
COUNTY OF CUMBERLAND MAIN ROADS FUND:	
Construction and reconstruction of Roads and Bridges	518,250
Acquisition of Land and Buildings for Road Widening	43,935
Maintenance and minor improvements of Roads and Bridges	548,093
Interest, Exchange and Repayment of Loans	52,322
Other Expenditure	111,709
Total	£1,274,309
COUNTRY MAIN ROADS FUND:	
Construction and reconstruction of Roads and Bridges	988,780
Acquisition of Land and Buildings for Road Widening	8,019
Maintenance and minor improvements of Roads and Bridges	2,202,846
Interest, Exchange and Repayment of Loans	107,688
Purchase and repair of Plant and Motor Vehicles	320,056
Other Expenditure	206,066
Total	£3,833,455
DEVELOPMENTAL ROADS FUND:	
Construction and reconstruction of Roads and Bridges	23,504
Other Expenditure	337
Total	£23,841
SUMMARY ALL FUNDS:	
Construction and reconstruction of Roads and Bridges	1,530,534
Acquisition of Land and Buildings for Road Widening	51,954
Maintenance and minor improvements of Roads and Bridges	2,750,939
Interest, Exchange and Repayment of Loans	160,010
Purchase and Repair of Plant and Motor Vehicles	320,056
Other Expenditure	318,112
Total	£5,131,605

British Road and Bridge Practice

Extracts from a preliminary report by J. A. L. Shaw, D.S.O., B.E., M.I.E.Aust., Chief Engineer, Department of Main Roads, New South Wales, following a visit to Great Britain during 1950.

[Further extracts will be printed in subsequent numbers of "Main Roads."]

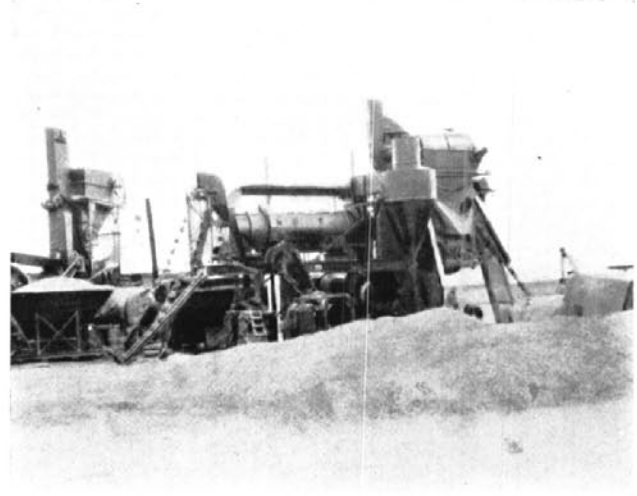
BITUMINOUS PAVEMENTS.

On Trunk Roads and major streets in the United Kingdom bituminous surface treatment of the type well-known in New South Wales and the United States is not extensively employed, even where gravel or broken stone is used for the upper courses of new pavements. Consequently, there is little re-sealing of the "spray and cover" type. Where such surface treatment is carried out, the method is similar to that employed in New South Wales or the United States, except that owing to the narrow rights-of-way and the softness of roadsides, sidetracks cannot be provided and, therefore, spraying is usually carried out half-width at a time. A greater variety of binders is available to the British road engineer than there is to the Australian engineer owing to the number of road tars and tar/bitumen compounds on the British market. However, so far as the more important roads and streets are concerned, preference seems to be for bitumen or tar/bitumen compounds and this preference is strengthened by the fact that there is less price difference between bitumen and tar than there is, currently, in Australia. At the time of my visit the landed cost of bitumen was £9 sterling per ton.

So far as the aggregate for surface treatment is concerned, and indeed for all classes of bituminous work, the British road engineer is fortunate in that practically everywhere good supplies of high-quality crushed stone or slag are readily available. In East Anglia, however, it has proved more economical for some jobs to screen river or glacial gravels from forest pits than to import crushed stone. The main point of interest to the overseas engineer is the attention paid to the selection of stone which is hard and tough with lasting sharp edges when crushed. In this latter connection I was informed that the hammer type of crushers or granulators produce a very good aggregate for use in surface dressings, as the hammering action does not result in flaws in the final product.

For programming purposes, the life of bituminous surface treatments is usually taken as four years, but in practice safe life may be six or eight years for reseals.

The more usual type of bituminous surface applied to new roads is the hot premixed macadam wearing course constructed according to one or other of the several excellent British specifications but with actual gradings, within the ranges allowed in the specifications, fixed to suit local conditions and supplies. On rural roads these premixed macadam surface courses vary in thickness from 2 inches to 2½ inches and they are almost always laid by mechanical spreading or spreader-tamper machines. The hot-mix material may be supplied from a central mixing plant owned by the road authority, but more usually it is purchased from a contractor who either has a fixed central plant or a knock-down type of plant which he sets up on the job or in the aggregate quarry, if this is nearby. At all plants that I saw there was either a fixed or mobile laboratory staffed by a laboratory technician and a labourer, whose job it was to analyse every day the grading and bitumen content of the mixes being turned out. I did not, however, note that stability tests of the pavement actually laid were being made, and in discussion on this point later on with various engineers, I was informed that it is thought that stability tests should be made.



Knockdown type Hot Mix Plant (20 tons per hour) in East Anglia.

In premixed work, as in surface treatment, a variety of binders is available but, again, the greatest use is of bitumen and tar/bitumen compounds. Particular attention is paid to the selection of aggregate and the mixes are designed so as to provide a lasting non-skid surface. If, however, any particular mix will not of itself produce a sufficient non-skid surface, it is common to spread precoated ¾-inch chips over the newly-laid premix and roll in these chips immediately behind the tamper-spreader. The rate of application of chips is 1 ton to 90/100 square yards and at this rate no two chips touch one another. The precoated chips are produced in a normal hot-mix plant, but it is preferable to use straight asphalt for the binder plus 2 per cent. of portland cement-filler, by weight. The use of straight asphalt enables the stone to be brought to a higher temperature and it is therefore thoroughly dried and the bitumen is less likely to strip.

Bus Stopping Place, Whitechapel, Liverpool, specially treated to produce rugose non-skid surface.

[Photo. by courtesy City Engineer and Surveyor's Department, Liverpool.

In city work which I saw I was impressed with the great pains taken to produce non-skid surfaces. Both in London and Liverpool, for instance, costs to £2 per square yard on surface course are incurred in order to secure the desired result, an extremely rugose surface.

In Liverpool where, perhaps, the rugosity of the city streets is not as great as that in the city of Westminster, an attempt is made to avoid all skidding of buses during starting and stopping operations by providing against the kerb a length of specially rugose pavement, using mastic asphalt, precoated chips and sicilian powdered rock asphalt. (See illustration.)

Details of the various mixes and methods used in carrying out premixed blacktop work in the United Kingdom are not given here but are available either in the British Standards Specifications or in other British publications now in the Department's library.

Where old surface-treated rural roads have to be resealed this may be done in the usual way, or the double seal coal method may be employed, *i.e.*, spray the binder, apply ¾-inch screenings, roll, spray again and apply ½-inch screenings and roll.

Should a rural blacktop road exhibit poor riding quality and require resealing, the usual treatment, and one which has been very successful in South Wales, is the application of a carpet coat of hot premixed macadam to give a depth of 1 to 1¼ inches after consolidation by rolling. Before the carpet coat is laid, usually by spreader-tamper machine, the grosser irregularities of contour are corrected by hand spotting with premixed material, but, as far as I could make

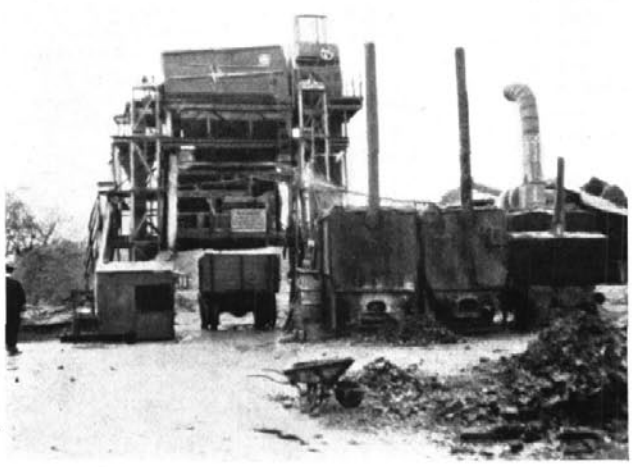
A Sub-Arterial road in outer suburbs of London. Rugose premixed macadam on cement concrete base. Note (i) wide planted median, (ii) cycle tracks between footway and carriageway with separating strip.

Portion of 3 Lane Trunk Road between Cardiff and Neath, South Wales. Premixed carpet coat on old *black top.*

Note (i) non-skid texture, (ii) plastic line markings, (iii) reduction of 3 lanes to 2 over crest, (iv) kerbed footpath, (v) grassed shoulder.

out, the corrected road is not left to traffic for a while before the carpet coat is applied. The cost of this carpet coat (to British Standard Specification) varies from 1s. 8d. to 2s. 6d. per square yard and this may be compared with 8d. to 1s. for ordinary resealing, or 1s. to 1s. 6d. for double resealing. Those roads which I saw in South Wales which had been recently provided with a carpet coat were in very good condition.

The penetration method of bituminous construction is rarely used, except for intermediate courses, and the road-mix method, as we know it, is not used at all. Something corresponding to the road-mix method is, however, carried out using scarified old surface plus a little new aggregate and bituminous emulsion for the binder. This is known as the retread method, but I did not find that it was much used on Trunk or other classified roads.



Another view of Knockdown Type Hot Mix Plant.

Regarding the machines used for bituminous work, I would say that deficiencies in the older spraying machines have been realised and new models of satisfactory types are now on the market. Considerable attention is now being given, both by spraying contractors and highway engineers, to the testing and calibration of sprayers. The plants used for production of hot premixed macadam or precoated chips are usually of the knock-down type with capacities of 10 or 20 tons per hour. I saw a variety of British made plants at work and it would appear that any one of them would be a satisfactory machine for general use.

As far as I could ascertain the cost of labour, oil and fuel at mobile mixing plants works out at 8s. 6d. per ton of hot-mix. Plant hire would have to be added to this figure, but the rates for hire vary considerably according to the contractor's or local authorities' method of accounting. At all set-ups in the field I noted that, irrespective of the make of mixer, the aggregates and the filler (cement) were fed to the top mixer hopper via a *ground hopper feeder* which is loaded by grab or front-end loader. I noted also that in some set-ups twin small diameter drier-heater cylinders were used in lieu of one large diameter single cylinder. In these connections one experienced contractor informed me that, notwithstanding whatever devices the mixing plants have for rescreening and batching the aggregates, he considered it conducive to even running of the plant and better output to have a ground feeder hopper supplying at an even rate to the driers. As to the heating cylinders he stated that his firm had found that two long small-diameter cylinders gave quicker and more intense heating and were definitely preferable to the single cylinder.

In most cases, the bitumen or other binder was heated in old style 4-wheel kettles and fired by coke. Coke is cheap in England, and until recently was readily available, but apart from this, it is considered that coke alone gives the required slow steady heat.

For spreading premix one or other of the common American types of machine is used. Drags, such as the Department uses, were not seen in England though their possibilities were known to most of the engineers to whom I spoke. For final consolidation, ordinary 3-wheel or tandem 8/10-ton rollers are used.

In the older cities, owing to narrowness of lane widths, numbers of man-holes, presence of tram-tracks, etc., it is not always practicable to use spreading machines, and in Liverpool particularly I saw a good deal of hand work being performed. It was remarkable to me what excellent permanent smoothness could be achieved by hand-spreading methods but, of course, most of the employees had had long experience.

Where an old blacktop road needs smoothing and strengthening by the application of one or more carpet coats, or even a single thick layer, it is sometimes considered necessary to remove the old surface to a depth

of an inch or so before applying the new. In towns this decision is often dictated by the loss of gutter depth due to past repeated resurfacings or by excessive crown in the old road. As in New South Wales and the United States, attempts have been made to devise a heater-planer machine which will easily and economically remove the old hard surface. So far, in England, only two combined heating and planing machines have been developed. One of these removes the old material after preheating, by a slow planing action transverse to the road centreline. The other machine has a double heater box and a series of cutters on horizontally rotating discs which can be raised or lowered to give the depth of cut required. I was informed that this machine performed very well on its first test, and it is expected that, after modification, it will be able to remove 1½ inches of old crusts, which can include stone up to 1½-inch gauge, at the rate of 600 square yards per hour.

In a discussion of the general problem of removal of old crusts containing an appreciable proportion of large gauge mineral aggregate, I was informed that, apart from the use of a special machine, it was considered that the best method of removing old crust is to have a separate heater unit, followed by a heavy blade grader. This view may be compared with the similar consensus of opinion in America, where there are one or two makes of combined heater-grader-planer units available.

In concluding this section on British bituminous practice, it is necessary, I think, to make some general observations. Firstly, it is important to remember that, with a few exceptions, all bituminous work in the United Kingdom is carried out on well-drained, adequately thick base courses. Where the base is not cement concrete—as is mostly the case in towns and cities—they may be gravel or broken stone well compacted, with an intermediate course of penetration, open-graded premixed bituminous macadam or even precoated 1½-in. metal. In most cases the depth of base and intermediate courses is not less than 8 inches for cement concrete and not less than 10 inches, but more usually 11 or 12 inches for gravel and metal.

Secondly, it has to be remembered that British practice provides good protection against entry of water at the edges of pavements and protection also against the nibbling effect of traffic. This is done either by the provision of high-quality precast or cast-in-situ concrete kerbs or by an edging of stone setts 12 to 18 inches wide. These provisions for adequate drainage, base thickness and edge protection are good insurances for the long life of bituminous pavements, which is the aim of most British design.

Thirdly, the aggregates used in bituminous work are always of high quality.

In general, it is the British practice, in respect of main roads and important city streets, to build surface courses which are intended to last for fifteen to twenty years without requiring more than minor attention.

Owing to the relatively small mileage of main roads in Britain in comparison with the United States and Australia, and because of adherence to "old pads," as well as to the availability of good aggregates and commercial premix plants, the designers' intention of long life can be achieved, or approached, even to-day with the limited funds available. The distance between towns or villages in Britain is quite small, so that high-class work can begin and end at points of definite traffic significance; there is no lack of continuity of pavement type between towns, as so often happens in Australia. Stage construction of a pavement is not needed or thought of either in length or thickness—that device is limited to the widening of roads.

BRIDGE CONSTRUCTION.

Very little new bridge construction is in hand owing to the limitation of funds, but very considerable repair work is being, and will have to be, done to the old bridges in order to keep them serviceable for the present volume and weights of traffic. At least once a week a bridge failure, or partial failure, occurs of old bridges, either masonry or steel, of 50-feet span or under. It was stated that in fact, 80 per cent. of the bridge problem in Britain relates to the strengthening, renewal or widening of bridges under 50-feet span.

A very considerable volume of repair work is being done to concrete bridges by the "Gunite" process and the bulk of the work is required on bridges about 25 years old. "Spalling" of concrete has been very marked in bridges of this age group and it is thought that this is due either to faulty design, bad construction supervision, or poor concrete. The spalling is particularly bad on bridges exposed to salt water and salt air due to the porous concrete and the thin cover for the reinforcement. It was stated to me that in some of these bridges quite large cavities were found in the concrete beams commencing about ¼ inch inside the surface of the beam. Most of the cavities were holding water.

Although little new bridge construction is being undertaken at present, there is considerable activity in designing new bridges which it is hoped to build as soon as the funds position permits.

Generally speaking, in the United Kingdom beam spans, whether in steel or concrete, continuous or discontinuous, are preferred to truss spans. Where conditions require the use of truss spans, the deck type is preferred to the through type, but an exception is in the use of Callendar-Hamilton trusses. A number of these "stock-span" trusses are being used for semi-permanent civilian bridges.

As regards reinforced concrete bridges, the continuous type with, perhaps, an arch-like appearance is commonly proposed for the larger spans. For the small and medium spans, continuous or simply supported beams are used, but there is a tendency now to consider the use of pre-stressed simply supported beams in the case of spans up to about 80 feet.

In respect of steel bridges, there has been great development in the design of riveted or welded plate web girders mainly of the continuous type for the larger spans and it is, in fact, the development of these long

span plate web girder bridges which has minimised the use of truss bridges such as we know them. Smaller spans may be bridged by straight simply supported plate web girders, welded or riveted, or by R.S.Js which may have welded on stiffeners. In all cases the carriageway deck is of reinforced concrete and where R.S.Js are used for girders, it is becoming increasingly common for the concrete deck slab to be made composite with the girders by the use of spiral sheer transfer devices welded to the top flanges of the R.S.Js. It is thought, however, that where composite concrete and R.S.J. bridges are to be built, the R.S.Js should be of a special section (rolled or built-up) providing a bottom flange considerably wider than the top flange.

As to whether welding or riveting should be used in the fabrication of plate web girders and trusses, I was informed that the Ministry of Transport accepts suitable designs of plate web girders providing for fabrication by electric welding, but, at present-day prices in Britain it is generally cheaper to carry out riveted designs than welded. So far there has been no building up, by welding, of bridge members of the same size and plate thickness as has been done in New South Wales. Where welding is used shop inspection is very strict and also in the field if welded splices are permitted. In addition, welds may be subject either to X-ray examination by semi-portable sets installed in welding shops, or by the supersonic method in the field. The shop X-ray units are rather heavy and limited in penetration but the supersonic test equipment is easily portable and is being used at present fairly extensively in the field for the detection of flaws in butt-welding of heavy plates.

As stated above, there is little new bridge construction in progress in Britain, but there is activity in building up at various centres stock-piles of bridge components which can be used for rapid replacement of bridges which may be destroyed by floods, or fractured by traffic. Stock-piling is being done in three categories—

1. 10 to 20 feet span pre-cast reinforced concrete beams.
2. 20 to 50 feet span R.S.Js. with or without vertical and horizontal stiffeners.
3. 50 to 100 feet Callendar-Hamilton spans.

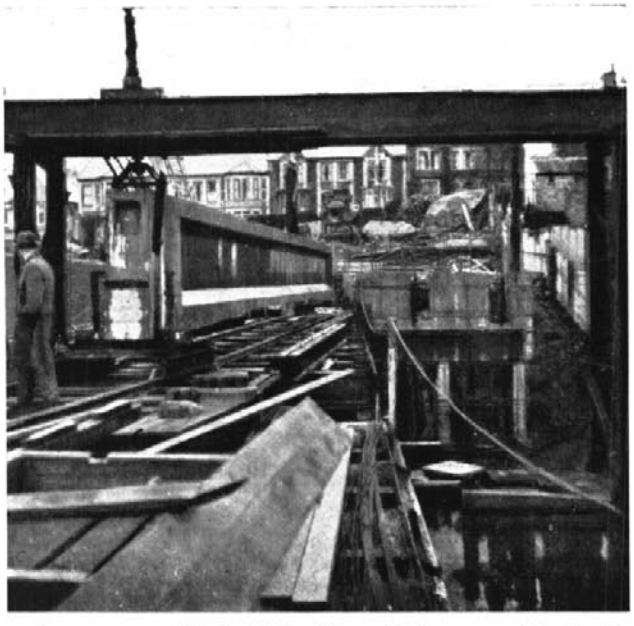
In regard to the use of aluminium and aluminium alloys as an alternative to mild steel, I was informed that, although there has been some use of these materials in railway bridge and dock wall construction, it is not likely to extend to normal road bridging programmes owing to the high first cost of the raw material.

Apart from small box and arch culverts in reinforced concrete, the only new bridge construction which I was able to see in England and Wales consisted of the following:—

1. The double lift steel bascule span bridge over the Blackwall River in the London area.
2. A very large steel plate web girder deck bridge over the River Neath in South Wales (main span 300 feet, including a suspended span of 124 feet 6 inches).
3. A single span (79 feet) pre-stressed reinforced concrete bridge over a railway line at Abertillery, South Wales.

Some technical details of these three bridges are available and descriptions of the methods of construction. It is of interest to note here that the two steel bridges were being constructed by the Cleveland Bridge and Engineering Company, which has been awarded the contracts for the construction of The Spit Bridge, in New South Wales. Both steel bridges are of riveted construction throughout and the piers of (2) are either of braced steel on concrete bases or reinforced concrete on caissons sunk through mud to hard stratum. In both bridges (2) and (3) the finish of the concrete work was very good due to the use of steel forms or plywood-lined timber forms.

The pre-stressed reinforced concrete bridge at Abertillery in South Wales is, I consider, a good example of current British practice in this type of work, carried out according to the Freyssinet method.



A pre-stressed R.C. Girder (for a 79' span road bridge) being launched into position over deep railway cutting and creek—Abertillery, Wales, Freyssinet system of pre-stressing.

LOW-COSTS ROADS IN SCOTLAND.

For main roads in Scotland "road gravel" is no longer used in the construction of the pavements. The chief reason for this position is that suitable gravel is now scarce whereas good stone for crushing is available everywhere within easy reach of any job. Also, economical modern crushing plants of a portable type can be readily purchased or hired.

In the past, as an alternative to road gravel, broken stone "dry-macadam" pavements have been constructed

using basalts or granites, 2 to 2½ inches nominal gauge, with screenings and selected gritty earth for a binder. Recently, however, the use of gritty earth has been discontinued and the normal so-called low-cost roadway in the Highlands consists of a "bottoming" (base course) 6 inches thick of 4 inches-1½ inches crusher-run stone on which is laid a 2-inch course of precoated 1½-inch gauge crushed stone. After one year of traffic use a final top course of hot pre-mixed macadam up to 2½ inches thick is laid.

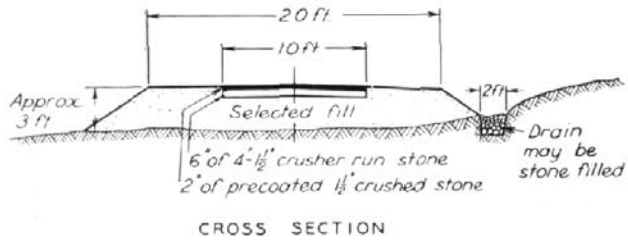
Where, however, some of the old surface treated gravel or dry macadam roads have to be strengthened and restored as to riding quality, the general method is to lay a carpet coat of hot premixed macadam 1 inch to 1¼ inches consolidated depth. This coat costs 1s. 8d. to 2s. 6d. per square yard and it is made up of ¾-inch down to ⅛-inch crushed aggregate plant-mixed with 85-100 bitumen, or one of the many tar/bitumen binders on the British market. Carpet coats are spread by machines when there is sufficient length to justify bringing the spreader or spreader-tamper to the job.

If the old surface treated gravel or dry macadam road has good riding quality it may be resealed with bitumen of tar/bitumen compound, at .20 to .25 gallons per square yard with cover stone of ¾ to ½ inch gauge spread at the rate of 1 ton to 80-100 square yards.

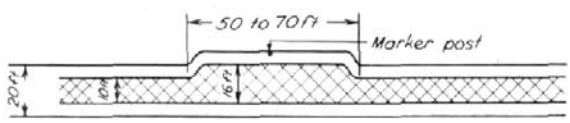
In the Highlands the lowest type of road now being constructed with assistance from the Ministry of Transport is the single-lane "Crofter" road, but at an average cost of £20,000 per mile (including the cost of small bridges) they can hardly be classed as low-cost roads by Australian standards.

These Crofter roads have a cross-section as indicated below and are intended to carry mixed traffic up to 300 vehicles per day in the summer. Where more than this volume of traffic is expected to arise following completion of the road, the width of pavement is increased to 16 feet, which is regarded as the minimum for two lanes in the Highlands.

ONE-WAY CROFTER ROAD
SCOTLAND



CROSS SECTION
ON EASY SIDE SLOPE



PLAN OF PASSING PLACE

The Crofter roads are designed for travel at 30 m.p.h., but where heavy rock work is required, the design speed is reduced to 25 m.p.h. Where it is necessary to adopt steep grades, *i.e.*, over 8½ per cent., or where curves have necessarily to be very sharp, a length of two-lane road is inserted over the difficult section.

The principal feature which makes these Crofter single-lane roads interesting to us is that the surprisingly high traffic capacity is achieved by the construction of vehicle passing places within sight of one another but at not less than 12 to the mile. These passing places have a length of 50 to 70 feet and the pavement over this length has a width of 16 feet. All crossing places are marked by a white diamond-shaped sign of 9-inch sides, supported 6 feet above the road by a post painted with black and white bands. I passed over several of these Crofter roads and noted that the passing manoeuvres were very easily carried out, but, of course, it is to be expected that on occasions in the tourist season some driving in reverse may be necessary where a motorist fails to see the on-coming vehicle and overruns a passing place.

Parts of the Crofter roads which I saw were on flats, in gullies or across upland moors. In all such locations the roadway is on embankment at a height of about 3 feet above the surrounding ground in order to avoid the accumulation of drift snow. Where the ground on the flats, or even on sidelings is peaty it is removed if it is only 2 to 3 feet deep, but in those cases where the peat bed is thicker than this the roadway embankment (3 feet high) is built up without disturbing the peat or the heather cover. It was stated to me that in such cases there is movement of the embankment but it is quite slow and more or less even.

SNOW CLEARING IN SCOTLAND.

During the time I was in Scotland heavy falls occurred and snow ploughs were at work, but I did not see any of the rotary type. I was informed that a high-wing snow plough, made in Scotland, for attachment to extra heavy six-wheel trucks, was very good for opening a track 8 feet wide through drifts up to 6 feet deep. This plough is hydraulically controlled and the bottoms of the plough blades being on skids, it is safely practicable to drive into drifts at 20 m.p.h. and continue through at 15 m.p.h.

In the Shetland Islands, removal of snow is effected both by "V" plough and rotary machines. I was informed that a rotary plough of American origin does good work in dry snow and has the advantage, over high-wing ploughs, that it throws the snow clear of the road at any truck speed.

In one Scottish county, the surveyor uses both "V" type snow ploughs and rotary ploughs, the rotary being used principally where it is desired to throw the snow clear of the full width of the road. This rotary machine is now made in England under license from American manufacturers and I understand that there are now eight such units situated in the north of England for clearing the Trunk and other classified roads.

A Trunk Road near Fort William, Scotland. (Traffic not hindered by the 6 inches of snow which has fallen but a further similar fall will require clearing by plough.)

It is understood that no particular difficulties are experienced in Scotland in keeping clear, or opening, a selection of the main roads during the snow season, provided that where roads have to be kept clear the crews are set to work as soon as possible after the snow begins to fall.

As regards the control of snow clearing operations by radio, it was learned that only in Lanarkshire is this done.

TRAFFIC LINE MARKING.

On the two-lane main routes in rural England and Wales there is some traffic line marking—carried out much in the same manner as in New South Wales—using yellow and white lacquer paint. Some experiments have been made, particularly in foggy areas, using glass beads set in the paint either before or after spraying. There has also been some use of white lines in thermo-setting plastic and in vulcanised rubber.

In general, however, the most common arrangement is glass reflector units set in the centre line of the pavement at intervals sometimes as close as 12 feet, but usually about 24 feet. The centre line may or may not be marked by paint or plastic. The general principle of the reflector unit is that two glass reflectors are mounted at each end of a flexible rubber pad which is sprung into a metal box-like container set in the road surface, such setting being done with bitumen filled with slate or limestone dust. When a vehicle wheel passes over the white rubber pad holding the reflectors this is depressed into the box and the reflectors are wiped by a soft rubber pad lining the box. After the wheel has passed the reflectors in their pad rise to their normal position. The life of the pad containing the four reflectors varies from two to four years according to traffic conditions.

This type of centre-line or lane marker is generally considered more effective in fog and at night than the painted and beaded line. It was my own experience in both fog and rain at night, that these "cat's-eyes" had a remarkable brilliancy.

There appeared to be very many thousands of these reflector units installed on the main roads and suburban streets of England.

4 Lane Trunk Road from Liverpool to Manchester (The East Lancashire Road) near Liverpool. Premixed macadam on cement concrete base. Note (i) kerbed edges and grassed verges, (ii) plastic lane marking with reflectors in centre line.

It should be pointed out, however, that in some cities yellow or white painted or plastic guide lines alone are used to divide multiple-lane roads, and also to delineate areas of pavement which must not be entered upon by traffic as well as, to mark, in conjunction with bright metal studs, the position of pedestrian crossings.

Turnpikes in Early New South Wales

The first turnpike in New South Wales had been erected in 1802, at a time when the turnpike system of road finance was widely used in Great Britain, and it was the British precedent that led to the institution of the turnpike system in early New Souh Wales.

The word "turnpike" was originally applied in England to an upright post surmounted by a horizontally revolving wooden cross, the ends of which were kept sharpened. It was studded with spikes or pikes—hence "turnpike." In time, the pikes were omitted, leaving only the wooden cross. This device had been commonly used to prevent horses from entering narrow streets in English medieval towns. Nowadays, we should probably call it a "turnstile." A character in a Ben Jonson play uses the words—"I move upon my axle like a turnpike".

By the seventeenth century, the name "turnpike" was being applied to the pivoted or hinged bar or pole used to close a road until toll had been paid. The word "turnpike" was frequently used in early Acts and statutes—*e.g.*, "turnpike or otherwise", "turnpike or gate", and so the turnpike gave its name to a system of highway finance by means of tolls, even though the word later disappeared from British Acts in favour of "gate or bar".

The Beginning of the Turnpike System in Britain.—The turnpike system was introduced in England during the seventeenth century, and developed rapidly during the eighteenth and early nineteenth centuries, until the coming of railways diverted most long-distance traffic from the roads.

About the middle of the seventeenth century, the number of coaches increased rapidly, and thus attention was drawn to the bad state of the roads, coaches had to cease running in autumn and winter, and to the need for some systematic attempt at improvement. To finance the road improvement required to meet the new traffic conditions, it was then proposed that those who used the roads should pay for them. In 1663, by the first English Turnpike Act, the first toll gates on a main rural road were established. The tolls were:—one penny for a horse, sixpence for a coach, eightpence a cart, a shilling a waggon, a score of sheep or lambs a halfpenny, cattle fivepence, and pigs twopence.

From 1663 to 1710, only a few isolated attempts were made to improve roads by means of tolls levied on travellers, but between 1710 and 1750 one hundred and fifty turnpike Acts were passed. Turnpike trusts erected toll houses and turnpike gates on the roads, and all who passed had to pay a toll. Each turnpike had a "Pikeman" in charge of it, and it was his duty to collect the "tolls" from travellers. The money so collected was to be used by the trust for the upkeep of the road for a specified distance, and the remainder was to go to the pikeman.

By 1750, extension of the toll system was seen as the only solution to the problem of meeting the cost of roads, and the yearly average of new turnpike trusts rose from three to twenty. During the second half of the eighteenth century, the number of turnpike trusts established by parliament increased steadily, until early in the nineteenth century they numbered eleven hundred, controlled twenty-three thousand miles of road and, in 1837, had a toll revenue of one and a half million pounds per annum.

Opposition to the turnpike system often resulted in riots in which toll barriers and the toll houses were pulled down, and toll keepers assaulted. In 1734, parliament passed a law imposing the death penalty for destruction of a turnpike.

The railway era commenced with the opening of the Stockton and Darlington railway line in 1825 and the Liverpool and Manchester line in 1830. As a result, travel by road coach ceased on routes served by the railways, and the turnpike system was largely deprived of its revenue. Whereas each stage coach had been paying about seven pounds per mile per annum in tolls, now tolls brought in practically no revenue at all. Turnpike trusts went out of existence, and road maintenance again became a local responsibility. The last turnpike trust was abolished in 1895.

Turnpikes in New South Wales.—It was in 1802 that permission was granted to Andrew Thompson, an early settler and constable, to collect tolls for fourteen years, and on this surety he constructed the first bridge over South Creek at Windsor. It was a pontoon bridge, and it was Andrew Thompson's duty to keep it in constant repair, accidents by flood or fire excepted. The rates of tolls were: for a foot passenger, fourpence, or ten shillings per annum; for a horse, two shillings, or two pounds ten shillings per annum; for a cart or carriage, one shilling and sixpence, or one pound ten shillings per annum. No person other than Andrew Thompson was allowed to convey people, horses or carts across the South Creek, on pain of a five pounds fine for each offence.

In 1813, a log bridge was erected by the trustees of Thompson's estate, in place of the pontoon bridge. This bridge was destroyed and was rebuilt about 1830. In 1848, it, in its turn, was replaced by another wooden bridge, and this was later superseded by an iron bridge in 1879-80. Tolls were collected on all these bridges until 1887.

In 1810, the *Sydney Gazette* of March 24th published the following: "It having been represented to His Excellency the Governor (Macquarie) that the Settlers at the Hawkesbury and Parramatta suffer considerable difficulties from the want of sufficient roads to convey their various produce to market at Sydney, and that they are anxious that Toll Bars should be erected at convenient distances between these places in order to raise a fund for the putting said roads into good repair and for their being regularly kept in good Order: This is therefore to give notice that His Excellency is disposed to approve of the erecting Toll

George Street Toll Gate erected in 1819 on site now known as Central Square.

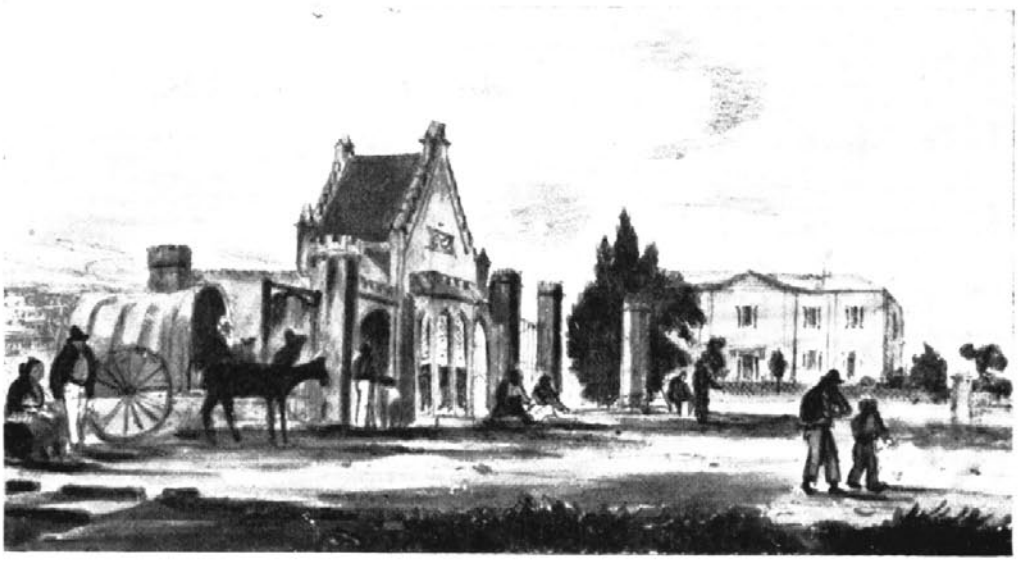
Gates and to establish certain rates thereon, for this beneficial object. All persons wishing to contract for said Toll Bars and repairs, are required to give in to the Secretary's office on or before 31st instant, in writing, the Terms on which they are disposed to undertake this Service. The Tenders must express the extent of road that will be made good, each month until the whole is completed, and specify such securities for faithful performance of the Terms of the Contract as may be deemed adequate by His Excellency—a Lease of said Tolls will be given for Seven Years (soon afterwards it was decided that tolls would be let for ten years), to whomsoever may offer the most eligible Terms of Contract."

From 1810 onwards, the *Sydney Gazette* had frequent notices announcing forthcoming auctions of tolls, which were held in the Sydney Market Place. In the issue for 15th December, 1810, for example, there appeared the notice: "The Public Road between Sydney and Parramatta being nearly completed, His Excellency the Governor has directed us to give notice that two Toll Bars will be erected thereon, viz. one at Sydney and the other at Parramatta, and that the Tolls arising therefrom will be let on Monday, 24th instant at a Public Auction, by Mr. Gaudry to the highest bidder for one year from the first day of January next, on his giving adequate Security for the Payment."

On 10th April, 1811, the reconstructed Parramatta Road was opened and two toll bars were erected: one near the site of Christ Church St. Laurence near the Central Railway Station, the other at A'Beckett's Creek, Parramatta. The cost of the road was met in the first instance out of the Police Fund, which was raised mainly on a duty of three shillings per gallon on spirits. The advance was repaid from the tolls since "all Persons riding, leading or driving any Horses, Mares, Geldings, Cattle, Sheep, Swine, Mules or Asses on the said Road, or using any Carriage, Gig, Chaise, Cart or Waggon on the said Road, or through the Turnpike Gates now established on the said Road, or either of them, shall pay to the Gatekeeper, thereof, or his Assistant, for the same" (*Sydney Gazette*, 30th March, 1811).

Provision was also made for those who made detours rather than pay toll, and all those who avoided payment were liable to a fine. In connection with fines, the following extract from the *Sydney Gazette* of 31st March, 1813, may be quoted: "South Head Road has been much cut up and injured by the Cars, Carts and Waggons passing over it for the Purpose of conveying Fire-wood from the adjacent Lands to make Sale at Sydney; and it being clearly ascertained that this practice has not arisen out of any Superior Faculty in procuring Fire-Wood in this direction, but from the

Toll Gate at A'Beckett's Creek on the Parramatta Road near Parramatta. Erected in 1811.



Another view of the George Street Toll Gate.

Sole motive of the Owners' avoiding the Toll to which they were subject when they brought the said Fire-Wood from the usual Grounds through the Turnpike, on the main road leading hence to Parramatta, His Excellency the Governor has deemed it expedient that all Cars, Carts . . . loaded with Firewood, Lime, or any other goods or Merchandise of whatever sort, which shall in future proceed along the said South Road from Botany Road, or elsewhere, to the Town of Sydney, shall, on and after 15th instant, pay the same Rate of Toll they would be liable to if they were to pass through the Turnpike Gate on the Road to Parramatta . . . His Excellency has lately caused a Toll-Gate to be erected on the said Road, leading from Sydney to the South Head, on the Boundary of Mr. Palmer's Lands at the south east extremity of Hyde Park, and this Toll-Gate being now completed at the Expense of the Government, the same Toll Dues are in the future to be demanded and paid there on all Cars, Carts, and Waggons passing through it, as at the Toll Gate on the Main Road to Parramatta."

In 1815 the revenue which accrued from tolls, after deducting the cost of collections, was four hundred and sixty-five pounds. In 1844, tolls at Lansdowne Bridge alone brought in nearly seven hundred pounds. Revenues went to form a fund used for the making and maintaining of public roads, bridges and ferries throughout the colony.

Growth of the Turnpike System.—Once the turnpike system was established it spread rapidly. On the 28th April, 1814, Governor Macquarie wrote: "The Road from Sydney to Windsor has Turnpikes on it in the Neighbourhood of the Towns of Sydney, Parramatta and Windsor (actually it was about 8 miles from Windsor, at Rouse Hill), and it is my intention to erect Turnpikes on that leading to Liverpool, and thence to Parramatta in the centre of the main street. The labourers are to continue at their work eight hours each working day."

In the district of Sydney, in addition to the toll bar at the site of Christ Church St. Laurence already mentioned, others were set up at Randwick, at the junction of Oxford and College Streets, on the Newtown Road near the Deaf and Dumb Institution, on Parramatta Road near the University, and at Rushcutter's Bay. There were five toll bars on the Great Western Road between Parramatta and Mount Victoria.

Frequently proclamations would appear, *e.g.*, in the *Government Gazette* of the 15th June, 1836, there appeared the following notice: "There shall be a Toll-Gate—

(1) On the road from Sydney to Parramatta, at the top of the hill at Grose Farm (now University grounds) where a new Toll-Gate has been erected, instead of at the former Sydney Toll-gate near the Benevolent Asylum, which has been taken down and removed (in 1839, this toll gate was removed again to Annandale Bridge).

(2) On the old Botany Road at or near its junction with the road from Sydney to Parramatta, near the Benevolent Asylum.

(3) On the Cook's River Road, at or near its junction with the road from Sydney to Parramatta, near the Brisbane Distillery."

Authorisation for a turnpike in the Illawarra district is given in the following proclamation, which appeared in the *Government Gazette* on the 3rd January, 1845: "I, Sir George Gipps, Knight, Governor of the said Colony, for the time being, do hereby authorise the Trustees of the said Jamberoo and Kiama Parish Road to grant a lease or leases of the Tolls to be collected thereon; . . . and I do hereby further approve of the erection of a Toll Bar on the said Parish Road, at the distance of one mile or thereabout, from Kiama, and adjoining the land occupied by the members of the Scotch Church as a Burial Ground."

Each toll-keeper had to erect a notice giving the name of the toll bar and a list of toll charges; they had also to keep books in which were entered each day's receipts, the books being inspected weekly by the Commissioners of the Roads. The toll keepers were allowed 10 per cent. of the toll revenue.

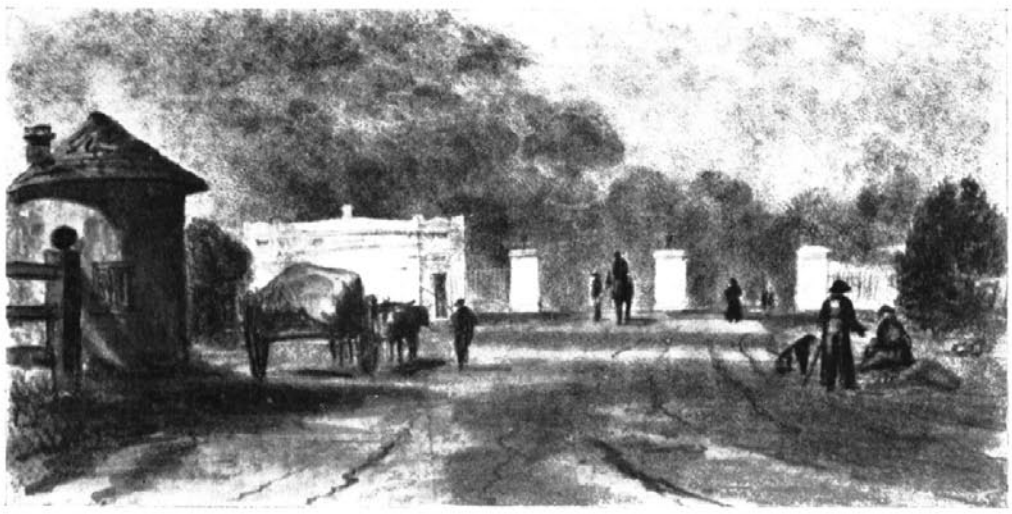
LACHLAN MACQUARIE.
Governor of New South Wales, 1810-1821.

The road toll charges in 1832 were for a sheep, lamb, pig or goat, a farthing; for an ox or a head of cattle, a penny; a horse, mare, gelding, ass or mule, twopence; a cart, dray or two-wheeled vehicle drawn by one horse or by one other animal, threepence; if drawn by two horses, fourpence, by three, fivepence, by four, sixpence, and so on; for every waggon or carriage with four wheels drawn by two horses, or two of any other animal, the charge was eightpence; if drawn by three horses, ninepence, by four horses, tenpence, and, for every horse above four, another twopence. Toll dues were double on Sundays; but, if a toll had been paid at one gate, no further toll could be demanded for 10 miles, and a gate could be repassed any number of times in the one day without further payment. At the ferry at Emu Ford, there was a special notice which said that "the young of every kind," if not yet weaned, were to be charged half price.

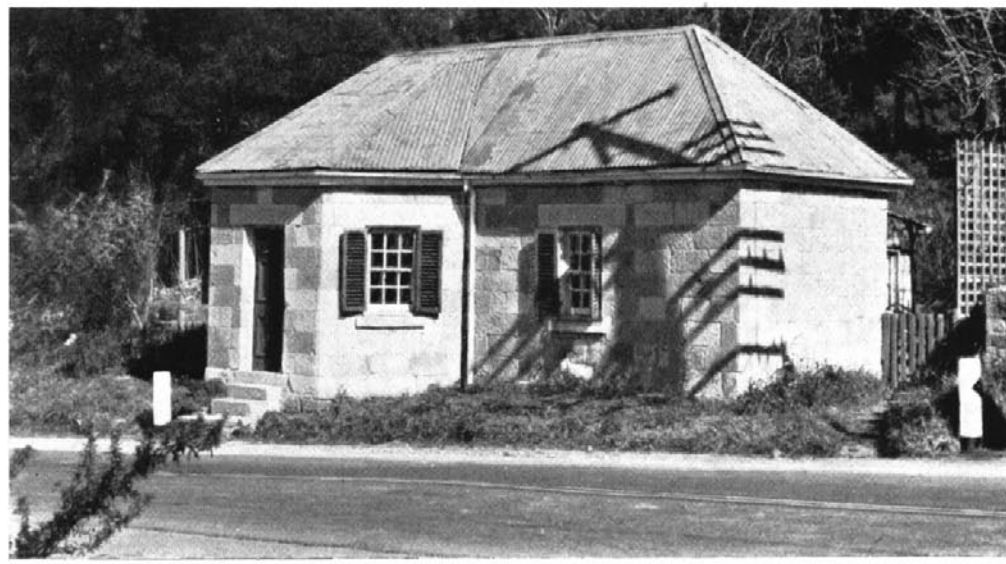
Certain exemptions from payment of tolls were granted to the army, to the governor and any person attending him and his family, to clergymen and "for or in respect of any horses, beast, carriage or other vehicle, conveying any clergyman in the discharge of his duty, or any other person or persons going to or returning from the proper church, chapel or other place of worship, of the person or persons riding or driving the same on Sundays, Christmas-day, or Good Friday; for or in respect of any horse, beast, carriage or other vehicle, attending funerals; for or in respect of any horse, beast, carriage or other vehicle, carrying the post-office mails; or for any carts, drays, or waggons, carrying manure; or for any horse, beast, carriage or other vehicle, which shall only cross any such turnpike-road, or shall not pass thereon above the distance of two hundred yards . . ." (*Government Gazette*, 21st March, 1832; par. VIII.)

One noticeable contrast of the Australian with the British turnpike system was that in Australia there was virtually no opposition as in Britain. As early as 1811 Governor Macquarie wrote: "The Rate of Toll established on the Parramatta Road has been on so moderate a scale that no Murmur or Complaint has ever been raised against it, the People feeling much pleased and happy with the Accommodation afforded them." (*Historical Records of Australia*, vol. VII, p. 386.)

Decline of the Turnpike System.—The decline of the turnpike system began with the passage of the Municipalities Act in 1858, which authorised the establishment of Municipalities, which were given the care of all public roads, bridges and ferries in their area, and



Toll Gate at A'Beckett's Creek on the Parramatta Road near Parramatta. Erected in 1836.



Old Toll House on the Great Western Highway at Mt. Victoria.

were empowered to levy rates. Under the Act, thirty-five municipalities were incorporated including such suburban municipalities as Paddington, Newtown and Hunter's Hill and country areas such as Albury, Bathurst and Grafton.

Outside the Municipalities, the Government accepted responsibility for roads, control having been transferred to the Public Works Department in 1858. In this latter year the Government passed a "Main Roads Management Act" which set out a list of main roads and transferred the responsibility for them to the Government. The funds for their upkeep were to be provided from consolidated revenue, aided by receipts from tolls. At that time there were ten toll bars in existence on the main roads (yielding a nett revenue of £8,957 in 1857) comprising:—

Five on the Western Road, and a ferry at Penrith.
Two on the Southern Road, and a ferry at Gundagai.
Three on the Northern Road.

This number had been increased to thirty-four in 1865 (yielding a nett revenue of £22,000 per annum), comprising:—

Thirteen on the Western Road and ferries at Penrith and Wellington.
Eleven on the Southern Road and a ferry at Gundagai.
Ten on the Northern Road and ferries at Singleton and Aberdeen.

With the expansion of local government (eighty-seven municipalities had been incorporated by 1880), and increasing public opposition to the turnpike system, the Government in 1877 abolished all tolls on roads throughout the State.

ACKNOWLEDGMENTS.

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The Public Library, New South Wales.
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The Royal Australian Historical Society, Sydney.
—P.F.O.

SYDNEY HARBOUR BRIDGE ACCOUNT.

Income and Expenditure for Period 1st July, 1950, to 31st March, 1951.

Income.	£
Road Tolls	388,839
Contributions—	
Railway Passengers	98,541
Tramway Passengers	10,154
Omnibus Passengers	9,736
Rent from Properties	10,183
Miscellaneous	297
	£517,750

Expenditure.	£	£
Cost of collecting Road Tolls		31,267
Maintenance and minor improvements		44,786
Alterations to archways		346
Construction of new Toll Barrier and Office		3,737
Administrative Expenses		2,290
Loan Charges—		
Interest	174,750	
Exchange	18,450	
Sinking Fund	50,625	
Management Expenses	1,500	
		245,325
Miscellaneous		425
		£328,176

Australian Road Statistics

The following road statistics have been compiled for the Annual Conference of State Road Authorities from data supplied by the individual States. Commonwealth Territories are not included.

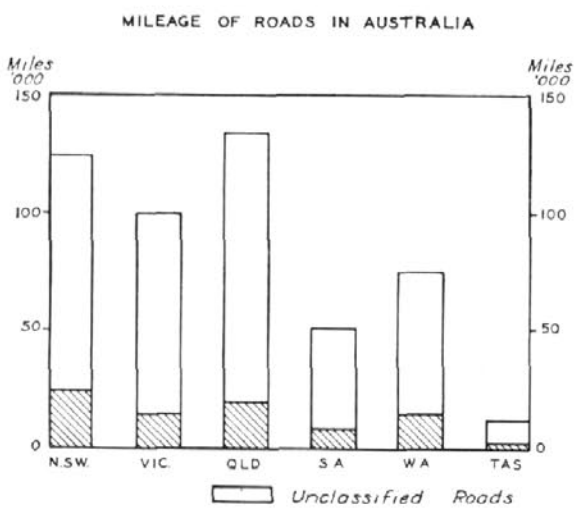
Earlier statistical data appeared in "Main Roads" Vol. 8 Nos. 1 and 2, November 1936 and February 1937.

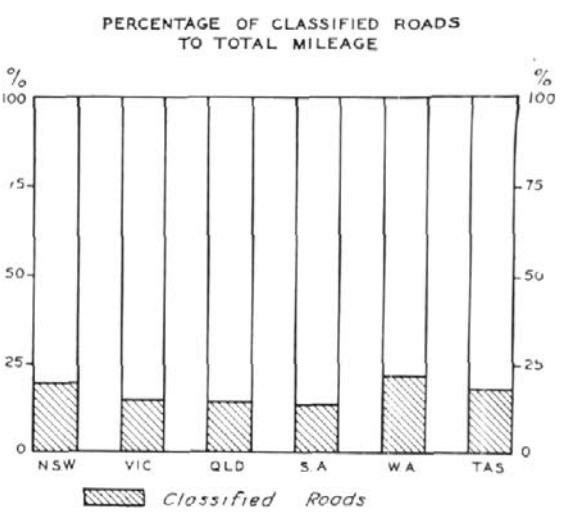
1.—MILEAGES OF ROADS IN AUSTRALIA AT 30th JUNE, 1950.

State.	Mileages.			Percentage of Total Mileage.		Total.
	Classified Roads.	Unclassified Roads.	Total.	Classified Roads.	Unclassified Roads.	
	miles.	miles.	miles.	per cent.	per cent.	per cent.
New South Wales	26,023	100,927†	126,950	20.50	79.50	100
Victoria	16,593	88,000	104,593	15.86	84.14	100
Queensland	20,608	114,755*	135,363	15.23	84.77	100
South Australia	7,554	44,643	52,197	14.47	85.53	100
Western Australia	15,997	58,030	74,027	21.60	78.40	100
Tasmania	2,187	10,142	12,329	17.74	82.26	100
TOTAL	88,962	416,497	505,459	17.60	82.40	100

* At 30th June, 1949—Latest information available.

† At 30th June, 1948—Latest information available.





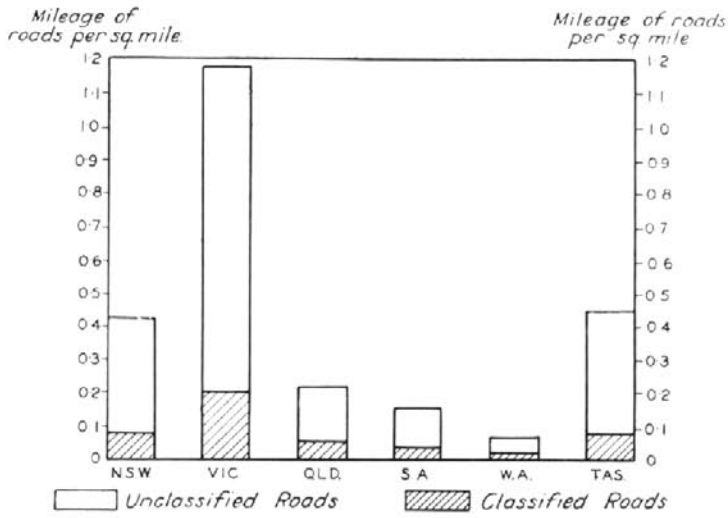
2.—RATIO OF MILEAGE OF ROADS TO AREA AT 30th JUNE, 1950.

MILEAGE OF ROADS PER SQUARE MILE.

State.	Area.	Classified Roads.	Unclassified Roads.	Total.
	square miles.	miles.	miles.	miles.
New South Wales ...	300,433	0.08	0.33	0.41
Victoria	87,884	0.19	1.00	1.19
Queensland	670,500	0.03	0.17	0.20
South Australia ...	380,070	0.02	0.12	0.14
Western Australia ...	975,920	0.01	0.06	0.07
Tasmania	26,215	0.08	0.38	0.46
TOTAL	2,450,022*	0.04	0.17	0.21

* Excludes Australian Capital Territory and Northern Territory.

RATIO OF ROAD MILEAGE TO AREA

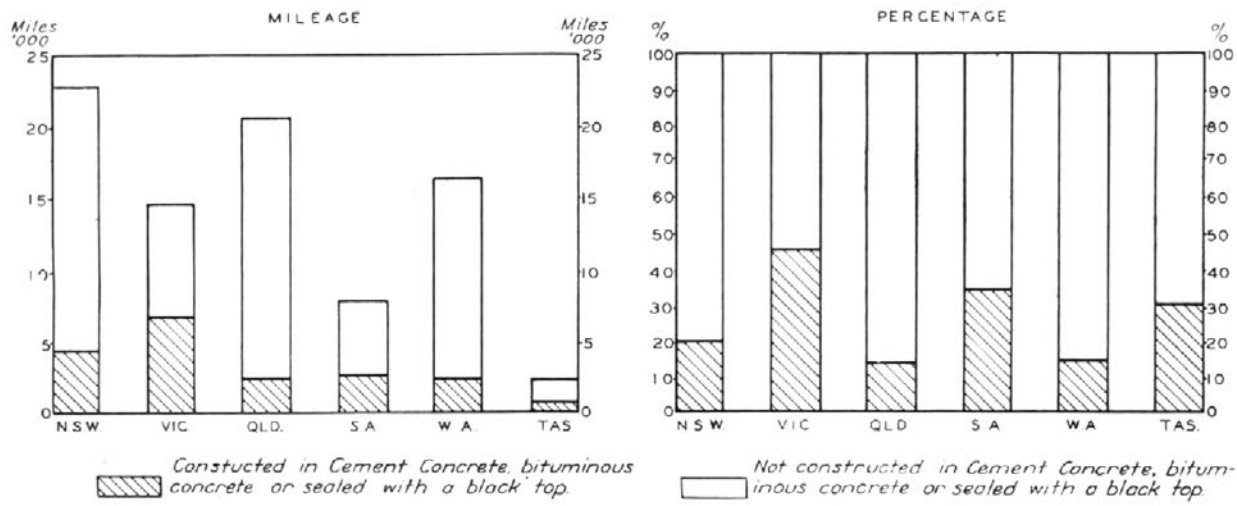


3.—CLASSIFIED ROADS—MILEAGE OF CONCRETE AND SEALED PAVEMENTS.

State.	As at—	Total length of classified roads.	Classified roads constructed in cement concrete, bituminous concrete or sealed with a black top.	Percentage of total length of classified roads.
		miles.	miles.	per cent.
New South Wales	30th June, 1949	22,678*	4,389*	19.36
Victoria	30th June, 1950	14,303*	6,477*	45.28
Queensland	30th June, 1949	20,608	2,399	11.64
South Australia	30th June, 1948	7,556	2,430	32.16
Western Australia	30th June, 1949	15,997	2,051	12.82
Tasmania	30th June, 1949	2,216	684	30.87
		83,358	18,430	22.11

* Excludes Developmental roads.

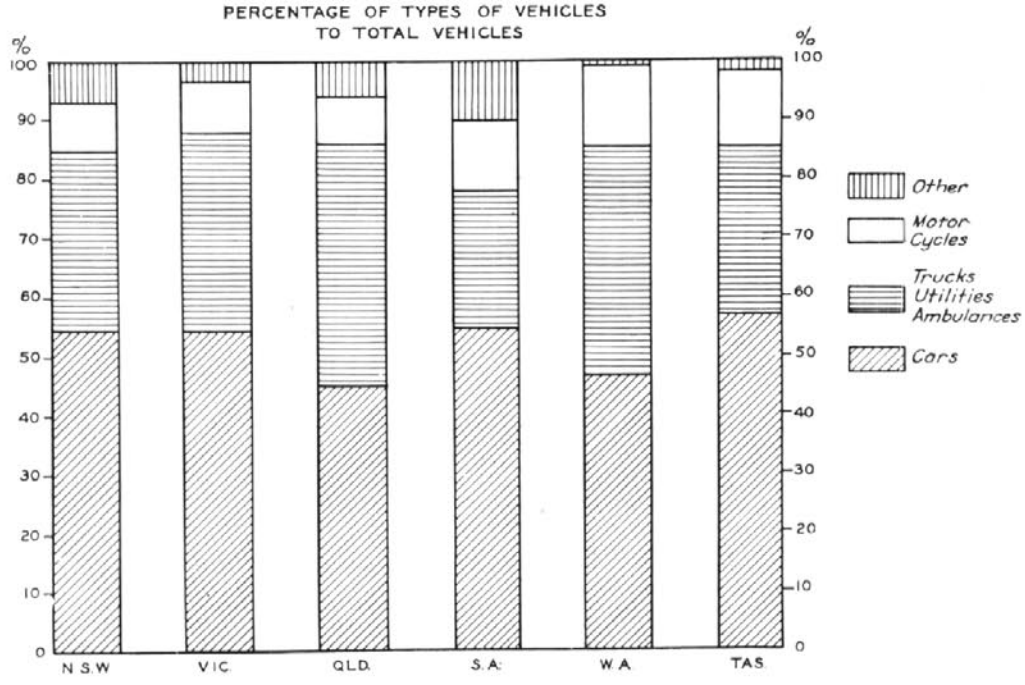
CLASSIFIED ROADS



4.—REGISTRATION OF MOTOR VEHICLES IN AUSTRALIA AT 30th JUNE, 1950.

State.	Number of vehicles.					Percentage of total vehicles.				
	Cars.	Trucks utilities and ambulances.	Motor cycles.	Other.	Total.	Cars.	Trucks utilities and ambulances.	Motor cycles.	Other.	Total.
						per cent.	per cent.	per cent.	per cent.	per cent.
New South Wales...	276,033	159,238	42,583	32,050	510,504	54.19	31.19	8.34	6.28	100
Victoria	222,251	143,405*	34,231	11,964	411,851	53.96	34.82	8.31	2.91	100
Queensland ...	99,584	91,669	19,064	10,606	220,923	45.08	41.49	8.63	4.80	100
South Australia ...	92,181	40,638	19,371	17,182	169,372	54.42	24.00	11.44	10.14	100
Western Australia...	47,815	41,250†	12,360	825	102,250	46.76	40.34	11.10	0.80	100
Tasmania	24,893	12,679	4,930	792	43,294	57.50	29.29	11.38	1.83	100
	763,357	488,879	132,539	73,419	1,458,194	52.35	33.53	9.09	5.03	100

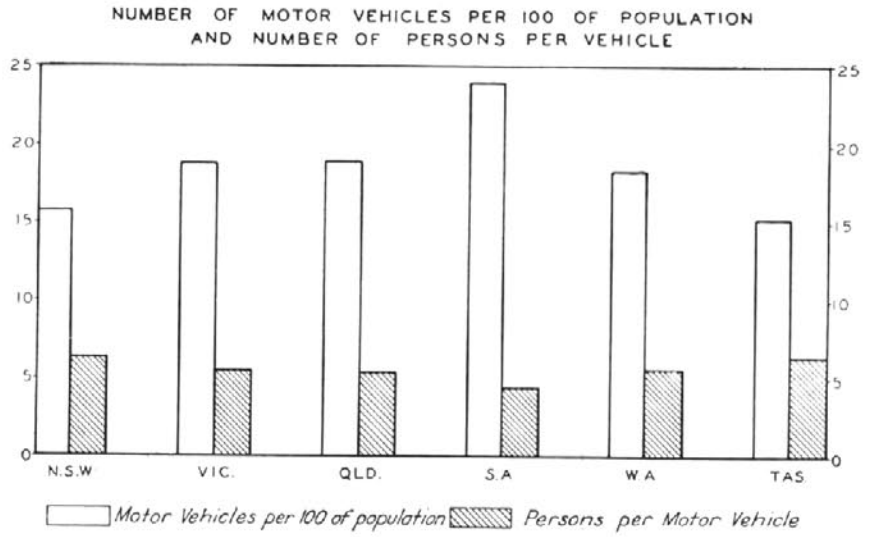
* Includes tractors. † Includes tractors, trailers.



5.—RATIO OF MOTOR VEHICLES TO POPULATION AT 30th JUNE, 1950.

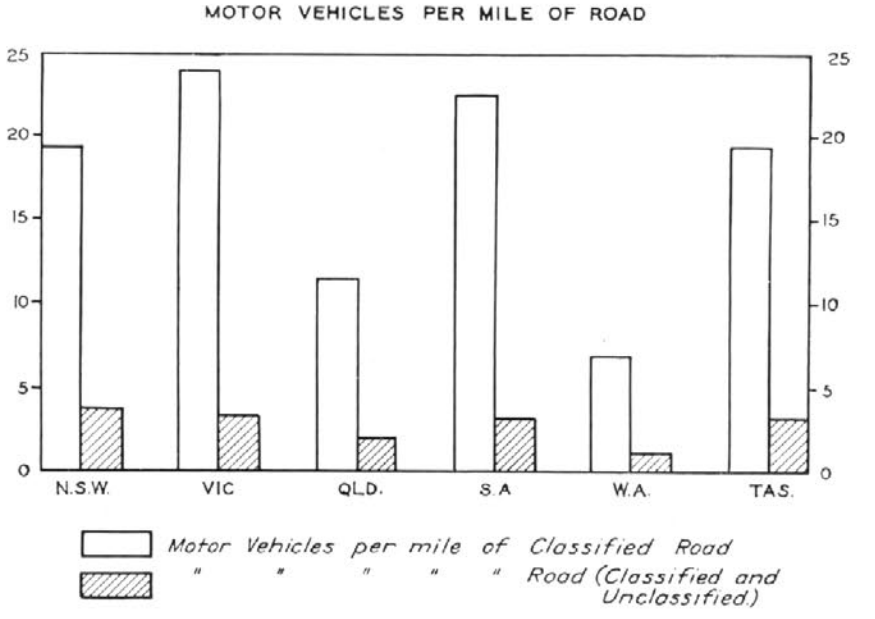
State.	Number of motor vehicles.	Population.	Number of motor vehicles per 100 of population.	Number of persons per motor vehicle.
			per cent.	per cent.
New South Wales ...	510,504	3,225,242	15.8	6.3
Victoria	411,851	2,202,869	18.7	5.3
Queensland	220,923	1,183,792	18.7	5.3
South Australia ...	169,372	700,257	24.2	4.1
Western Australia ...	102,250	557,918	18.3	5.4
Tasmania	43,294	279,386	15.3	6.5
TOTAL	1,458,194	8,149,464*	17.9	5.6

* Excludes Australian Capital Territory and Northern Territory.



6. RATIO OF MOTOR VEHICLES TO MILEAGE OF ROADS AT 30th JUNE, 1950.

State.	Number of motor Vehicles.	Mileage of Roads.		Number of Motor Vehicles per mile of road.	
		Classified Roads.	All Roads.	Classified Roads.	All Roads.
	miles.	miles.	miles.	per cent.	per cent.
New South Wales	510,504	26,023	126,950	19·61	4·02
Victoria	411,851	16,593	104,593	24·82	3·94
Queensland	220,923	20,608	135,363	10·72	1·63
South Australia	169,372	7,554	52,197	22·41	3·24
Western Australia	102,250	15,997	74,027	6·39	1·38
Tasmania	43,294	2,187	12,329	19·79	3·51
TOTAL	1,458,194	88,962	505,459	16·39	2·84

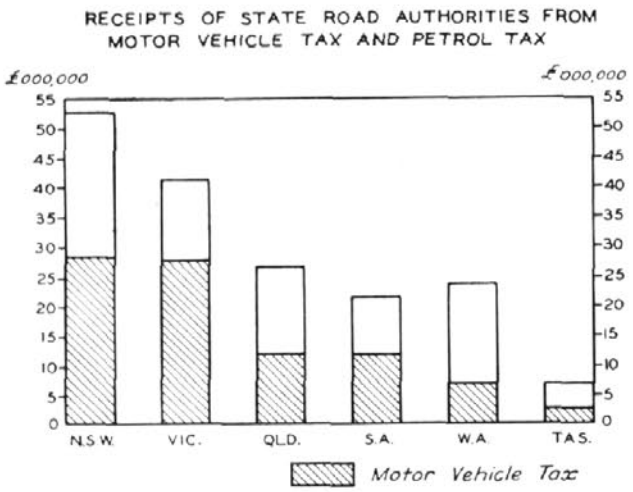


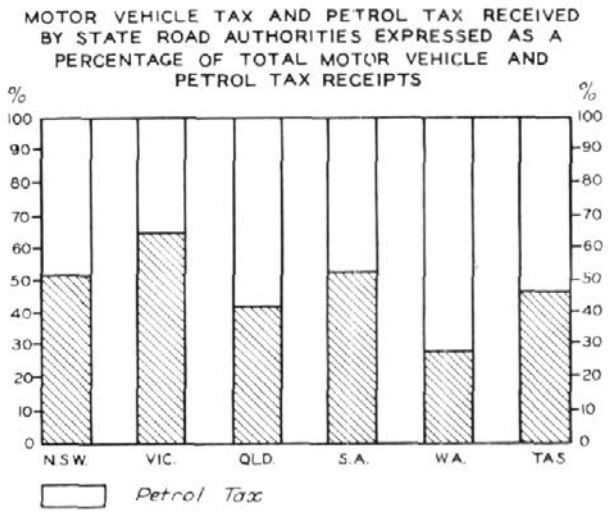
7. RECEIPTS OF STATE ROAD AUTHORITIES FROM MOTOR VEHICLE TAX AND PETROL TAX, 1949–50.

State.	Amount.			Percentage of Total Motor Vehicle and Petrol Tax.		
	Motor Vehicle Tax.	Petrol Tax.	Total.	Motor Vehicle Tax.	Petrol Tax.	Total.
	£	£	£	per cent.	per cent.	per cent.
New South Wales	2,744,617	2,497,469*	5,242,086	52·36	47·64	100
Victoria	2,687,490	1,370,528	4,058,018	66·23	33·77	100
Queensland	1,165,888	1,481,817	2,647,705	44·03	55·97	100
South Australia	1,144,454	973,711	2,118,165	54·03	45·97	100
Western Australia†	689,995	1,699,567	2,389,562	28·88	71·12	100
Tasmania	327,475	350,929	678,404	48·27	51·73	100
TOTAL	8,759,919	8,374,021	17,133,940	51·13	48·87	100

* Includes Petrol Tax received by Department of Public Works for distribution to Local Authorities for road works.

† Includes Motor Taxation received by State Road Authority and Local Authorities.



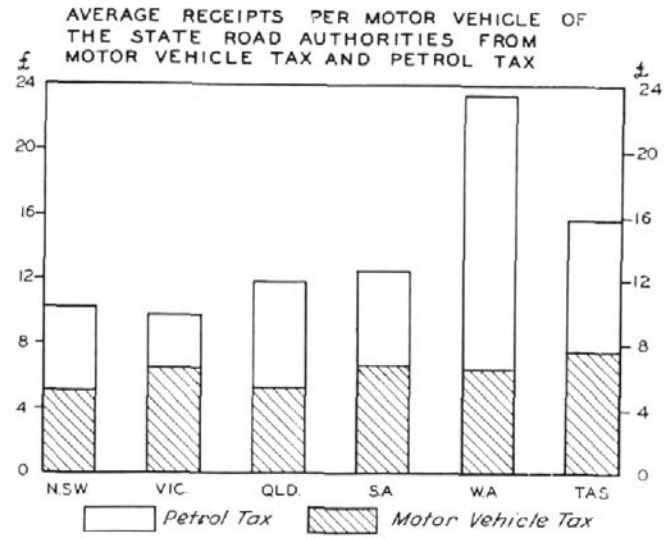


8.—RATIO OF RECEIPTS OF STATE ROAD AUTHORITIES FROM MOTOR VEHICLE TAX AND PETROL TAX TO NUMBER OF MOTOR VEHICLES, 1949–50.

State.	Number of Motor Vehicles.	Receipts.			Per motor vehicle.		
		Motor Vehicle Tax.	Petrol Tax.	Total.	Motor Vehicle Tax.	Petrol Tax.	Total.
		£	£	£	£ s. d.	£ s. d.	£ s. d.
New South Wales	510,504	2,744,617	*2,497,469	5,242,086	5 7 6	4 17 10	10 5 4
Victoria	411,851	2,687,490	1,370,528	4,058,018	6 10 5	3 6 7	9 17 0
Queensland	220,923	1,165,888	1,481,817	2,647,705	5 5 7	6 14 2	11 19 9
South Australia	169,372	1,144,454	973,711	2,118,165	6 15 2	5 14 11	12 10 1
Western Australia	102,250	†689,995	1,699,567	2,389,562	6 12 0	16 12 5	23 4 5
Tasmania	43,294	327,475	350,929	678,404	7 11 3	8 2 1	15 13 4
TOTAL	1,458,194	8,759,919	8,374,021	17,133,940	6 0 1	5 14 11	11 15 0

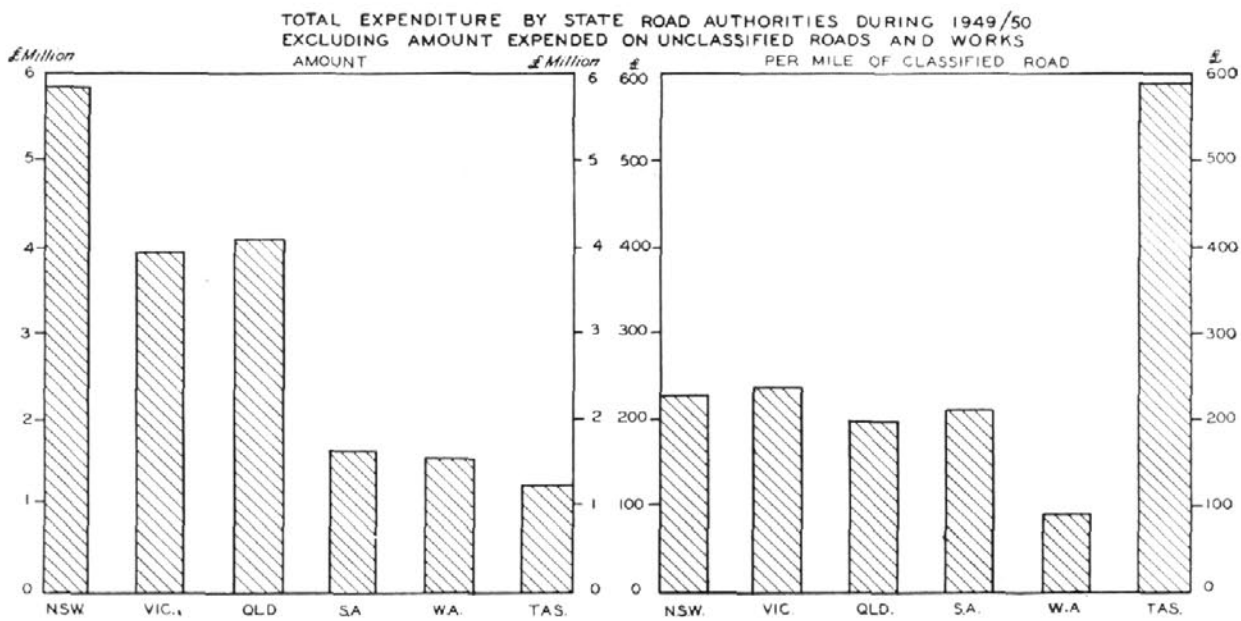
* Includes Petrol Tax received by Department of Public Works for distribution to Local Authorities for road works.

† Includes Motor Taxation received by State Road Authority and Local Authorities.



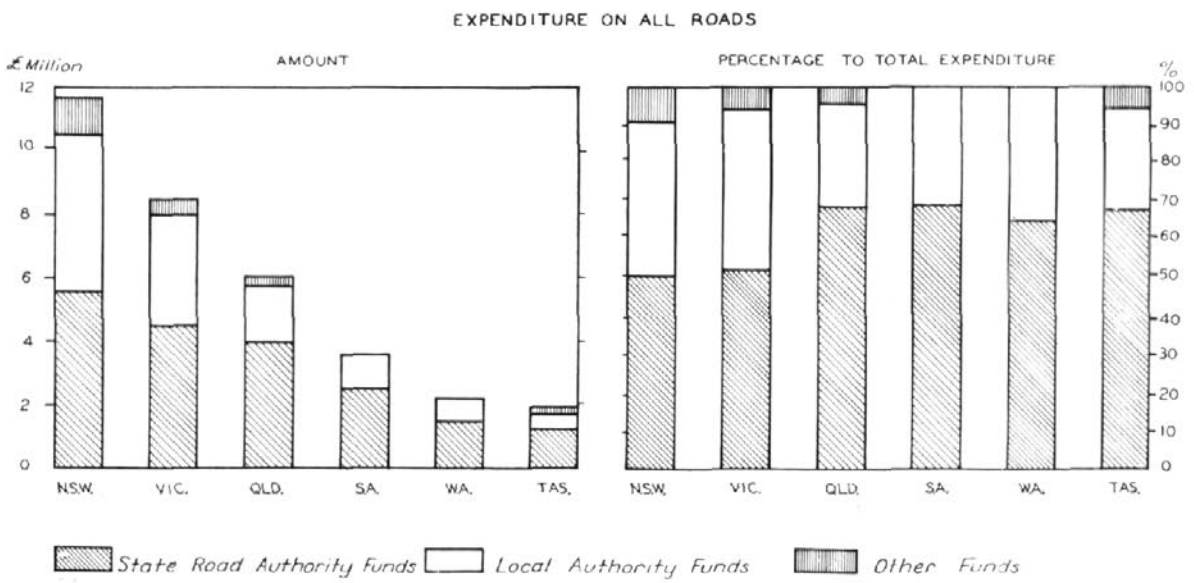
9.—TOTAL EXPENDITURE BY STATE ROAD AUTHORITIES DURING 1949–50, EXCLUDING AMOUNT EXPENDED ON UNCLASSIFIED ROADS AND WORKS.

State	Total Expenditure.	Mileage of classified roads.	Expenditure per mile of classified road.
	£	miles.	£ s. d.
New South Wales	5,816,512	26,023	223 10 3
Victoria	3,938,532	16,593	237 7 3
Queensland	4,068,142	20,608	197 8 1
South Australia	1,618,822	7,554	214 6 0
Western Australia	1,534,276	15,997	95 18 2
Tasmania	1,288,214	2,187	589 0 8
TOTAL	18,264,498	88,962	205 4 6



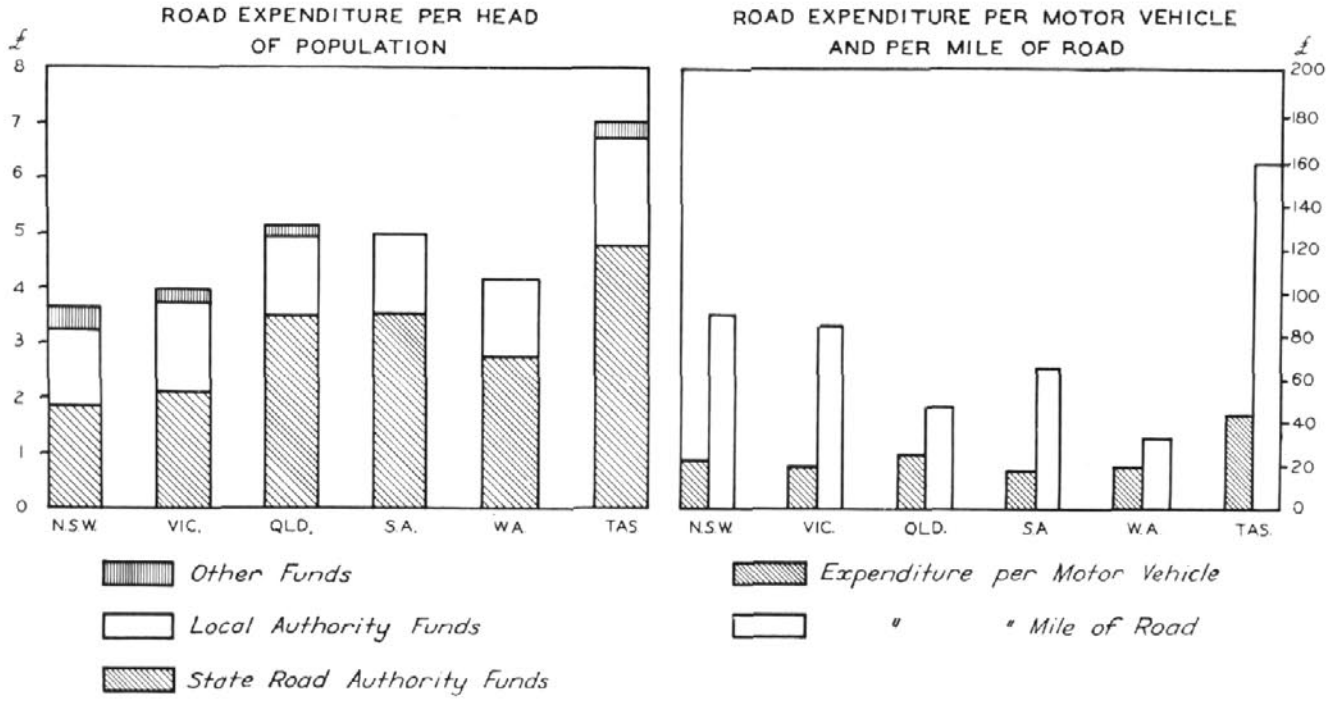
10. EXPENDITURE ON ALL ROADS IN 1949–50.

State.	Amount.				Percentage to Total Expenditure, from all sources.			
	State Road Authority Funds.	Local Authority Funds.	Other Funds.	Total.	State Road Authority Funds.	Local Authority Funds.	Other Funds.	Total.
	£	£	£	£	per cent.	per cent.	per cent.	per cent.
New South Wales ...	5,022,012	4,800,000	1,059,329	11,781,341	50·27	40·74	8·99	100
Victoria	4,648,263	3,587,878	541,512	8,777,653	52·95	40·88	6·17	100
Queensland	4,230,910	1,724,391	275,510	6,230,811	67·90	27·68	4·42	100
South Australia	2,520,579	1,002,000	.....	3,522,579	71·56	28·44	.....	100
Western Australia ...	1,540,829	823,135	.....	2,363,964	65·18	34·82	.....	100
Tasmania	1,344,915	574,896	62,915	1,982,726	67·83	28·99	3·18	100
TOTAL	20,207,508	12,512,300	1,939,266	34,659,074	58·33	36·11	5·56	100



11. EXPENDITURE ON ALL ROADS, 1949–50 PER HEAD OF POPULATION PER MOTOR VEHICLE AND PER MILE OF ROAD.

State.	Expenditure per Head of Population.				Expenditure per Motor Vehicle.	Expenditure per Mile of Road.
	State Road Authority Funds.	Local Authority Funds.	Other Funds.	Total.	Total	Total.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
New South Wales	1 16 8	1 9 9	0 6 7	3 13 0	23 1 6	92 16 1
Victoria	2 2 2	1 12 7	0 4 11	3 19 8	21 1 5	83 18 5
Queensland	3 11 5	1 9 2	0 4 7	5 5 2	28 4 1	46 0 7
South Australia	3 12 0	1 8 7	.....	5 0 7	20 15 10	67 9 9
Western Australia	2 15 2	1 9 5	.....	4 4 7	23 2 4	31 18 8
Tasmania	4 16 2	2 1 2	0 4 5	7 1 9	45 15 11	160 16 5
TOTAL ... ... £	2 9 7	1 10 8	0 4 9	4 5 0	23 15 4	68 11 5



Tenders Accepted.

The following Tende s (exceeding £1,000) were accepted by the respective Councils during the period 1st January to 31st March, 1951 :—

Council.	Road No.	Work.	Tenderer.	Amount.
				£ s. d.
Bogan S. ...	204	Supply, delivery and spreading 1,760 c. yds. gravel between 0.3 m. and 11.3 m.	D. E. Gibson	1,151 6 8
Canobolas S. ...	7	Supply of 837 tons of aggregate	Macquarie Sand & Gravel Co.	1,171 16 0
Carrathool S. ...	6	Supply and delivery 4,960 c. yds. screened gravel and 20,700 c. yds. loam.	P. H. Micchel	4,817 0 0
Coreen S. ...	299 384	Sealing on Main Road 299 and re-sealing on Main Road 384.	B.H.P. By-Products Pty. Ltd.	2,810 10 7
Hume S.	57 197	Re-sealing on T.R. 57 and sealing on Main Roads 197 ...	" " ...	1,750 1 11
Illabo S.	57	Surfacing between 11 m. 3,070 feet and 15 m. 3,100 feet...	" " ...	2,489 8 2
Kempsey M. ...	198	Bitumen resurfacing	" " ...	1,294 7 7
Kyeamba S. ...	384	Erection of bridge over Murraguldrie Creek	E. J. Dryden	2,477 3 0
Marthaguy S. ...	202 203	Supply, delivery and spreading 11,505 c. yds. loam ...	McLellan & Death ...	2,642 8 9
Nymboida S. ...	74	Replacement of collapsed timber culvert near Nymboida Power Station with two 72-inch concrete pipe culverts.	Scroope and Coy. ...	1,160 0 0
Patrick Plains S....	128 181 220	Surfacing, including supply of tar and binder	B.H.P. By-Products Pty. Ltd.	2,884 10 9
Severn S. ...	12	Supply 1,275 c. yds. aggregate at 121 m.	Frost and Spriggs ...	1,646 17 0
Tumbarumba S....	284	Construction of two 7 ft. x 2 ft. R.C. culverts and realignment of approaches.	W. A. Winnett ...	1,308 16 9
" ...	282	Construction of pipe culvert at Clegg's, about 2 m. from Jingellic.	" ...	1,377 11 0
Tumut S.... ...	4	Supply and delivery of 6,720 c. yds. gravel	K. Kennedy	1,606 10 0
Weddin S. ...	6	Supply, delivery and spreading 4,184 c. yds. gravel ...	A. J. Gam	1,023 14 4

Tenders accepted by Department on page 125.

Snow Removal on Main Roads in the Monaro District

Extent of Snowfalls in New South Wales.—Snowfalls occur regularly in winter on the three main tableland areas of New South Wales, namely the New England district, the Blue Mountains and elevated regions to the immediate west, and the Monaro and adjacent areas. It is only on two main roads in the Monaro district that snow removal on main roads is necessary each winter. Elsewhere, depth of snow is usually not sufficient to inconvenience main road traffic, and only seldom is it sufficient to require removal by motor graders.

The following table shows the average number of snowfalls per year for typical localities:—

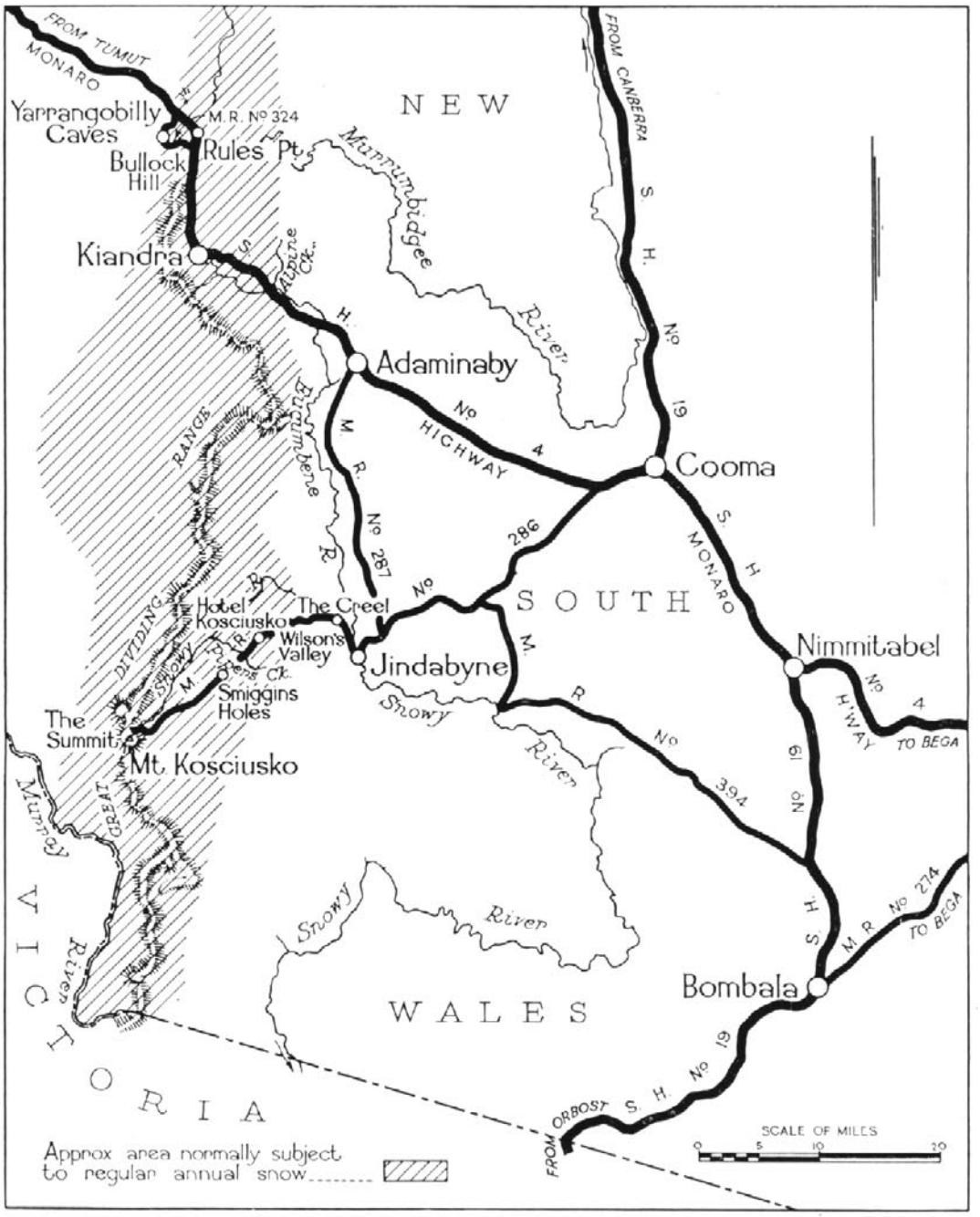
District.	*Locality.*	*Average number of snowfalls per annum.*
Monaro and adjacent areas	Kiandra	43·6
	Kosciusko	33·4
	Adaminaby	11·4
	Bombala	4·9
	Batlow	3·7
	Cooma	2·8
	Tumbarumba	2·5
	Adelong	1 fall in 4 years
	Gundagai, Braidwood	1 fall in 8 years
Blue Mountains and area to the west	Orange, Lithgow, Mt. Victoria, Katoomba	4·5
New England	Guyra	10·3
	Armidale	2·6
	Glen Innes	1 fall in 2 years

Conditions Where Snow Removal is Required.—In the Monaro district, the main roads requiring annual snow removal work are the Monaro Highway (State Highway No. 4) and the Jindabyne-Mount Kosciusko Road (Main Road No. 286). (See map.) The Monaro Highway is the direct road link between the south-west and the south-east of the State and, in winter, also serves to provide access to winter sports areas. The Highway rises to maximum elevations of 4,900 feet at Sawyers' Hill and Bullock Hill, and passes through Kiandra (elevation 4,600 feet), the highest town in Australia. In 1860, Kiandra was the centre of a gold rush, when its population is recorded as having reached about 15,000 people. To-day its regular population is about a dozen persons.

The Jindabyne-Mount Kosciusko Main Road extends from Jindabyne, on the Snowy River, to the summit of Mount Kosciusko (7,328 feet elevation), the highest point in Australia. Snow removal is regularly carried out only from a point known as Wilson's Valley (elevation 4,800 feet) to the Hotel Kosciusko (elevation 5,000 feet), a length of about 2½ miles.

The Hotel Kosciusko, which is situated at distances of 14½ miles and 16½ miles respectively from Jindabyne and the Summit, was built for the New South Wales Government Tourist Bureau in 1909. The area in the vicinity has since been gradually opened up as a resort for tourists in both summer and winter. The hotel was recently destroyed by fire.

Typical view of country subject to regular winter snowfalls, Monaro Highway, S.H. 4, 6 miles east of Kiandra.



Locality Map.

On account of the variable depth and extent of annual snowfalls, the rate at which snow is removed from these two main roads varies from year to year. The plant available quickly clears the roads in most years, but when the snow is of special intensity or when other main roads in the district also require snow clearance at the same time, removal is likely to be delayed. Holding plant at hand each year to meet exceptional conditions which occur only at irregular intervals, would not be justified.

The policy followed by the Department of Main Roads in respect of snow clearance on the Monaro Highway and the Mount Kosciusko Main Road is that every effort is made to keep open the Monaro Highway between the coast and the limit of settlement beyond Kiandra, and also from Tumut to Rules Point, and Main Road No. 286 between Cooma and the Hotel Kosciusko. Provided that the sections of road referred to can be kept free of snow, the equipment is next used on Main Road No. 286 beyond the Hotel Kosciusko as far as Piper's Creek or possibly Smiggin's Holes, a winter sports area 4 miles south of the hotel, and on the Monaro Highway to keep the road open from Kiandra west beyond Rules Point to where the snow ceases.

View of Mt. Kosciusko in winter from Jindabyne Hill.

From June to September there is usually permanent snow above altitude 5,000 feet, with some snow on the ground between July and August or September above 4,500 feet. Below 4,500 feet snow lying on the ground is not continuous as thawing occurs between the snowfalls. There is no accurate measure of depth of snowfalls in the Kosciusko-Kiandra district, snow being registered as rainfall at both places and recordings of actual depths of snow being incomplete.

In order that snow removal can be carried out successfully, it is essential that the road pavement be wide enough and strong enough to withstand both damage from the snow and frost action and from the superimposed loads it will be required to carry, including the snow-clearing equipment.

The pavement must be of sufficient thickness to spread the loading over the weakened subgrade, and the materials comprising it must be selected with care. It is desirable that the shoulders be paved in the same manner as the rest of the pavement. Good drainage is essential in order that surface water from melting snow can be quickly removed and ground water kept to a reasonable level. Adequate cross drainage and subsoil drainage should be provided, particularly where seepage and springs normally occur in wet weather.

Because the section of the Monaro Highway between Adaminaby and Yarrangobilly has not yet been brought to the standard required, restrictions have been imposed on the weight of vehicles using it during the winter months. Prior to the winter of 1949, the loading was limited to a maximum of 10 cwt. per wheel, which included any group of co-axial wheels on one side of the longitudinal centre line of the vehicle. During the winters of 1949 and 1950, however, the use of vehicles up to 4½ tons total weight with a maximum rear axle load of 3 tons was allowed, provided the vehicle was shod with low pressure tyres.

Engineering Organisation.—Snow removal on the Monaro Highway to Rules Point and on the Jindabyne-Kosciusko Main Road is undertaken directly by the Department of Main Roads. Snow removal over the short length of the Monaro Highway affected west of Rules Point is carried out by contract with the Tumut Shire Council, which attends also to snow removal required on Main Road No. 324 from its western junction with the Monaro Highway to the Yarrangobilly Caves.

The main depot of the Department's maintenance organisation for work on the Monaro Highway and Main Road No. 286 is located at Adaminaby, on the Monaro Highway, where the Maintenance Foreman resides. The Foreman has direct contact with the gang working on the Highway and telephone communication with a ganger stationed at Wilson's Valley on Main Road No. 286, and also with the Divisional Office at Bega. A liaison is maintained which enables the available plant to be directed to ensure the most satisfactory service with regard to snow removal.

The Department has also arranged to establish radio communication between the Bega Office and the snow removal organisation so that machines can be directed at short notice to places where snow removal is most urgent. It is hoped to have the system in operation for the 1951 winter.

The snow removal gang working from Wilson's Valley in the case of Main Road No. 286, and that from Adaminaby in the case of the Monaro Highway, each comprises a ganger, three to four maintenance

patrolmen, and plant operators. Plant in each case comprises a four-wheel drive tractor fitted with "V" type snow plough and wings, lights, etc.; a heavy pneumatic tyred drawn grader for use with the tractor; a light two-wheeled pneumatic tyred grader, lorry drawn; and a 3-ton tipping lorry with Berriman loader.

Further plant available for use by either gang as required includes a medium sized crawler tractor fitted with angle-dozer, enclosed cabin, lights, etc., and capable of being transported on the tray of the four-wheel drive tractors; a substitute four-wheel drive tractor fitted to take snow plough in case of breakdown of tractor in use by either ganger; a motor grader fitted with snow plough and enclosed cabin; and a pneumatic tyred 132 h.p. tractor-dozer with "V" type snow plough.

When not actually required for snow removal work, each of the gangs is engaged on normal routine road maintenance work.

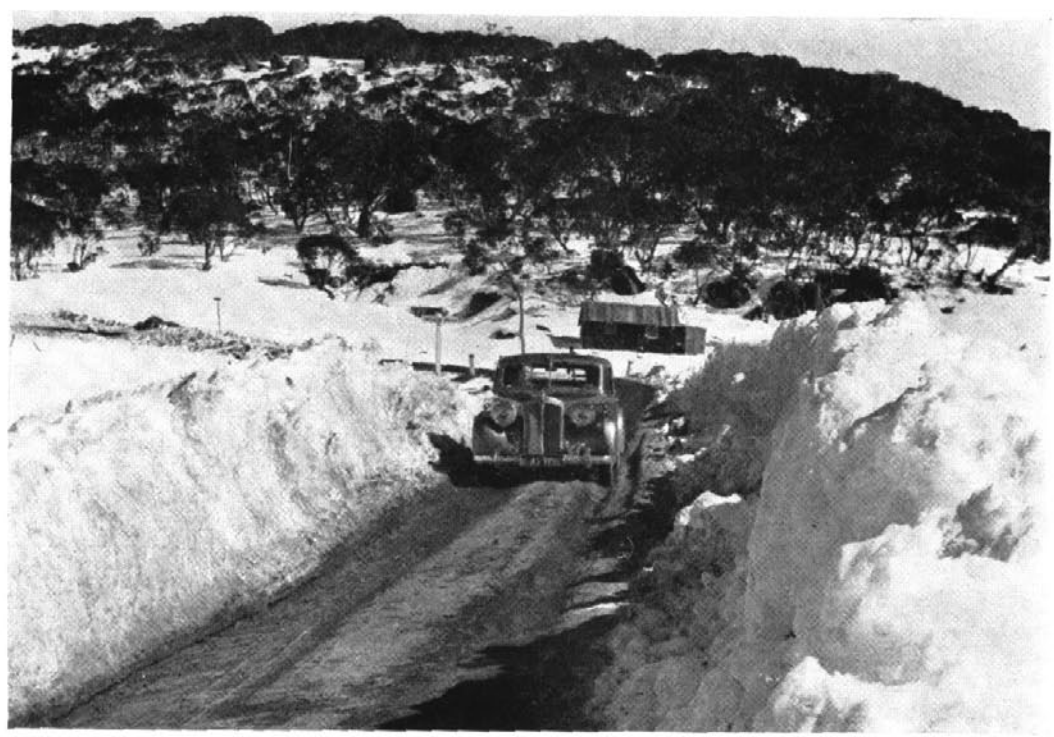
Snow removal west of Rules Point by the Tumut Shire Council is based on the use of a small V-type plough owned by the Department, fitted to a four-wheel drive motor lorry.

The Department has permanent camps on both Main Road No. 286 and the Monaro Highway. At Wilson's Valley, 17 miles from Jindabyne, on Main Road No. 286, there are quarters capable of accommodating six men. Wilson's Valley is at the normal snow line and the section of Main Road No. 286 between it and Jindabyne is usually kept clear of snow without difficulty. In times of heavy snow, a control point is also established at Wilson's Valley for the regulation of traffic to and from the Hotel Kosciusko. At times this traffic is considerable, particularly at week-ends, when the number of vehicles often taxes the capacity of all available parking areas. Departmental huts or shelters are also provided at 5 miles from Jindabyne (The Creel), 8½ miles, 13 miles (the Green Hut), and 25 miles (the Red Hut) from Jindabyne. In addition, huts belonging to the Tourist Bureau at 19 miles (Smiggin's Holes Cafe), 21 miles (Perisher Hut) and 23 miles (Bett's Camp) from Jindabyne can usually be made available for accommodation of Departmental employees in the summer months.

On the Monaro Highway, there is a sleeping hut available for eight men at Alpine Creek 14 miles west of Adaminaby, and for two men on Bullock Hill 6 miles west of Kiandra.

Method of Working.—The work involved in snow removal includes the shifting by mechanical equipment of newly fallen snow, packed snow, and snow drifts. Indirect methods would include the adoption of devices to minimise the accumulation of snow on the roads, such as the construction of "snow fences" at appropriate places, flattening of the batters of road cuttings and embankments, and the relocation of roads where practicable with a view to minimising the accumulation of drifts by having the road on fill rather than in cut.

The extent of the mechanical work of snow removal undertaken by the Department consists mainly of the operation of snow ploughs with such assistance from motor graders, angle-dozers or bulldozers as may be possible or available. The snow ploughs in use are "V" shaped and in two sizes. The large type is attached on the front of four-wheel drive, rubber-tyred, artillery tractors. These, when necessary, are assisted by a smaller type of "V" plough attached to a motor grader.



Track cleared by snow plough at Smiggin's Holes near Mt. Kosciusko.

Snow Plough fitted to 4 Wheel Drive Tractor.

The weight of the larger unit including the tractor is approximately 10 tons, and its tractive effort is 4,500 lb. at a speed of 1 mile per hour in low gear. The engine is of compression-ignition type developing 95 b.h.p. The tractor and plough are capable of clearing a lane 10 feet wide through newly fallen snow drifts 5 feet deep. The plough is raised by hydraulic power worked from the power take-off of the engine, and is lowered by its own weight. It is frequently desirable, when ploughing hard snow or ice, to weight the plough with about one half ton of sand to assist its cutting. Each tractor also has a separate wing attachable to two davits on the offside of the vehicle behind the cab. The wings are approximately 10 feet long and 2 feet high. The wing can be raised or lowered by chain blocks and the angle of projection to the line of travel can be altered. The purpose of the wing is to push away the top of the snow shifted by the main plough in order that it may then undertake further lateral clearing.

The plough on the motor grader is operated mechanically by the control normally used for the leaning of the front wheels. The normal wide track of the front wheels has been decreased to enable the blades of the plough to extend past the wheels. The leading edge of the snow plough used with the motor grader is not shaped to a curved point as in the ploughs used with the four-wheel drive tractors. It also has less uplift and its capacity for breaking compacted snow is, therefore, less than with the other ploughs.

4 Wheel Drive Tractor with wing in use.

Vehicles can follow after both types of plough. However, a single pass of the plough is insufficient to provide passing places for vehicles and, to enable passing, it is necessary for a double lane to be cleared, requiring several passes of the plough, or for passing places to be provided at chosen points.

The use of motor graders with snow plough attached is limited to road conditions under which the grader can propel itself, and is therefore generally restricted in hilly country to falls of snow not exceeding 2 feet in depth. Chains are used on all four driving wheels and on the front wheels also to facilitate steering. The "V" plough clears down to within about 3 inches to 6 inches of the pavement, which in turn can be cleared by the grading blade.

The normal blades of angle or bulldozers are relatively too low in height for the duty of snow removal and the turning movements during operation, also, cause severe damage to the pavement. The use of dozers is therefore restricted mainly to emergency conditions, or clearing of very heavy drifts when the

Snow on New England Highway, S.H. 9, Armidale.

machine can run over the surface of the snow and attack it by pushing downhill and taking it out in layers. It is to be noted that the height of the four-wheel drive tractor assists the operator in seeing the route to be followed and to note the operation of the plough.

It is desirable that vehicles carrying snow ploughs be fitted with a rear light as this enables backing to be safely accomplished at night, and the operator to see the effect of his work.

During blizzard conditions or heavy snowfalls, it is sometimes impracticable for the snow ploughs to be operated, and commencement of the removal of snow must then await daylight or reasonably fair conditions. If the weather is expected to improve quickly, it is preferable to wait until after the snowfall, in order to minimise the number of passes by the plough. In this respect, however, conditions of strong wind may cause the building up of snow drifts on a cleared length of road, and make additional work by the plough necessary.

The speed at which the snow ploughs can operate depends on the depth and condition of the snow and upon the alignment, grading and width of the roads. In the case of the Monaro Highway and Main Road No. 286 alignment and grading are not of a high standard, and on the Monaro Highway formation width is narrow. The highest speeds considered safe are attempted as this not only clears the roads in a minimum of time, but causes the snow to be thrown further to the sides than at slow speeds. In practice, under the conditions prevailing, working speeds must be kept below 20 miles per hour.

With snow on the roads, particularly as the result of heavy falls or when drifts are considerable, it may be very difficult for the operators of snow removal equipment or drivers of vehicles to be certain of the location of the road. To assist operators on sections of road which are considerably curved or which would cause the vehicle to be subject to loss or damage if it went off the road, it has been found useful to provide ample guide posts with the top 4 inches painted black and the remainder of the posts white. The black top of the posts stands out well against the generally white background, particularly under the headlights of vehicles at night. On Main Road No. 286, above Wilson's Valley, snow poles have been provided and are of assistance to operators of the snow removal equipment when the road is completely bound.

Growth of Traffic.—Apart from normal traffic increase, traffic flow on the Monaro Highway and on the Jindabyne-Kosciusko Main Road has grown rapidly during the last two years as a result of the operations of the Snowy Mountains Hydro-Electric Authority, many of whose works are served by these roads. Road improvements being carried out were described in the last number of this journal.

The establishment of the Snowy Mountains National Park and the consequent greater development of the area for tourists is likely to lead to a steady growth in tourist traffic, of a more enduring nature than the constructional traffic associated with hydro-electric works.

Supervision.—The snow removal work carried out directly by the Department on the Monaro Highway and on Main Road No. 286 is under the supervision of the Department's Divisional Engineer, Bega, Mr. R. W. P. Hirt. The work carried out west of Rules Point by the Tumut Shire Council comes under the general supervision of the Department's Divisional Engineer, Wagga, Mr. D. White.

Tenders Accepted.

The following Tenders (exceeding £1,000) were accepted by the Department during the period 1st January to 31st March, 1951:—

Council.	Road No.	Work or Service.	Name of Accepted Tenderer.	Amount.
				£ s. d.
Mosman M. / Manly M....	164	Manufacture, supply and delivery of metalwork and machinery for a steel and reinforced concrete bridge over Middle Harbour at The Spit. Contract No. 1.	The Cleveland Bridge and Engineering Pty. Ltd., Darlington, England.	173,361 5 7 Sterling.
,, ...	164	Construction, erection and final completion of a steel and reinforced concrete bridge over Middle Harbour at The Spit. Contract No. 2.	,, ,, ...	384,981 12 10 Australian.
Ryde M.	165	Adjustment of properties Nos. 822 and 826 Victoria Road	H. Mills, Lane Cove ...	2,126 0 0
Holroyd M. ...	5	Relocation of cottages Nos. 356 and 358, Great Western Highway, Wentworthville.	W. Diggleman, Granville.	1,680 0 0
		Supply and delivery of two (2) crushing plants complete in conformity with D.M.R. Specification No. P.17D.	Industrial Sales & Service (N.S.W.) Pty. Ltd., Alexandria.	46,710 16 0
		Supply, delivery and erection of structural steelwork for Aggregate Plant at Metropolitan Maintenance Depot, Granville. Contract No. 1.	Arcos Products Pty. Ltd., Lidcombe.	27,999 11 0
		Manufacture, supply and delivery of structural steelwork for the extension of buildings at the Department's Central Workshop, Granville. Contract No. 1.	,, ,, ...	2,999 0 0

Tenders accepted by Councils on page 119.

CORRECTION.

The reference to the 'Tasmanian Blue Gum" (Eucalyptus globulus) in the article "Successes and Failures in Roadside Tree Planting" in the December, 1950, issue of the "Main Roads" Journal, page 52, column 2, should have been to "Eurabbie" (Eucalyptus bicostata). Eurabbie closely resembles Tasmanian Blue Gum in appearance.

New Road Formation Built Connecting Bourke and Wanaaring, 118 Miles Apart

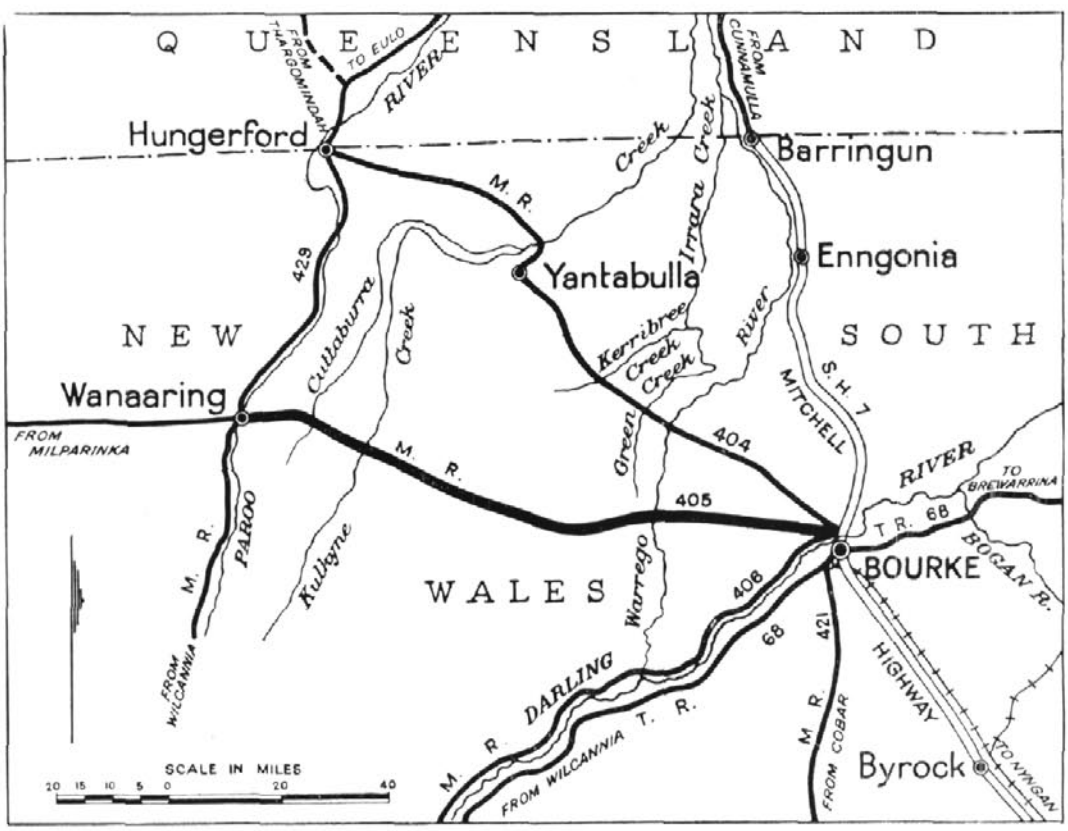
The construction of a formed and partially gravelled road has recently been completed by the Department of Main Roads on Main Road No. 405 between Bourke and Wanaaring. This length includes several sections formed in earlier years. The route from Bourke to Wanaaring first traverses State Highway No. 7 for a distance of 4 miles, and then Main Road No. 404 for one mile. The length of Main Road No. 405 is therefore 113 miles. Wanaaring is situated on the Paroo River, being 606 miles distant from Sydney by road.

The work carried out forms part of a general programme of main road improvement in the northern portion of the Western Division of New South Wales. Other main roads whose construction has been completed throughout during recent years include the Bourke-Barringun Main Road (86 miles), the Bourke-Hungerford Main Road (132 miles), the Brewarrina-Mungindi Main Road (187 miles), and the Walgett-Queensland Border Main Road with branch to Goodooga (106 miles).

The Bourke-Wanaaring Main Road serves two main functions. It connects the Wanaaring district and adjacent areas in New South Wales and Queensland to meatworks and railhead at Bourke. It also forms part of an important route connecting extensive sheep grazing areas in the north-western portion of New South Wales with sheep and cattle country in south-western Queensland, as far as the area known as the "Channel Country."

Before the connection of Broken Hill to Sydney by rail in 1919, Bourke was also the railhead and central point for distribution of stores to the north-western corner of New South Wales and to areas lying north and west in Queensland and South Australia. At that time Milparinka and Tibooburra found their main outlet through Wanaaring. Since the rail extension to Broken Hill, the road from Wanaaring to Milparinka and Tibooburra is little used as a through route, but Wanaaring remains a focal point to which roads and tracks serving a large area converge, and from where motor vehicles and stock travel to Bourke.

Nature of Country.—The country through which the road passes is mainly undulating, with red sandy loam soil carrying a thick growth of low trees of the eucalypt and acacia families, but there are a number of isolated treeless black soil plains. A total length of approximately 20 miles of the road is across such plains. One of these, known as Walkden Plain, is 2 miles wide,



Construction of raised formation by Elevating Grader, 79 miles from Bourke.

and another, known as Poison Point Plain, is 7 miles wide. These are situated between 7 and 9 miles, and between 43 and 50 miles respectively from Bourke.

There are no villages or settlements on the road between Bourke and Wanaaring, but because the road coincides with a travelling stock route, it is well provided with public watering places, principally served by artesian bores, the area being within the Great Artesian Basin. Other sources of water supply are the Warrego River at 39 miles from Bourke, and the Paroo River and Byewash at 116 miles near Wanaaring. The Paroo Billabong skirts the western side of Wanaaring and is the source of the reticulated water supply of the village.

The Road Work.—The work carried out out by the Department of Main Roads on the Bourke-Wanaaring road has been done jointly with other work, and for this reason, and on account of climatic and other difficulties, has extended intermittently over three years. The work includes the following:—

(1) Clearing of trees and scrub for a length of 65 miles to widen existing narrow clearings and to provide complete clearings on new alignments. This was carried out by bull-dozers.

(2) Construction of approximately 80 miles of new formations raised to a height of about 18 inches above natural surface. Over 521,000 cubic yards of soil was excavated and deposited to make these formations. An elevating grader, a drawn grader, sheeps-foot roller and pneumatic tyred roller were used.

(3) Provision of drainage by the construction of causeways and culverts and roadside drains.

(4) Gravelling black soil formations over plains for a total length of 17 miles, for which over 19,000 cubic yards of gravel were used.

(5) Partial stabilisation with sand of short lengths of black soil and other formations slippery when wet.

The construction of the road necessitated crossing several loose sand ridges, the largest of which are near Goonery Bore, about 55 miles from Bourke. The

Pavement under construction using limestone gravel on raised formation, 44 miles from Bourke.

Completed Formation, approximately 100 miles from Bourke.

formation over the sand ridges was compacted under traffic and has so far provided a reasonably sound surface. When a prolonged dry period again occurs, it may be necessary to sheet the formation with gravel.

Typical Bore Drain.

Cost and Results.—The work on the Bourke-Wanaaring Main Road has cost approximately £40,000. The result is a road which in normal times can be traversed much more quickly and with much less wear and tear on vehicles, goods and persons than in the past. In periods of rain, if heavy vehicles are kept off the road, interruption to the movement of light vehicles will also be much less than in the past, for a raised road formation can shed water quickly, and rapidly dries after rain. If, however, heavy vehicles use such a formation in wet periods, perhaps forcing their way through with four-wheel drives, the formation inevitably will get rutted, water will get caught in the ruts and the road surface will get softened. Light vehicles with four-wheel drives can also be very damaging to earth formations when wet.

The full benefit of the work between Bourke and Wanaaring will be secured if restraint is exercised by road users in wet periods. At a later stage it may be possible to provide improved surfacing on the lengths where the soils are most subject to softening when wet.

Supervision.—The work on the Bourke-Wanaaring Road was carried out under the general supervision of the Department's Assistant Maintenance Engineer, Mr. F. I. Peterson, the former District Engineer, Bourke, Mr. J. L. Allan, and the present Acting District Engineer, Bourke, Mr. T. Mackintosh, were in immediate charge of the construction, in succession.

Visitor from Thailand

Mr. Amphon Sunananta, Divisional Engineer, Provincial and Rural Highways Division, Department of Ways, Thailand, is spending some months with the Department of Main Roads studying and observing road and bridge construction and maintenance and general main road organisation and administration in New South Wales. He has already spent some months with the Main Roads Commission, Queensland. Mr. Sunananta is visiting Australia under the terms of the U.N.E.S.C.O. Fellowship.

MAIN ROADS STANDARDS.

NOTE: Numbers prefixed by "A" are drawings, the remainder are specifications unless otherwise noted

Form No.

EARTHWORKS AND FORMATION.

70 Formation. (Revised, June, 1949.
A 1532 Standard Typical Cross-sections.
A 1149 Flat Country Cross-section, Type A. (Revised, 1930.
A 1150 Flat Country Cross-section, Type B. (Revised, 1936.)
A 1151 Flat Country Cross-section, Type D1. (Revised, 1936.
A 1152 Flat Country Cross-section Type D2. (Revised, 1930.)
A 1476 Flat Country Cross-section, Type E1. (Revised, 1937.)
A 1101 Typical Cross-section One-way Feeder Road. (1936.)
A 1102 Typical Cross-section Two-way Feeder Road. (1931.)
A 114 Rubble Retaining Wall. (1941.)

PAVEMENTS.

71 Gravel Pavement. (Revised, June, 1949.)
228 Reconstruction with Gravel of Existing Pavements. (Revised, January, 1939.)
254 Supply and Delivery of Gravel. (Revised, August, 1939.)
72 Broken Stone Base Course. (Reprinted with amendments. August, 1947.)
68 Reconstruction with Broken Stone of Existing Pavement to form a Base Course. (Revised, October, 1933.)
296 Tar. (Revised, May, 1949.)
337 Bitumen. (Revised, February, 1939.)
305 Bitumen Emulsion. (Revised, September, 1942.)
351 Supply and Delivery of Aggregate. (Revised, July, 1941.)
65 Waterbound Macadam Surface Course. (July, 1939.)
301 Supply and Application of Tar and/or Bitumen. (Revised, June, 1950.)
122 Surfacing with Tar. (Revised, January, 1949.)
145 Surfacing with Bitumen. (Revised, January, 1949.)
93 Re-surfacing with Tar. (Revised, January, 1949.)
94 Re-surfacing with Bitumen. (Revised, January, 1949.)
230 Tar or Bitumen Penetration Macadam, Surface Course, 2 inches thick. (Revised, December, 1936.)
66 Tar or Bitumen Penetration Macadam, Surface Course, inches thick. (Revised, September, 1936.)
125 Cement Concrete Pavement (April, 1939) and Plan and Cross-section A 1147 (March, 1932).
466 Bituminous Flush Seals and Reseals—Fluxing of Binders. (January, 1949.)

GENERAL.

342 Cover Sheet for Specifications, Council Contract. (Revised, January, 1948.)
24B General Conditions of Contract, Council Contract. (Revised, September 1950.)
64 Schedule of Quantities.
39 Bulk Sum Tender Form, Council Contract. (Revised, August, 1946.)
38 Bulk Sum Contract Form, Council Contract.
121 Provision for Traffic (Revised, June, 1947) with general arrangement, A 1323 and details A 1325 of temporary signs. (Revised January, 1947.)
A 1342 Warning Signs, Details of Construction.
A 1346 Iron Trestles for Road Barriers.
A 1341 Timber Trestle and Barrier.
A 1824 Light Broom Drag. (1941.)
A 1924 Pipe Frame Drag.
A 178 Mould for Concrete Test Cylinder.
A 1381–3, A 1452–5 } Tree Guards, Types A, B, C, D, E, F, and G.
197 Hire of Council's Plant. (Revised, April, 1937.)
A 478 Specimen Drawings, Rural Road Design, with drawings A478A and A 478B.
A 478C Specimen Drawing, Flat Country Road Design.
A 1113 Rural Road Plan and Longitudinal Section Form tracing cloth).
A 1114 Rural Road Cross-section Form (tracing cloth).
A 1115 Urban Road Plan Forms (tracing cloth).
193 Duties of Superintending Officer (instructions). (Revised, July, 1938.)
314 Standard Regulations for Running of Ferries. (Revised, December, 1948.)
A 1645 Stadia Reduction Diagram. (1939.)
355 Instructions for Design of Two-lane Rural Highways (1937).
A 1487 Horizontal Curve Transitions (diagrams).
A 1488, A 1488A, A 1488B, and A 1488C.—Horizontal Curve Transitions (tables for speeds of 30, 40, 50, and 60 miles per hour).
A 1614 Widening of Shoulders on Crests.
369 Instructions for Design of Urban Roads (1939).
288 Instructions for Design of Intersections (Revised, January, 1948.)
402 Instructions for Design of Rural Intersections (acceleration and deceleration lanes). (1941.)

Form No.

KERBS, GUTTERS, AND GULLY PITS.

243 Integral Concrete Kerb and Gutter and Vehicle and Dish Crossing (Revised, July, 1939) and Drawing. (A134A.)
245 Gully Pit (Revised, May, 1939) and Drawings (a) with grating (A 1042); (b) Kerb inlet only (A 1043); (c) with grating and extended kerb inlet (A 1352); (d) extended kerb inlet (A 1353).
A 190 Gully Grating. (1933.)
A 1418 Concrete Converter. (1936.)

FENCING.

142 Split Post and Rail Fencing and Drawing (A 43).
141 Post and Wire Fencing (Revised, December, 1947) and Drawings (a) Plain (A 494); (b) Rabbit-proof (A 498); (c) Flood gate (A 316).
143 Ordnance Fencing (Revised, February 1934) and Drawing A 7. (Revised, November, 1939.)
144 Chain Wire Protection Fencing and Drawing (A 149).
246 Location of Protection Fencing (instruction). (Revised, May, 1940.)
A 1301 Motor Traffic By-pass 9 feet wide. (1936.)
A 1875 Motor Traffic By-pass 20 feet wide. (1942.)

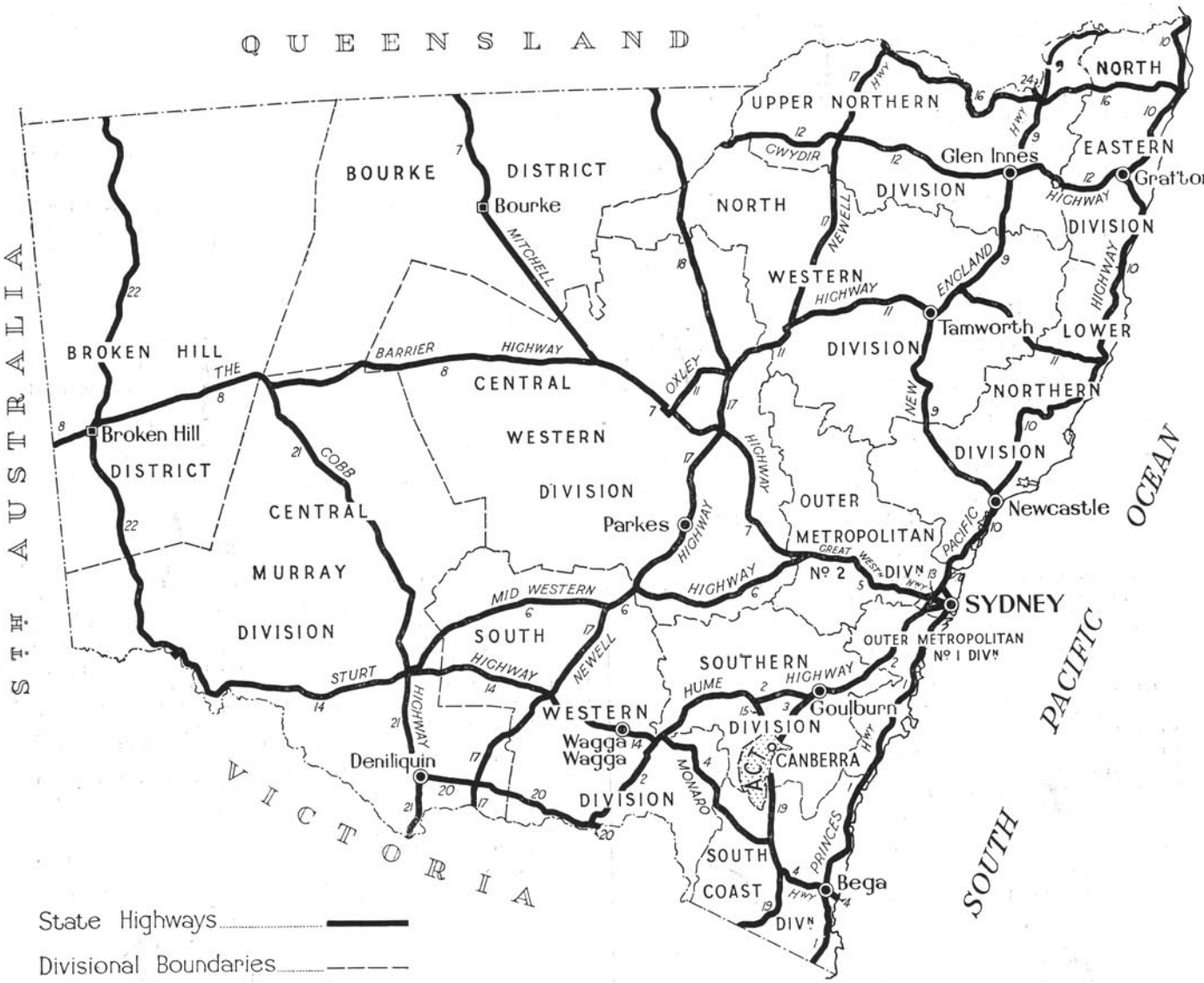
BRIDGES AND CULVERTS.

A 4 Standard Bridge Loading (general instruction). (1948.)
A 4A Standard Bridge Loading (instruction for dead-end Developmental Roads.) (Revised, 1938.)
18 Data for Bridge Design. (Revised, November, 1948.)
84 Data accompanying Bridge or Culvert Designs.
A 26 Waterway Diagram. (Revised, 1943.)
371 Waterway Calculations. (1939.)
A 421 Boring Gear. 2 inches. (1930.)
A 44 Boring Gear, 3½ inches. (1949.)
A 2995 Rod Sounding Apparatus, with tripod (1947).
25 Pipe Culverts and Headwalls (Revised, December, 1939) and drawings, Single Rows of Pipes, 15 in. to 21 in. dia. (A 143), 2–3 ft. dia. (A 139), 3 ft. 6 in. dia. (A 172), 4 ft. dia. (A 173), 4 ft. 6 in. dia. (A 174), 5 ft. dia. (A 175) 6 ft. dia. (A 177); Double Rows of Pipes, 15 in. to 21 in. dia. (A 211) 2–3 ft. dia. (A 203), 3 ft. 6 in. dia. (A 215), 4 ft. dia. (A 208), 4 ft. 6 in. dia. (A 207), 5 ft. dia. (A 206), 6 ft. dia. (A 213); Treble Rows of Pipes, 15 in. to 21 in. dia. (A 210), 2–3 ft. dia. (A 216) and Straight Headwalls for Pipe Culverts, 15–24 in. dia. (A 1153).
A 1 Joint for Concrete Pipes. (Revised, August, 1933.)
A 142 Inlet Sump Pipe Culverts for 3 ft. dia. or less. (Revised, December, 1947.
138 Pre-Cast Concrete Box Culvert (Revised, February, 1948) and drawings, 9 in. high (A 485), 12 in. (A 446), 1 ft. 6 in. (A 447), 2 ft. (A 448), 2 ft. 6 in. (A 449).
206 Reinforced Concrete Culvert (Revised, February, 1948) and instruction sheets (A 305, A 359, A 306, A 304).
A 1832 Cast-in-Place Concrete Pipe Culverts. (1942.)
A 309 Concrete Culvert Posts. (Revised, June, 1937.)
300 Pile Drivers, specification for 25 ft., and drawings for 50 ft. (A 209) 40 ft. (A 253), and 25 ft. portable (A 1148).
A 1886 Arrangement of Bolting Planks for various widths of deck. (Revised, September, 1948.)
A 45 Timber Bridge, Standard Details. (Revised, May, 1949.)
A 1791 Timber Beam Skew Bridge Details. (Revised, May, 1949.)
164 Timber Beam Bridge (Revised, April, 1947) and instruction sheets, 12 ft. (A 3469), 20 ft. (A 70) revised, May, 1949, and 22 ft. (A 1761). (Revised, May, 1949.)
A 3470 and A 3471.—Low Level Timber Bridges—Instruction sheets for 12 feet and 20ft. between kerbs. (Revised, May, 1949.)
A 1223 (Revised, May, 1949) and A 3472 (Revised, May, 1949) Single Span Timber Culverts instruction sheets for 20 ft. and 22 ft. between kerbs.
139 Timber Culvert (Revised, January, 1950) and drawings, 1 ft. 6 in. high (A 427), 2 ft (A 428), 3 ft. (A 429), 4 ft. (A 430), 5 ft. to 8 ft. high, (A 431). (1928.)
326 Extermination of Termites in Timber Bridges. (Revised, October, 1940).
A 222 Pipe Handrailing Details. (Revised, July, 1947.)
350 Reinforced Concrete Bridge. (Revised, April, 1949.
495 Design of Forms and Falsework for Concrete Bridge Construction. (September, 1947.)

All Standards may be purchased from the Head Office of the Department of Main Roads, 309 Castlereagh Street, Sydney, single copies being free to Councils.

Sydney: A. H. Pettifer, Government Printer—1951.

State Highway System of the State of New South Wales



State Highways .....

Divisional Boundaries .....

Divisional Offices .....

SCALE OF MILES

40 20 0 40 80 120 160 200

Area of New South Wales, 309,433 square miles.
Length of public roads within New South Wales, 126,272 miles.

MILEAGE OF ROADS CLASSIFIED UNDER THE MAIN ROADS ACT, AS AT 1st JULY, 1950.

State Highways	6,513
Trunk Roads	4,031
Main Roads	12,628
Secondary Roads (County of Cumberland only)	68
Developmental Roads	2,783
	26,023
UNCLASSIFIED ROADS, in Western part of State, coming within the provisions of the Main Roads Act	2,617
TOTAL	28,640