MAIN ROADS

A month to month account of the activities of

THE MAIN ROADS BOARD OF NEW SOUTH WALES

Issued by and with the authority of the Board

Vol. III, No. 3. November, 1931

Federal Aid Roads Agreement.

ON 30th September, 1931, the Federal Aid Roads (Further Agreement) Act, 1931, was passsed by both Houses of Parliament, and on 7th October received the Governor's assent. This Act ratifies the amended agreement along the lines indicated in the August, 1931, issue of *Main Roads*. The amended agreement—

(i) maintains the amount to be contributed by the Commonwealth at the fixed sum of £2,000,000 per annum up to 1st July, 1931, but alters it thereafter to the yield of a 2½d. per gallons customs tax on imported petrol and of a 1½d. per gallon excise tax on all locally refined petrol;

(ii) extends the period of contribution by the Commonwealth by six months, *i.e.*, from 30th June, 1936, to 31st December, 1936;

(iii) eliminates all further contributions by the States;

(iv) retains the sinking fund provisions and basis of distribution of the original agreement;

(v) leaves the State a free hand to spend the money on roads without the need to secure the Commonwealth Minister's approval to works;

(vi) permits the money to be used for maintenance or construction as may be required, instead of for construction or reconstruction only as heretofore.

These variations, so far as they will assist the Commonwealth and State to balance their budgets (by freeing the Commonwealth from having to provide more than it collects for the purpose, and by freeing the State from the necessity of embarrassing itself to secure the Commonwealth Government's grant), were urgently necessary on financial grounds. So far as they will permit the money to be used for maintenance or construction as the needs of the roads may require, they were also highly desirable. The funds available for the maintenance of main roads in the County of Cumberland and Country Main Roads Funds are not now sufficient for the purpose and need the assistance of the Federal Aid moneys.

As there will, from 1st July, 1931, be no longer any distinction in the use of Federal Aid moneys and State motor taxation so far as the class of road work which can be done with each is concerned, there was no further need for the Main Roads Board to maintain a separate Federal Aid Roads Fund. The Main Roads Act was therefore amended by the repeal of the Part (VIA) which established this fund; and by providing that any moneys received for the year 1931-32 and onwards should be paid into the two other Main Roads Funds, viz., the County of Cumberland Main Roads Fund and the Country Main Roads Fund. These moneys are to be divided between these two funds in the same ratio as the State motor taxation is divided between them, this division having been found to hold the balance fairly well between the county of Cumberland and the country in the past, and being in accord with the present needs of the two groups. Provision was made for the continuance of assistance to Western Division roads on a basis proportionate to the reduced amount of Federal money received each year by the Board.

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The differential rates of tax (*i.e.*, 2½d. per gallon on imported petrol and 1½d. per gallon on locally refined petrol), set aside for road purposes were the subject of special representations by certain of the States, because of the possibility of the change in the aggregate sum which would be available for road purposes if any considerable change should occur, by reason of a greater proportion of the petrol used being imported as crude oil and refined locally. The ideal arrangement is clearly that a uniform rate shall apply to both imported and locally refined petrol. The Prime Minister has undertaken that if there should be a substantial fall in customs revenue or a substantial increase in the rate of excise duty, the Commonwealth Government will go into the matter again.

News of the Month.

Metropolitan Division.

The periodical docking and overhaul of the Hawkesbury River motor ferry vessel "George Peat" has been completed by Mort's Dock and Engineering Company Limited. Both this vessel and the "Frances Peat" were in commission on Eight Hour Day (5th October), and transported a total number of 1,802 vehicles and 5,130 passengers across the river.

On the Prince's Highway, from Madden's Plains to the top of Bulli Pass, a distance of 6 miles, additional gravel has been spread, overcoming the difficulty of keeping smooth with graders the surface of the small quantity of gravel previously existing.

During August and September the new embankments on Bulli Pass (Prince's Highway), which were eroded by the cyclone in July last, were built up, and steps have been taken to reduce the risk of a similar occurrence in the future. At the same time, the pavement at the foot of the Pass was reconditioned.

Outer Metropolitan Division.

A reinforced concrete bridge is being constructed over Spring Creek, on the Prince's Highway in the Municipality of Kiama. The new structure is being built by direct labour. It will consist of three spans, each of 25 feet, having a carriageway 20 feet wide, with piers founded upon reinforced concrete piles. It will replace an old timber bridge which has reached the end of its useful life.

Jamberoo Municipal Council is building a pipe culvert, having twin 5 feet diameter pipes, on the Kiama-Jamberoo-Robertson road (No. 264), at Robb's Creek. The new culvert replaces a worn-out timber structure.

Wollongong Municipal Council has recently reconditioned and tar-surfaced 1,254 feet of the Wollongong-Port Kembla road (No. 295), near the bridge over Tom Thumb Lagoon. It has also built 1,077 square yards of light penetration macadam on the Prince's Highway within the municipality.

Upper Northern Division.

On the Lismore-Bangalow trunk road (No. 65), in the Shire of Byron, the council is reshaping the existing macadam pavement to standard cross-fall, and surfacing it with tar, between 13¾ miles and 16¾ miles east of Lismore. This completes the surface treatment of the road between the shire boundary near Clunes and Bangalow.

Three 25 feet single-span timber-beam bridges, with approaches, are being constructed on the Coff's Harbour-Grafton road (No. 297), in the Shire of Dorrigo, at 24¼, 30¼, and 33½ miles from Coff's Harbour. Each will replace a worn-out existing structure.

In consequence of a recent alteration in the boundaries of the Municipality of Lismore, approximately 1¾ miles of the Lismore-Murwillumbah road (No. 142), previously within the municipality, are now in the Shire of Terania. By agreement between the councils, this length will be surfaced with a 2-inch tar-penetration-macadam wearing-course before the end of the present year. This will eliminate the only gap in the surfaced pavement extending for 11½ miles from Lismore towards Nimbin.

Lower Northern Division.

In the Municipality of Armidale, work is proceeding on the deviation of the Great Northern Highway *via* Kentucky-street and the railway overbridge into Dangar-street. The earthworks and culverts have been completed by day labour. This part of the work has been considerably delayed by frequent spells of wet weather, which made working on the black soil very difficult. The gravel pavement is now being constructed. It is intended to apply a tar surfacing during the latter part of the approaching summer. Rapid progress is being made with the gravelling, and it is expected that the new road will be opened to traffic in approximately six weeks. In addition to providing a much improved location for the highway approaching the city, this deviation eliminates a very awkwardly situated railway level crossing in Butler-street.

Central Western Division.

A new reinforced concrete culvert is to be built in replacement of a worn-out timber structure at the junction of the Mid-Western Highway and the Lyndhurst-Bigga road (No. 201), in Lyndhurst Shire. The new culvert will be situated 27 miles north-east of Cowra, towards Blayney. It will consist of two cells, each 9 feet x 5 feet, with a width of 29 feet between kerbs, as it is situated at the junction of the two roads.

The contract of Model Homes, Limited, for the reconstruction in tar penetration macadam of two miles of the Mid-Western Highway between Holmwood and Cowra, in Waugoola Shire, will be completed as originally intended, and not with portion gravelled, as was proposed when the payment of Federal Aid funds to the State was suspended, and announced in the September issue of *Main Roads*.

Southern Division.

The reconstruction of the Federal Highway south-west of Yarra, which is being effected by Mulwaree Shire Council, has been greatly hampered by the unusually wet season. The embankments have been saturated, so that the rolling and preparation of the formation in readiness for gravelling have been practically impossible. The highway between Yarra and Collector is open to traffic in fine weather only for the present.

On the Goulburn-Boorowa road (No. 248), the bridge over the Wollondilly River at Mummel is being repaired by the divisional bridge maintenance gang. This structure, which consists of three 75 feet timber truss spans, was built in 1883, and the timber has now reached such a condition that the replacement of defective members is not practicable. Therefore, the bridge is being strengthened by reinforcing the lower chords with steel cables, in an effort to prolong the life of the structure for another year or two.

Riverina Division.

A deviation 1,250 feet long, for the elimination of a dangerous sharp turn on the Hume Highway between Lower Tarcutta and Tarcutta, in Kyeamba Shire, has been formed and gravelled by Contractor A. A. Wilson and opened to traffic.

The Urana-Rand road (No. 125), in Urana Shire, is again trafficable. Flood damage at Walsh's Creek has been repaired and a temporary timber bridge has been erected across the washed-out approach to a double 8 feet x 8 feet reinforced concrete box culvert over an anabranch of the Billabong Creek, approximately three miles from Rand.

Contractors Winnett and Son have completed the construction of a three-cell 10 feet x 9 feet reinforced concrete box culvert and approaches at Keajura Creek, on the Hume Highway between Tarcutta and Kyeamba, in Kyeamba Shire.

Expenditure from 1st July, 1931, to 30th September, 1931.

	Expenditure from 1st July, 1931, to 31st August, 1931.	Expenditure for month of September, 1931.	Total Expenditure to 31st September, 1931.
County of Cumberland Main Roads Fund—	£ s. d.	£ s. d.	£ s. d.
Construction of Roads and Bridges	4,299 16 10	1,880 19 9	6,180 16 7
Cost of Land Resumptions	7,562 3 3	12,222 17 4	19,785 0 7
Maintenance of Roads and Bridges	25,823 2 8	19,411 9 3	45,234 11 11
Repayment of Loans	20,423 19 9	7,656 6 10	28,080 6 7
Survey, Design, Supervision, and Administration	11,900 6 2	8,034 9 7	19,934 15 9
Miscellaneous	.....	.....	.....
Totals	70,009 8 8	49,206 2 9	119,215 11 5
Country Main Roads Fund—			
Construction of Roads and Bridges, including Resumptions	24,542 19 8	8,813 17 2	33,356 16 10
Maintenance of Roads and Bridges	98,135 10 1	61,804 17 8	159,940 7 9
Repayment of Loans	.....	.....	.....
Survey, Design, Supervision, and Administration	9,242 16 2	6,921 9 4	16,164 5 6
Miscellaneous	824 17 2	1,294 11 8	2,119 8 10
Totals	132,746 3 1	78,834 15 10	211,580 18 11
Federal Aid Roads Fund—			
Construction of Roads and Bridges, including Resumptions	14,005 2 11	19,259 14 4	33,264 17 3
Miscellaneous	6 10 0	44 6 2	50 16 2
Totals	14,011 12 11	19,304 0 6	33,315 13 5
Developmental Roads Fund—			
Construction of Roads and Bridges	7,599 10 3	4,973 17 1	12,573 7 4
Survey, Design, Supervision, and Administration	.....	504 2 9*	504 2 9*
Miscellaneous	.....	15 5 2	15 5 2
Totals	7,599 10 3	4,484 19 6	12,084 9 9
Summary, All Funds—			
Construction of Roads and Bridges, including Resumptions	58,009 12 11	47,151 5 8	105,160 18 7
Maintenance of Roads and Bridges	123,958 12 9	81,216 6 11	205,174 19 8
Repayment of Loans	20,423 19 9	7,656 6 10	28,080 6 7
Survey, Design, Supervision, and Administration	21,143 2 4	14,451 16 2	35,594 18 6
Miscellaneous	831 7 2	1,354 3 0	2,185 10 2
Grand Total £	224,366 14 11	151,829 18 7	376,196 13 6

* Credits.

Mixed-in-place Tar Macadam, Great Northern Highway, Tamworth.

ONE of the first examples of mixed-in-place construction in New South Wales was built in April, 1929, on the Great Northern Highway north of Tamworth, within the Municipality of Tamworth, and adjacent to the Cockburn Shire boundary. The new surface course was constructed 19 feet wide and 2 inches thick, consolidated, upon an old re-shaped shale road, the materials used being blast furnace slag and coke oven tar produced by Broken Hill Pty. Ltd., and supplied to the work by B.H.P. (By-Products) Ltd. Maintenance expenditure upon this work during the past two and a half years was nil until September last, when approximately £5 was spent, mainly in repairing the edges, so that the methods adopted in construction may be said to have been eminently successful. In view of the advantages of low cost, high-class riding qualities, and suitability to mechanical handling possessed by this type of work, and the likelihood of substantial encroachment by it upon the field hitherto occupied in this State by penetration macadam, it is of interest to review the constructional details of the Tamworth section and present some of the observations of those connected with the work.

The existing shale road was scarified and re-shaped to act as a base late in March, 1929, opened to traffic for a week and then traffic was diverted to side tracks. Then the base was swept clean with a horse-drawn broom, and 1½-inch gauge slag spread by hand from piles in the centre of the road to a loose thickness of 2½ inches. On 16th March, 1929, a cloudy, cool day, hot tar, equivalent to the Board's standard No. 2 grade, was machine-sprayed on the slag in one application at the rate of three-fifths gallon per square yard.

Mixing was commenced immediately, using a 20 H.P. caterpillar tractor and an 8-feet blade grader. The first stage of the mixing was to pile the tarred slag in five parallel windrows with the blade set at an angle of about 50 degrees of the road, and about ½ to 1 inch clear of the base, the aim being to get the blade-setting which gave the maximum rolling and mixing effect. Then each windrow was spread to a uniform thickness, the tractor operating in low gear while making each windrow and in second gear for the re-spreading, except when spreading to the edge of the pavement, when low gear was necessary for this more exact work.

On the morning of the following day, the mixed material was finally smoothed by the grader, and then rolled once over with a 10-ton steam roller. After rolling, hot tar, corresponding to the Board's No. 3 grade, was sprayed on at the rate of one-third gallon per square yard. Slag screenings of ¾-inch gauge were spread by hand, a little at a time, and rolling continued until 1 cubic yard of screenings was rolled into each 75 square yards of surface and the pavement was tightly consolidated. Next day, the road was opened to traffic, and a very light application of ⅛-inch river sand was made to fill the surface voids due to the lack of fine gauge material in the slag screenings.

The gang employed, after the initial spreading of the aggregate, was as follows:—

One tractor driver.
One grader operator.
One driver and one assistant on the pressure sprayer.
One steam roller driver.
One general labourer.

Such an organisation is capable of building about 1 mile of surface course per week.

The cost of the work was as shown hereunder.

	£	s.	d.
Supply of slag, f.o.r. Tamworth (1½ in., 208 tons at 16s. 5d. per ton; ¾ in., 48 tons at 17s. 11d. per ton)	213	14	10
Supply of tar, sprayed hot on road (at 1s. 3d. gall.)	173	2	6
Supply of coarse sand	4	14	7
Scarifying, re-shaping and rolling base—			
Wages	10	2	3
Plant hire	5	13	0
	15	15	3
Sweeping base (horse broom)—			
Wages	7	9	2
Plant hire	0	1	10
	7	11	0
Unloading and hauling slag (3 miles)—			
Wages	42	0	6
Plant hire	8	0	0
	50	1	6
Spreading aggregate—			
Wages	16	16	0
Mixing aggregate and tar—			
Wages	1	11	4
Plant hire	5	0	0
	6	11	4
Rolling pavement—			
Wages	5	14	1
Plant hire	6	16	6
Stores and materials	1	13	0
	14	3	7
Forming shoulders—			
Wages	7	0	6
Side-tracks—			
Wages	5	17	4
Miscellaneous—			
Wages	2	11	2
Stores and materials	1	17	5
Insurance	2	1	3
	6	9	10
Total	£521	18	3

The area of the work is approximately 3,000 square yards, so that the direct charges amounted to 3s. 6d. per square yard, materials delivered at the site costing 2s. 11½d., and the actual manipulation of the materials to form the surface course costing 6½d. The materials in this case, having been brought from Newcastle, a distance of approximately 180 miles, were more costly than is usual, but the relatively low cost of building the materials into a pavement indicates one of the advantages of mixed-in-place work over penetration macadam, the latter requiring a greater proportion of hand labour.

The traffic over the new work consists of vehicles of all classes, amounting to a daily average of 150-200 vehicles, and double this number on Fridays. As has

already been stated, no maintenance of any kind was necessary until September of this year, when portion of the edges was patched with premixed material and a few places in the body of the pavement, where pot-holes appeared to be starting, were painted with hot tar and covered with ½-inch gauge river gravel. At the latter points, there were indications that some of the larger and less tough pieces of slag had cracked under the impact of steel tyres or horse-shoes, and had then been loosened and removed by traffic. The illustrations show how the surface appeared just after it was built, and how it appears at the present time. It is proposed to patch any defective areas as they occur, and later (probably during the coming summer) to resurface the whole area with tar applied at the rate of approximately one-third gallon per square yard.

Some of the points emerging from this experiment are as follows:—

Base.—A smooth, hard and clean base is necessary to give a uniform thickness of mixed material and freedom from dirt and foreign matter in the mixture. This is secured by preliminary grading, dragging and sweeping, which must be extended to the shoulders, particularly if a wheel of the grader used for mixing is likely to run on the shoulders.

Aggregate.—Toughness and uniformity of quality are necessary to resist traffic impact and avoid ravelling due to fracture of the individual stones. The

1. Slag spread, ready for spraying.
2. Mixed tar and slag in the first windrow.
3. Forming the second windrow.
4. Spreading a windrow.
5. Ready for final trimming and second application of tar.
6. After the second application of tar, screenings being spread on the left.

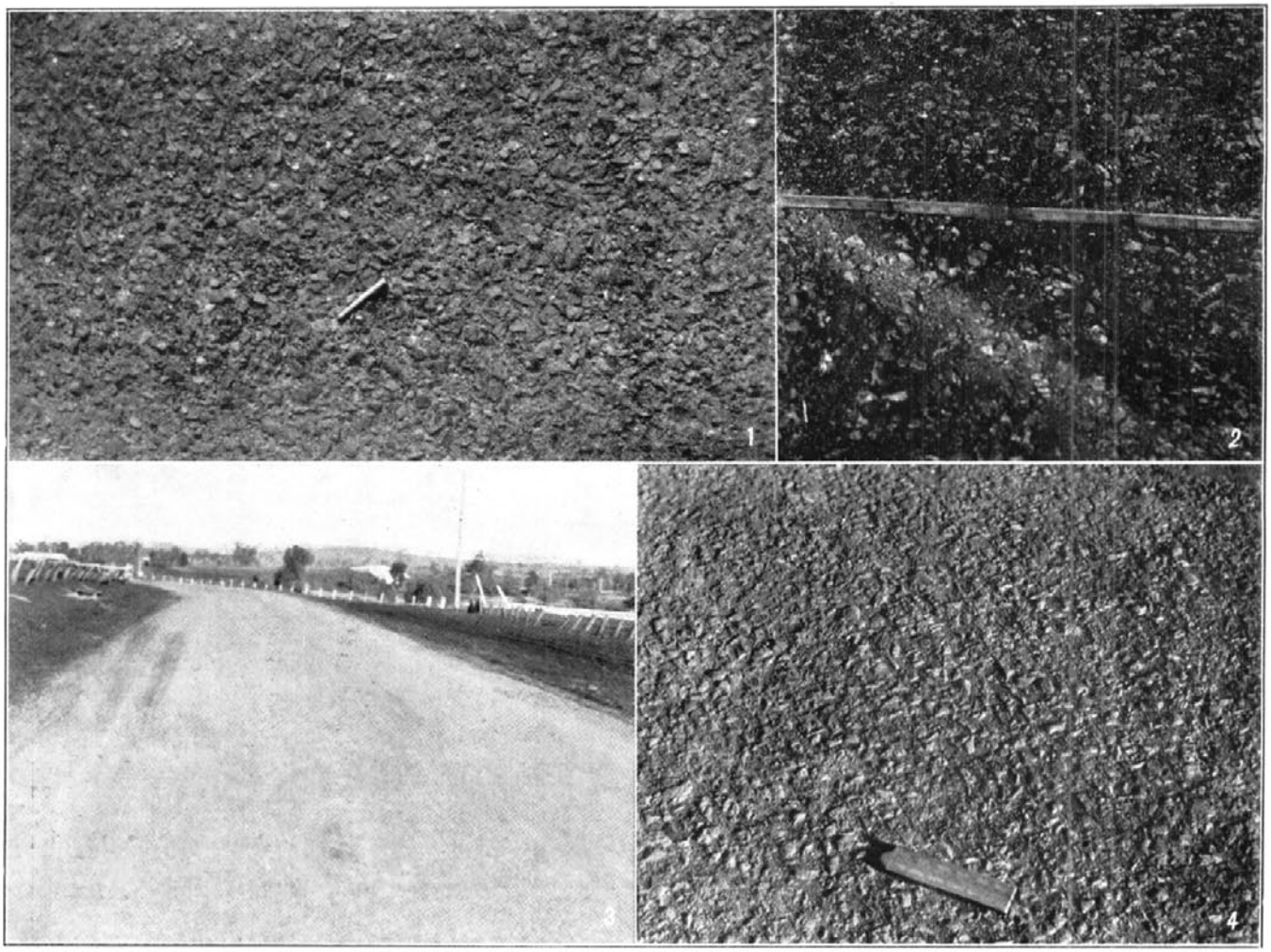
aggregate should be cuboidal in shape, rather than flakey or elongated, so that it will roll along the grader blade rather than slide, thus facilitating mixing with the tar. The aggregate should be sufficiently angular to give appreciable mechanical bond; for example, rounded river gravel would probably not be suitable unless it were feasible to use a heavy binder to counteract the deficiency in mechanical bond.

Binder.—The No. 2 tar used was sprayed at about 10 a.m., and was still mixing freely at 5 p.m. on the same day, although slightly tacky. After a cold night, final smoothing was carried out without any difficulty on the following day, which, like the first, was dull and windy. The quantity of three-fifths gallons per square yard was applied in one application to a bed of 1½-inch aggregate 2½ inches deep, and the subsequent mixing, commenced about an hour afterwards, disclosed that there was no waste of tar due to running or soaking through into the base. The quantity and grade of binder (factors that are bound up with the character of the aggregate and the weather to be expected during construction) are best determined from small scale experiments; the quantity can be checked against one of the formulae giving the percentage of binder in terms of the grading and character of surface of the aggregate.

Edge Protection.—There is little need to provide for rolling against a temporary wooden kerb, or to form a feather edge, since the material can be spread almost to a vertical edge and can be consolidated without appreciable spreading sidewards. At Tamworth the earth shoulders were formed up after the pavement was opened to traffic. A little fretting of the edges has occurred, mainly due to heavy steel-tyred traffic.

Riding Qualities.—As a result of the machine construction, the mixed-in-place work is very definitely smoother longitudinally than penetration macadam or surface treated roads, even though, in this instance, the complete procedure of planing during consolidation was not followed. The riding quality at high speed is excellent, and the matt surface is non-skid in the worst weather, as well as being non-slippery for shod horses during frosts.

The basic economy of this work lies in reducing the quantities of materials, compared with other methods, without impairing the serviceability of the resulting pavement. The machine processes are not only cheaper



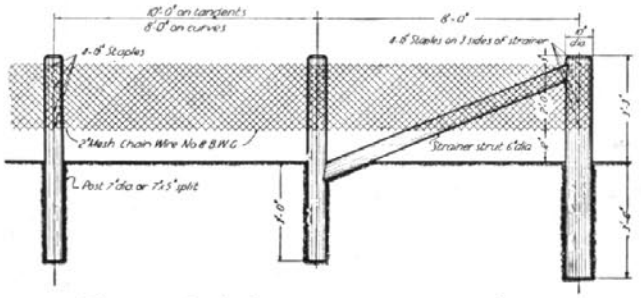
1. Close-up view of surface in July, 1929.
(This view by courtesy of B.H.P. (By-Products) Ltd.)
2. Incipient pot-hole, September, 1931.
3. General view of section, September, 1931.
4. Typical view of surface, September, 1931.

than hand labour, but they also combine the materials in a more thorough and effective manner.

Consideration of accounts of mixed-in-place work such as the above, and the descriptions of similar work in Mr. Sherrard's account of his visit to the United States of America and Canada,* indicate that there are a number of alternatives in regard to this type of work. There is wide scope for the skill and judgment of the engineer in utilising plant and materials to the best advantage, but close and intelligent supervision is plainly necessary.

Road Safety.

AN interesting comparison is afforded by the maintenance costs for the past year of safety fencing on the Great Western Highway between Penrith and Mount Victoria, in the Blue Mountains district, and the Pacific Highway between Mount Colah and the Hawkesbury.



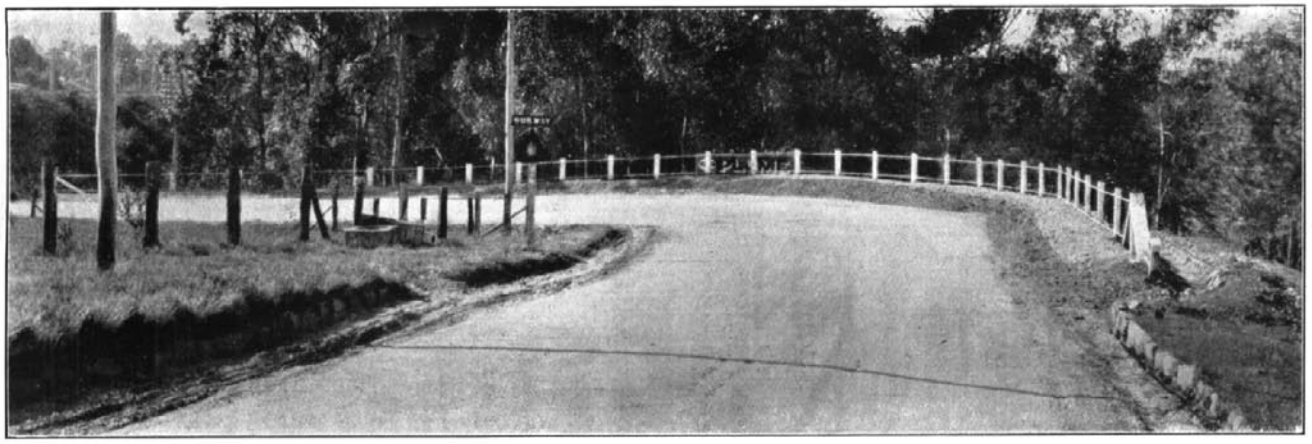
The standard chain wire protection fence.

Of the total length of the former road—41 miles—only one-third has been reconstructed since the inception of the Board, the remainder having a narrow and somewhat rough pavement, and numerous sharp curves with poor visibility, many of which are not superelevated. The Board has maintained this road during the last three years, and has erected some 3 miles of protection fencing at points of danger.

The Pacific Highway between Mount Colah and the Hawkesbury River is a completely new road, 11½ miles long, having standard grades and curves and a cement concrete pavement, 20 feet wide, broadened at curves. The country traversed is, in parts, precipitous, necessitating many high embankments and side-cuttings on steep slopes. In the interests of safety, an aggregate length of 6 miles of chain wire protection fencing has been erected at the more hazardous points.

In both instances, the fencing has saved many vehicles from disaster. In practically every case, contact between a vehicle and the fencing involves the replacement of one or more panels of stretched and distorted chain wire, and though such contact may not necessarily mean that the vehicle would otherwise suffer an accident (in some cases on the Western road, on account of the narrow formation, the fencing has had to be placed close to the edge of the pavement, and is, therefore, liable to be touched by a vehicle merely swerving off the pavement), the length of wire replaced indicates the number of mishaps. On the Western road, 1,060 lin. ft. of chain wire (6.5 per cent. of the total) have been damaged and replaced, whereas on the Pacific Highway only 320 feet (1 per cent. of the total) have needed to be replaced.

While traffic on the Western road is heavier than on the Pacific Highway, and protection fencing exists only at the more dangerous curves and embankments on the former road, the contrast between the respective lengths of fencing damaged is striking. The difference affords a clear indication of the benefits of a wide, smooth pavement and the absence of sharp or un-superelevated curves. Moreover, apart from the question of safety, the difference is reflected in maintenance costs. At current rates, the repairs on the Western road amounted to approximately £10 per annum per mile of fencing, whereas on the Pacific Highway the corresponding cost was only £1 10s. per mile, illustrating one aspect of how an improvement in width, alignment and condition of a road is reflected in more ways than the benefit derived by traffic.



On the Great Western Highway east of Springwood,—a curve improved by constructing a bank and erecting cable protection fencing.

By utilising a pair of wire cables in lieu of chain wire mesh, it is possible to eliminate, or greatly reduce, replacements consequent upon collisions of vehicles with protection fencing but, normally, the extra cost of the cable greatly outweighs its advantages as regards maintenance. However, some short lengths of cable fencing have been constructed with worn-out ferry cables, with a view to determining their suitability for protection fencing.

*See page 158, *Main Roads*, June, 1930.

Types of Pavement on Main Roads.

ON the establishment of the Board's divisional offices, each divisional engineer prepared a map of the main roads in his division, showing the different types of pavement construction on the main roads, *e.g.*, gravel, water-bound macadam, and so on. This information was collected mainly in the course of ordinary inspection work, speedometer mileages being used. In a few cases it was supplied by councils. This "stock-taking" has been kept up to date, and the results, as at 30th June, 1931, have been analysed in the figures here illustrated, and compared with conditions in other places. In addition there is shown diagrammatically the condition of all public roads in the State, the figures for this having been obtained from the State *Statistical Register*.

Fig. 1 shows the position in the Eastern and Central Divisions of New South Wales (excluding municipalities in the County of Cumberland). From this it will be seen that 29.8 per cent. of the main road system is yet unsurfaced. Some 50.5 per cent. of that system is gravel surfaced, this rightly being the predominant form of construction, while there are nearly 1,700 miles of water-bound macadam, a type of construction which is now costly to maintain in satisfactory order under ordinary conditions. The comparison of the main roads as classified into the three grades of State highways, trunk roads and ordinary main roads is of interest as showing that the degree of improvement of the highways, measured on the proportions of the various types of pavement thereon, is yet but little in advance of that of the balance of the main road system, although the condition of the highways is generally superior, as it deserves to be, to the condition of the trunk and ordinary main roads.

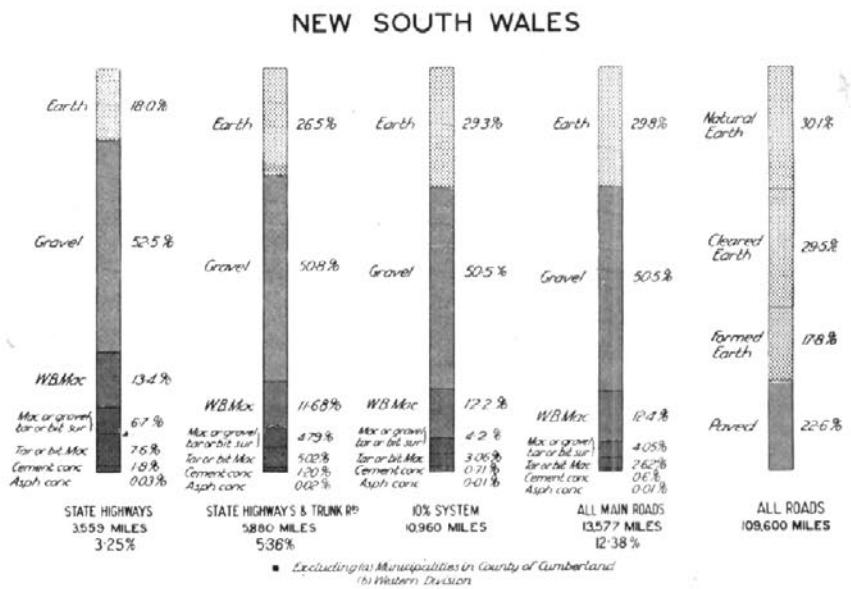


Fig. 1

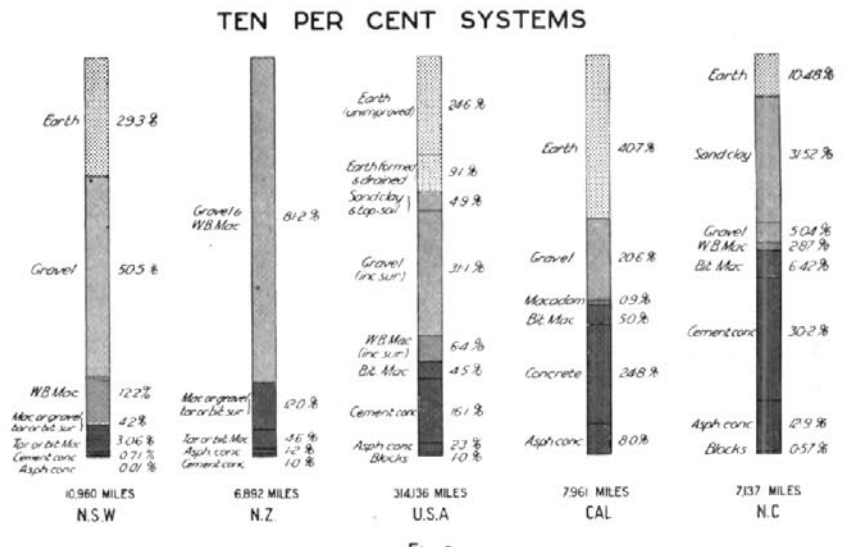


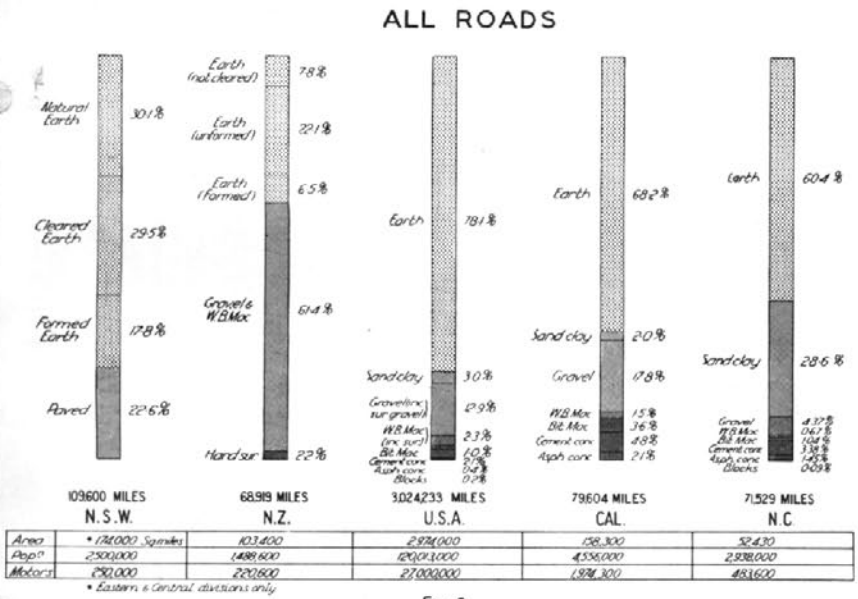
Fig. 3

Figs. 2 and 3 give a comparison between conditions in New South Wales, and those in New Zealand, United States, and the American States of California and North Carolina. The two latter were selected as having somewhat similar climatic conditions to New South Wales, and being not unlike in having both rural and limited manufacturing industries. California, one of the largest American States, has an area only about half that of New South Wales (*i.e.*, of the same order of magnitude as the area of the combined Eastern and Central Divisions of this State) and a population nearly twice that of New South Wales. In spite of this it will be seen (Fig. 2) that 68.2 per cent. of its total road system is still of earth—compared with 77.4 per cent. in New South Wales. It must be remembered, however, that the greater part of the mileage of earth roads of California has been formed and

treated with oil, a process which is not available in New South Wales on account of cost, and which provides in California an excellent running surface for moderate traffic.

The "ten per cent." systems shown on Fig. 3 give a comparison of the most improved ten per cent. of the various road systems. Both in this case and in Fig. 2 will be seen the favourable position of New Zealand compared with New South Wales. This is believed to be due, at least to some extent, to the large deposits of river gravel available in many parts of the Dominion.

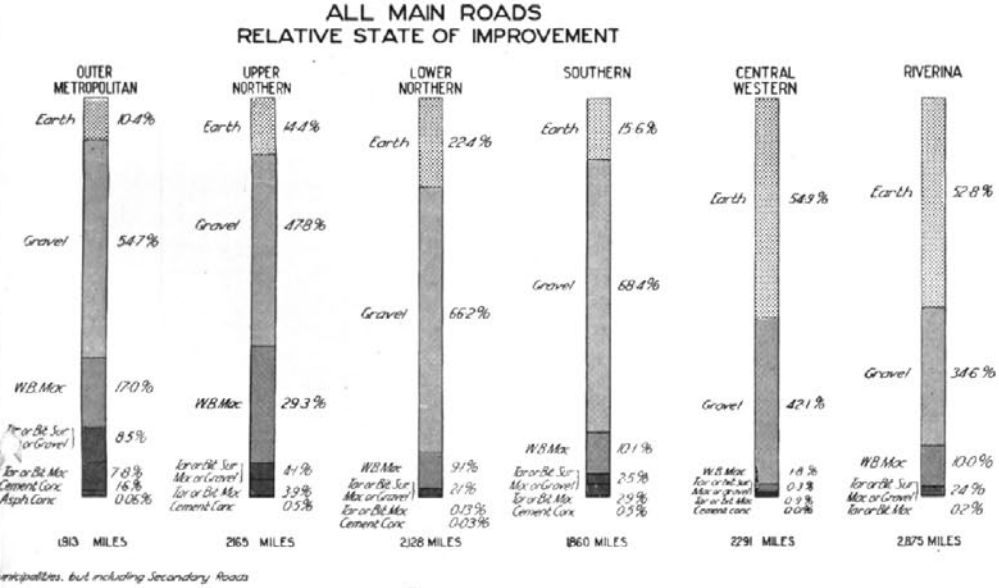
Fig. 4 shows a comparison between the conditions prevailing in the Board's seven highway divisions. The most notable feature here is perhaps the large mileage of unsurfaced water-bound macadam in the Upper Northern Division, the satisfactory maintenance and improvement of which, with the limited funds available, represents one of the most pressing problems at present.



	N.S.W.	N.Z.	U.S.A.	CAL.	N.C.
Area	* 174,000 Sq miles	103,400	2,974,000	158,300	52,430
Pop'n	2,500,000	1,488,800	120,013,000	4,556,000	2,938,000
Motors	250,000	220,600	27,000,000	1,974,300	483,600

* Eastern & Central divisions only

Fig 2



Municipalities, but including Secondary Roads

Fig. 4

N.B.—For purposes of Board's administration, the Central and Eastern Divisions of the State are divided into seven "Highway Divisions." (See map on cover of this journal.)

Coolah-Mullaley Trunk Road.

At a time when it is difficult to provide funds for all desirable maintenance work, it is satisfactory to be able to report roads which are not only being maintained in first-class order, but are actually being improved. The Coolah-Mullaley trunk road (No. 55), in Liverpool Plains Shire, was originally a black-soil-and-clay track, which frequently held up traffic in wet weather. The worst of the boggy sections were constructed in water-bound macadam many years ago, but with the growth of motor traffic this type of pavement became unsuitable, and has had to be surfaced with gravel during recent years. In addition, the lengths of unconstructed black soil and clay have been steadily reduced by forming and gravelling. The constructed lengths have been kept in shape meanwhile by regular grading with a baby grader, and by occasional scarifying and reshaping with a power grader. This year the remaining unconstructed lengths became badly scoured during the wet weather, but all scours have since been filled and the surface roughly graded over, with the result that the road is now in very good condition. The cost of maintaining this road for the past five years has averaged just over £40 per mile per annum, this year's cost being approximately £35 per mile. The road carries a fair volume of traffic, being the through route from Narrabri, Gunnedah and beyond to Mudgee, Bathurst and the central western districts of the State, and to Sydney *via* the Blue Mountains.

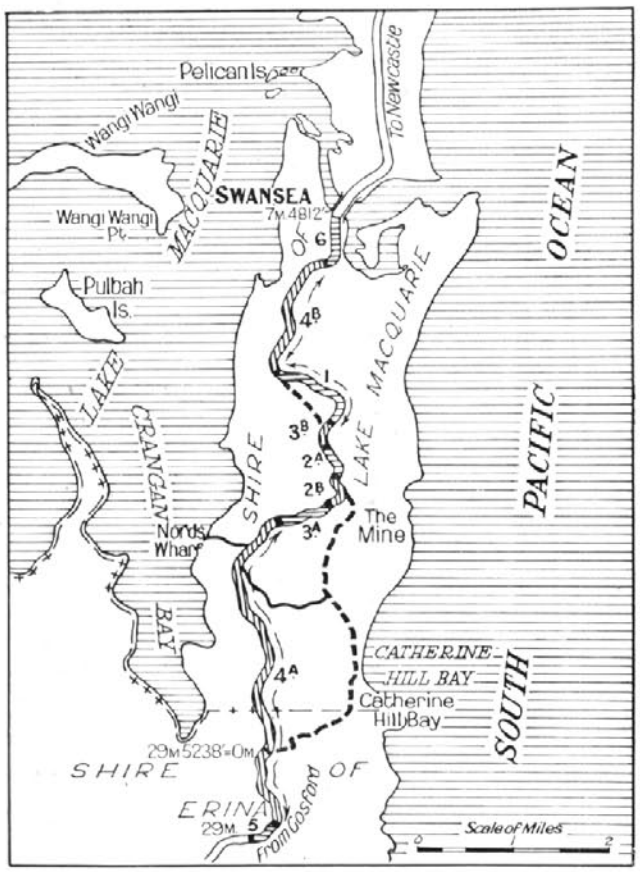
Hannell Street, Wickham.

Wickham Municipal Council is reconditioning Hannell-street from Cowper-street to Tudor-street (Main Road No. 316) in tar-penetration macadam.

Surfacing the Pacific Highway near Swansea.

By C. K. Oliver, A.M.I.E. Aust.
Engineer.

A LENGTH of tar-surfacing which has just been completed on the Pacific Highway between Catherine Hill Bay and Swansea is the final constructional work contemplated on this section under the general scheme of reconstruction for the Highway described in an earlier number of *Main Roads*.* In that issue, the steps taken to reorganise the alignment between Wyong and Swansea and the advantages of the deviation at Catherine Hill Bay, which substitutes an evenly-graded road along the main ridge between Lake Macquarie and the sea for the former steep grades, sharp curves and excessive rise and fall through Catherine Hill Bay township, were explained. The



Sketch of the Pacific Highway between Catherine Hill Bay and Swansea.

policy followed in deciding the order of constructing the different sections, which hinged principally on allowing maximum time for the consolidation of new embankments, and the basis of selecting materials and types of construction, of which the economical utilisation of the local sandstone and conglomerate gravel was the central feature, were also dealt with in the earlier article.

* *Main Roads*, Vol. 1, No. 9, June, 1930.

Early in 1929, the 7 miles of Catherine Hill Bay deviation, beginning about 3 miles south of Catherine Hill Bay township and continuing northwards to within 2 miles of Swansea, were gravelled with 7 inches of the local conglomerate, taken from the roadside, and laid in two courses. Towards the end of the same year, the remaining distance to Swansea, traversing mostly low-lying country, was re-aligned and regraded to a minor degree and similarly surfaced with local gravel. A typical mechanical analysis of the gravel used is as follows:—

	Per cent.
Passing 1¾-inch dia. laboratory screen ...	100
Retained on ⅜-inch dia. laboratory screen ...	15
Retained on ¼-inch dia. laboratory screen ...	40
Binding clay and loam	12

This gravel, although very satisfactory in most respects, wasted rather rapidly under wear by traffic and the disturbance consequent upon the necessary maintenance operations. However, by the middle of 1930, the earthworks were becoming reasonably well seasoned, so that experiments were undertaken in the Board's laboratory to determine the affinity of the gravel for tar and bituminous binders, in the hope of meeting the extra wear likely to occur upon the commencement of the ferry service at Peat's Ferry by some form of cheap surface treatment. The experiments led to full scale field trials over a total length of 3 miles at the Swansea end of the deviation proper, details of which are as follows:—

Section No. 1—4 m. 5,188 ft. to 5 m. 5,140 ft.

Primer.—Board's standard priming tar, ⅛ gal. per sq. yard.
Seal.— ,, ,, No. 2 tar, ¼ gal. ,, ,,
Aggregate for Seal Coat.—Blast furnace slag, ¾ in. gauge, 1 cub. yard per 75 sq. yards of surface.
Consolidation.—Tandem steam roller, 6–8 tons.

Observation of this section disclosed that the priming tar penetrated the gravel very slightly, suggesting that satisfactory results might be obtained, and economy promoted, by dispensing with the first coat of priming tar. Accordingly, a further section was treated as follows:—

Section No. 2—3 m. 1,377 ft. to 4 m. 1,337 ft.

Primer.—None.
Seal.—Board's standard No. 2 tar, ¼ gal. per sq. yard.
Aggregate for Seal Coat.—
Section No. 2A.—3 m. 3,977 ft. to 4 m. 1,337 ft., $\frac{5}{16}$ in. slag.
Section No. 2B.—3 m. 1,337 ft. to 3 m. 3,977 ft., ¾ in. slag.
Consolidation.—Tandem steam roller, 6–8 tons.

The indications of this work, which was carried out in August, 1930, were, firstly, that the two-coat work sustained traffic better than the single coat work and, secondly, that the coarse aggregate yielded better results than the fine. The remainder of the length allotted for the field trials, *i.e.*, section 3A, from 2 m. 5,188 ft. to 3 m. 1,377 ft. and section 3B, from 4 m. 1,337 ft. to 4 m. 5,188 ft. was thereupon dealt with during November, 1930, in a manner exactly similar to section 1.

The trial sections showed the practicability of similar treatment for the remainder of the reconstruction, and a contract for this was let in December, 1930. Included in this work were two short trial sections of sodium silicate treatment and mixed-in-place tar-slag macadam, respectively. Details of the work are as follows:—

Section No. 4A { **29 m. 1,225 ft. to 29 m. 5,238 ft. (0 m. 00 ft.).**
0 m. 00 ft. to 2 m. 5,188 ft.

Section No. 4B—5 m. 5,140 ft. to 7 m. 2,200 ft.

Primer.—Board's standard priming tar, $\frac{1}{3}$ gal. per sq. yard.
Seal.— ,, ,, No. 2 tar, $\frac{1}{4}$ gal. ,, ,,
Aggregate for Seal Coat.—Slag, $\frac{3}{4}$ in. gauge, 1 cubic yard per 75 sq. yards.
Consolidation.—Power roller, 10 tons.

Section No. 5—29 m. 00 ft. to 29 m. 1,225 ft.

Primer.—Sodium silicate solution, $\frac{1}{2}$ gallon per sq. yard. (One part of sodium silicate to three parts of water free from organic impurities or excess of mineral salts.)
Seal.—Board's standard No. 2 tar, $\frac{1}{4}$ gal. per sq. yard.
Aggregate for Seal Coat.—Slag, $\frac{3}{4}$ in. gauge, 1 cubic yard per 75 sq. yards.
Consolidation.—Power roller, 10 tons.

Section No. 6—7 m. 2,200 ft. to 7 m. 4,812 ft.

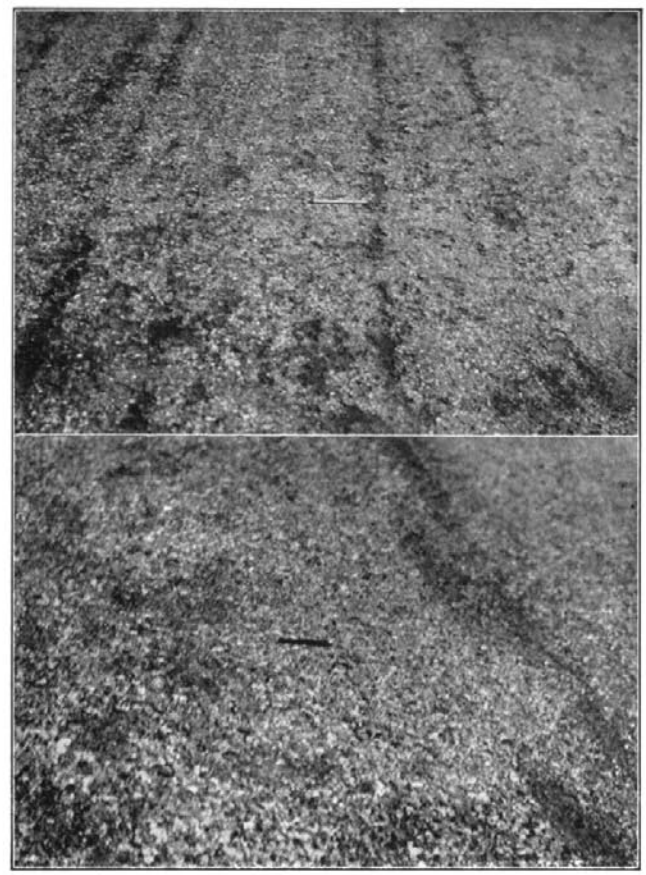
Binder.—Board's standard No. 2 tar, $\frac{11}{20}$ gal. per sq. yard.
Aggregate.—Slag, 60 per cent. $1\frac{1}{2}$ in. gauge, and 40 per cent. $\frac{3}{4}$ in. gauge.
Seal.—Board's standard No. 2 tar, $\frac{1}{3}$ gal. per sq. yard.
Aggregate for Seal Coat.—Slag, $\frac{3}{4}$ in. gauge, 1 cubic yard per 80 sq. yards.
Consolidation.—Power roller, 10 tons.

During the contract, which was commenced in January, 1931, and has just been completed, a certain amount of gravel was added to make good the wear, principally at curves, and some scarifying and addition of gravel was necessary where the gravel appeared to be laminated, as evidenced by flaking of the surface when rolling the aggregate into the tar.

Sodium silicate was substituted for priming tar for a short distance, to fill and harden the gravel surface. In this instance the western half-width of the road only was treated with the solution and tar surfaced, but the tar-slag surface mat broke away from the gravel in places. The silicate applied to the eastern half-width was washed off by heavy rains before the sealing could be completed and, in view of the results obtained on the western half-width in the meantime, this treatment was not persisted in when the weather again became fine. The eastern half-width was primed and sealed with tar, just as for section 4, and the western half-width, upon which partial failure of the tar-seal, attributed to the silicate of soda, had occurred, was re-sealed with No. 2 tar at the rate of ¼ gallon per square yard and ¾-inch slag aggregate.

The binder for the mixed-in-place surfacing was No. 2 tar at the commencement of the work, but No. 1 tar was substituted as the weather became colder, and hindered free mixing of the slag and tar. The slag was spread over the gravel base, then sprayed in one application, and mixed with two tractor-drawn graders. Part of the mixture was turned twenty or more times until the slag was completely and uniformly coated with tar, and part was turned only 12-15 times, and consolidated by rolling when the slag presented a mottled appearance. Judging from this work, No. 2 tar is preferable, except when mixing must be undertaken in cold weather, and there is no apparent difference in the sections completely and partially mixed. As the mixing was effected during May, it is probable that, during the summer months, satisfactory results could be obtained with less than the minimum number of turns used in this distance. Sealing closely followed mixing and consolidating.

The work on sections 1 to 3 inclusive was carried out by the Board's maintenance staff, using tar supplied and sprayed by B.H.P. By-Products Proprietary Ltd. and crushed slag supplied by the same company. Sections 4 to 6, inclusive, were surfaced under contract by Messrs. Bryant and Buchanan Ltd., using tar supplied and sprayed by the City of Newcastle Gas and Coke Co. Ltd., and crushed slag supplied by B.H.P. By-Products Proprietary Ltd. As an extra to the latter contract, the gravel pavement on the short deviation north of Swansea has also been tar-surfaced, thus completing a dustless surface on the highway between Newcastle and a point about 3 miles south of Catherine Hill Bay, while there remains under construction between Peat's Ferry and Newcastle only a length of 6 miles extending southerly from the surfacing just completed.



Upper, close-up view of two-coat surfacing, using 5/16 in. aggregate.
Lower, two-coat surfacing, using ¾ in. aggregate.

Belmore Bridge, West Maitland.

THE cylinder piers of Belmore Bridge, over the Hunter River at West Maitland, on the West Maitland-Paterson road (No. 101) are being strengthened. The work has been delayed by the continued high level of the river.

Fine Crushed Rock Surfacing.

IN certain parts of the State of New South Wales, notably in the far North Coast, gravel supplies, which are so valuable for the production and maintenance of smooth running low cost roads, are unfortunately not available. Due to this, and to the need of something superior to earth roads, waterbound macadam has been used in these parts for many years, until the burden of attempting to maintain the comparatively extensive lengths of this type of surfacing in the Upper Northern Division in a reasonably smooth and traffickable condition has become a conspicuous

Fine crushed rock surfacing between Raleigh and Coff's Harbour, on the Pacific Highway in Bellingen Shire.

feature of the general maintenance problem. Its extent may be gauged from the fact that on the main road system there are 1,700 miles of water-bound macadam, of which 635 are found in the Upper Northern Division. As is well known, gravel, when available, can be placed on a road cheaply and maintained in a smooth condition by patrol grading and dragging, both of which are relatively cheap processes. Waterbound macadam, on the other hand, is more costly to construct, since more costly operations, viz., crushing and power rolling, are involved, but, in addition, its maintenance demands expensive work in scarifying, reshaping, rolling and hand-patching, and in spite of all efforts gives a result which in a short time leaves much to be desired—due to roughness, loose stones, and loss of shape. Waterbound macadam, therefore, while more costly to construct and maintain than gravel, now renders very much less satisfactory service than the latter—a situation which is the product of the displacement of animal-drawn iron-tyred vehicles by fast-moving rubber-tyred motor vehicles. The former, by abrasion, used to cause the formation of sufficient fine material to keep the macadam roads bound, but the latter dissipate the binding material and do not produce any to replace that scattered.

Considerations of this nature have led, both here and abroad, but particularly in the United States of America, to endeavours to create artificial gravels by the fine crushing of rock and to use them for road construction in much the same way as natural gravels. The basic innovation lies in converting the stone which would otherwise be utilised in waterbound macadam into small gauge granular material which is thereafter regarded as artificial gravel and placed and maintained upon the road by methods appropriate to natural gravel. Slight modification of technique is required by reason of the fact that consolidation is effected, generally, by traffic only.

Materials.—Any durable material, crushed into angular fragments, can be utilised. In the United States, crushed stone, slag, cinders, limestone, sandstone, shale, and burnt clay waste from brick and tile works have all been exploited. The material is crushed to pass a 1¼-inch screen, as a maximum, with a decided preference, in most instances, for a maximum size of 1 inch, or even ¾ inch.

Construction Methods.—There are two principal methods of construction of fine-crushed rock surfacings, viz.:—

(i) by constructing, in one or more courses, a pavement of "artificial gravel," i.e., fine-crushed stone containing sufficient suitable binder;

(ii) by spreading a thin layer of fine-crushed rock on an earth subgrade, into which the rock is gradually forced by traffic, then adding another thin layer, and so on, until a sufficiently strong crust or pavement is built up,

Fine crushed rock surfacing on the Pacific Highway, Washington, U.S.A.*

the surface being maintained continuously by graders or drags during the process. This method is especially suited to light traffic conditions.

The former method is readily adaptable to contract work, but the latter is mainly a maintenance operation and can best be carried out by day-labour working.

* This pavement consists of a waterbound base course, 6 in. thick, built in two layers of 3 in., using stone passing a 3-in. screen. The base was filled and watered, and compacted by a 14-ton roller. The surface course is 4 in. thick, constructed in two layers of 2 in., the stone consisting of 100 per cent. passing a 1-in. screen, 40–60 per cent. passing a 3-mesh screen, and 8–12 per cent. passing a 200-mesh. Each layer was consolidated by hauling over it with the twin pneumatic tyred trucks used for the construction, and is kept smooth by dragging. These details, and the photograph, were furnished by Mr. H. W. Sando, Amaroo Shire Engineer.

For the first method, viz., that of constructing in one operation a pavement of artificial gravel, if the crushed rock does not contain sufficient binding material, then more is added, being mixed either by blending at the crushing plant, or by spreading over the crushed material on the roadway and then mixing with it by use of a blade-grader, moving the material in windrows back and forth across the subgrade.

The binder may consist of fine rock screenings resulting from the crushing operations, disintegrated granite, or any other available cementitious material. Consolidation is secured by the combined effects of traffic and blading.

In other respects, the procedure is substantially the same as that for the construction of a gravel pavement. Construction is arranged to proceed away from the source of supply of the materials, so that the haulage vehicles may assist in consolidating the new surfacing. For surface course, stone should not exceed 1-inch gauge, but the base-course material is often somewhat coarser, and may even be constructed as an ordinary coarse broken-stone base. In this case, however, it is essential that the surface course be subsequently maintained of adequate thickness as, should it be allowed to wear thin, ravelling of the base will be liable to occur, when there will follow all the disadvantages of coarse gauge broken-stone construction. On this account, it is sometimes preferred to have the base course of material little, if any, coarser than the surface course.

The second method of construction calls for the deposition of the crushed material, in quantities to yield a loose depth of up to 3 inches, upon the graded and drained formation, previously rendered smooth by blading or dragging. The stone is formed into either a central windrow or a windrow on each shoulder, and then bladed over the subgrade by grader in a layer approximately one stone thick, forming a coating of loose material which is worked into the subgrade by traffic and the subsequent smoothing operations. The depth of loose material is maintained by blading further material in from the windrows, and smoothness is maintained by the continuous use of either the grader or a drag of the long-base planer type. The result of the first year's operations is a consolidated thickness of new material of 2 inches to 3 inches, any deficiency of binding material having been made up by admixture with the sub-grade material.

Maintenance.—Maintenance of both types consists of preserving a thickness of approximately ½ inch of loose material evenly distributed upon the surface of the pavement and of blading or planing to retain satisfactory smoothness and riding quality. In the case of the work constructed by the second method described, new material is brought in, when necessary, by blading from windrows, stone added in the second and subsequent years being often of slightly smaller gauge than that added during construction, 1 inch to ¾ inch being the favoured sizes, and building up is continued during two or more years until a thickness of 5 inches to 6 inches is attained on a stable subgrade. A patrol grader is the principal tool required for maintenance, with occasional assistance from a long-base planer-drag in restoring smoothness.

General.—This type of surfacing is constructed with a very flat crown, viz., 1:32 to 1:48, and as there is less fine material present and the crushed particles tend to interlock more strongly than natural gravel, there is less wastage of material by wear, and somewhat less dust. A refinement in maintenance is to reduce the crown during the dry months and to increase it when new material is being worked in during wet weather. Excess clay causes dust and potholes, and excess fine material causes corrugations. Too coarse material tends towards excessive tyre wear, while the loose surface layer, if too deep, or of too coarse material, tends to increase the tractive resistance of vehicles. First-class riding qualities are assured, however, by dragging with a planer-type drag.

The illustration shows an example of fine-crushed rock surfacing in this State, and indicates the type of surface produced although, in this instance, the gauge of the stone is somewhat larger than is generally desirable. In crushing the material, it is important to bear in mind that crusher jaws in good order are necessary to secure a well-shaped product, and that reduction to a fine gauge, if any quantity is involved, is most economically accomplished by the use of a secondary crusher for the final reduction rather than by reducing the aperture of the primary crusher sufficiently to perform the reduction in one operation.

Pacific Highway, Mooney Point-Wyee.

On the Sydney-Newcastle section of the Pacific Highway the pavement for 8 miles north of Mooney Point has been resurfaced with tar by the Australian Gas Light Company. Between Gosford and Wyong, the shoulders have been widened. At Wyee, preparations are being made for completing the only unsurfaced section between Gosford and Newcastle. The latter work will comprise 3 miles of premixed macadam pavement and 3 miles of two-coat tar surfacing upon gravel.

North-Western Highway, Wellington.

The reconstruction of the North-Western Highway in the Municipality of Wellington has been completed between the southern municipal boundary and Maughan-street. This work links up with the deviation recently constructed south of the municipality, and the reconstruction completed earlier in the year between Maughan-street and the bridge over the Macquarie River at the northern boundary. Between the boundary and Hawkins-street, a gravel pavement 18 feet wide has been built. For the remaining length of 2,100 feet, a tar emulsion penetration pavement 20 feet wide has been constructed (the portion between Maxwell-street and Maughan-street being divided into two 10 feet strips). The balance of the roadway between kerbs has been constructed at the expense of the council. The work was undertaken by the Board by direct labour, and has now been handed over to the council for maintenance.

The Main Roads Board as a Training Ground for Highway Engineers.

THROUGH the courtesy of Mr. C. H. N. Smart, Clerk to the Local Government Examination Committee, the information set out in the following table giving particulars of the number of persons who have been examined by the Engineering Committee and been granted interim or final certificates during the past six years, has been obtained. Its objective was to discover, as far as the results of the Local Government Engineers' Examination would show, to what extent the Board was, through direct employment on its staff, actively influencing the training and outlook of prospective highway engineers. In its first annual report the Board indicated that it felt it had a definite part to play in this respect. Between the establishment of local government in the State and the creation of the Main Roads Board, the chief practical training ground of highway engineers, apart from the University and the technical schools, had been the shires and municipalities. This is still largely the case. With the advent of the Board, engaged solely on highway work, a new opportunity came into being for young men desiring to make highway engineering (or some branch of it) their profession, to secure practical and administrative experience under expert direction in a fairly concentrated manner. The Board has therefore encouraged those who have joined its staff and who were not graduates or already certificated local government engineers, to qualify as such, so that they could not only render increasingly good service while in its employ, but also, should they in due course pass into the direct employment of municipal and shire councils, be thoroughly reliable advisers and administrators, capable of bringing scientific and constructive minds to bear on the problems with which they would be faced.

Year.	No. of persons examined.	No. of (*a*) granted Interim or Full Certificate.	No. of persons other than those examined in year under reference granted Interim or Full Certificate.	No. of (*c*) who were graduates of a University.	No. of (*b*) who were at the time of examination in the employ of the Main Roads Board.	No. of (*b*) who although not in employ of the Main Roads Board at time of examination had been so employed.	No. of (*c*) who were in the employ of Main Roads Board at time of granting their Certificates.	No. of (*c*) who were employed by Main Roads Board at some time prior to the granting of their Certificates.	No. of (*d*) who were in employ of Main Roads Board at time their Certificates were granted.	No. of (*d*) who were employed by the Main Roads Board at some time prior to the granting of their Certificates.
	(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)	(*g*)	(*h*)	(*i*)	(*j*)
1924–25	11	1	24	9	...	...	...	...	...	...
1925–26	11	3	19	9	...	...	...	...	1	...
1926–27	17	3	34	10	1	1	...	...	1	...
1927–28	26	5	36	14	1	...	...	1	1	...
1928–29	40	9	42	15	1	...	3	1	1	2
1929–30	34	6	39	9	2	2	1	1	4	4
Totals ...	139	27	194	66	5	3	4	3	8	6

NOTE.—University Graduates in Civil Engineering do not sit for the examination, as they can obtain certificates as Local Government Engineer without examination.

The figures given in the table, although only a partial measure of the Board's work in this respect, indicate to some degree the extent to which this ideal has been realised to date. They show:—

(1) That out of a total number of candidates who have sat for the Local Government Engineers' Examination during the past six years, an average of 20 per cent. pass annually.

(2) That 30 per cent. of those who so pass are or have been at some time employed by the Board.

(3) That of the number of persons who are granted an interim or full certificate in any year—excluding those passing the examination in that year—30 per cent. are graduates of the University.

(4) That of such graduates, 21 per cent. are or have been at some time employed by the Board.

(5) That, in addition, 4 per cent. of the persons admitted to certificate in any year—excluding those passing the examination in that year—are or have been at some time employed by the Board.

Were these percentages calculated on the returns for the last four years—which would be more truly appropriate, since the Board did not commence operations until March, 1925—they would be slightly higher.

Oldmangunyah Creek Bridge.

CONTRACTORS Jackson and Sons have completed the abutments and are working on the piers of the new three-span concrete bridge over Oldmangunyah Creek, on the Goulburn-Boorowa road (No. 248).

Shoalhaven River Bridge, Nowra.

ON the iron bridge over the Shoalhaven River at Nowra, on the Prince's Highway, improvements have recently been made to eliminate vibration of the diagonal tension members in the counter-braced panels of the trusses. Vibration under traffic has caused considerable noise, and some wear of the holes in the truss verticals, through which the tension members pass. Washers, each in two sections, were fitted closely to each diagonal and then electrically welded to the vertical, thus confining the first-mentioned members and eliminating further lateral movement.

Demountable Spraying Unit.

ONE of the methods available to the engineer in his efforts to protect gravel and macadam roads from the surface-disintegrating effect of motor traffic is surface treatment with tar or bitumen. In the country areas, particularly, effective use of this method is bound up with other questions, namely, the comparatively light applications required, which involve relatively small quantities of materials; the difficulty of preparing considerable lengths for treatment at one time; the long distances between jobs; and the liability of spraying schedules to be dislocated by unfavourable weather.

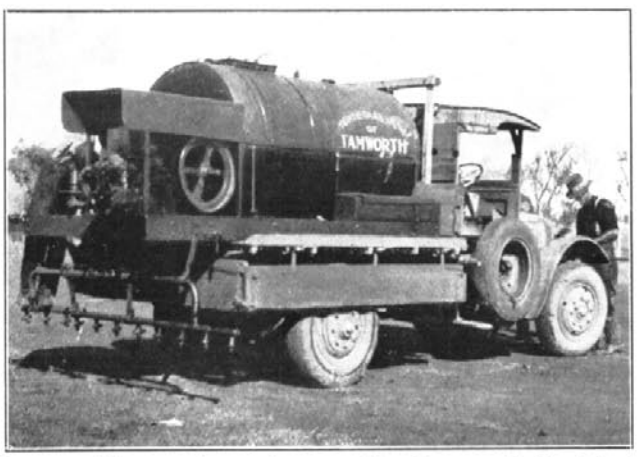
The heavy-duty sprayer, built on a steam or petrol-driven chassis, and carrying 800-900 gallons of heated material in its insulated tank, is a well-tried, standard implement for applying tar or bitumen uniformly and quickly wherever the quantities are sufficient to bear the expense of a full-time spraying unit. Unless mounted on pneumatic tyres, the speed from job to job of such machines is low. The application of lesser quantities than a full tank load is obviously outside their scope, and their heavy weight is a handicap.

Spraying devices attached to heating kettles represent an advance upon hand methods but are not notably efficient and are generally slow to move about, and slow in handling the hot material. Hand spreading is impracticable for the light applications often used in surface treatment; and, when practicable, does not, in general, give a uniform thicknesss of application.

The need for flexible and efficient plant for applying tar or bitumen is being met by the use of light spraying equipment designed as a unit—comprising tank, power pump, and spraying manifold. Such units have a tank capacity of about 400 gallons and can be lifted bodily from the motor vehicle used for their transportation, and stored between periods of use, rendering the lorry (of 2-3 tons load capacity) available for other work as required.

A brief description of such a machine, owned by the Tamworth Municipal Council, and illustrated on this page, is as follows. The circular insulated tank is of 400 gallons capacity and is fitted with filling, cleaning, and straining facilities. The spraying mechanism is operated by a 4 H.P. petrol engine and consists of a 1½-inch sliding vane pump, jacketed and heated by the engine exhaust. The spraying manifold is fitted with independently controlled jets 9 inches apart, and there is provision for an independent hand spraying nozzle to be attached to an armoured hose. A complete set of auxiliaries, including engine clutch, relief valves, pressure gauges, control-cocks, &c., is provided. This machine will spray tar to a width of 9 feet 6 inches and bitumen to a width of 8 feet 6 inches in one operation, developing a pressure of 20-30 lb. per square inch, according to the number of jets in operation. As the engine and pump run at a constant speed, the rates of application, for a uniform width, are varied by altering the speed of travel of the truck. Tank, engine, pump and manifold are assembled as a unit and, when not in use, are lifted from the lorry and stored at the council's depot.

The Tamworth machine is believed to be the first of its type to be manufactured in New South Wales and is understood to be proving a useful unit. Several minor improvements could be made, with advantage, to secure somewhat greater discharge and pressure from the pumping gear and to increase the accessibility of the various components, and these will doubtless be made in future machines. The cost of the sprayer to the Tamworth Council was £275.



Demountable spraying unit owned by Tamworth Municipal Council.

A light demountable sprayer would appear to be eminently suited to the requirements of councils having sufficient work to justify the initial outlay. It seems possible, also, that a council owning such a machine could arrange for its use by councils in adjoining areas upon terms mutually advantageous.

Road Traffic between Sydney and Newcastle.

SINCE the commencement of the operation of the ferries across the Hawkesbury River between Kangaroo Point and Mooney Point, in August, 1930, a record has been kept of the traffic using them. So far as they relate to vehicles, they represent almost wholly "through" traffic, and they may be taken as a measure of the road traffic between the two principal cities of New South Wales.

The particulars up to 30th June, 1931, are as follows:—

Denomination.	Mondays to Fridays.	Saturdays.	Sundays.	Public Holidays.	Total.	Percentage of Total
Passengers	161,562	64,535	113,351	48,915	388,363	...
Motor cars with one passenger, and motor cycles with sidecars ...	72,112	24,394	36,866	15,901	149,273	85·51
Motor cycles, solo ...	2,656	1,141	2,011	881	6,689	3·83
Bicycles	1,082	285	590	247	2,204	1·26
Horse-drawn vehicles ...	503	103	15	8	629	·36
Motor lorries—						
Under 3 tons	8,756	1,678	1,816	659	12,909	7·40
3–4 tons	1,184	146	63	7	1,400	·80
4–5 tons	496	56	23	1	576	·33
Over 5 tons	789	65	8	1	863	·49
Motor omnibuses... ...	31	4	4	2	41	·02
Total vehicles ...	87,609	27,872	41,396	17,707	174,584	100·00
Percentage of total ...	50·18	15·97	23·71	10·14	100	
Daily average	370	589	875	1,610	529	

Taren Point Ferry, George's River.

At the request of the Metropolitan Transport Trust the time-table of the Taren Point ferry over George's River has been altered in order to give improved connection with the tramway services. On week days the previous half-hourly service between 10 a.m. and 8 p.m. has been brought forward five minutes, so that the ferry now leaves Taren Point at 9.55 a.m. and thence half-hourly until 7.55 p.m., and leaves Sans Souci at 10.10 a.m., thence half-hourly until 7.4 p.m. On Sundays a regular half-hourly service has been initiated between 9.55 a.m. and 4.55 p.m., conforming to the same time-table as on week days. Outside the hours mentioned, the ferry runs continuously when required.

Mid-Western Highway, Hay-Balranald.

The Mid-Western Highway between Hay and Balranald is for the greater part of its length an earth road. In June, heavy rains and floods saturated the country to such an extent that it has taken from June to October for the road to dry out and become firm enough to carry the traffic. The road is now being used again. The greatest amount of damage as a result of floods has occurred in the extreme south-western portion of the division, where the waters from the Murray River washed away a two-span bridge on the Moulamein-Barham road (No. 319), and a second bridge on the same road was severely damaged by flood waters from the Wakool River. At each of these places temporary structures have been erected until such time as the water subsides sufficiently to permit of the structures being replaced. Several of the "developmental roads" have been damaged, notably the Neimur siding road (No. 1,106), where the approaches to Yarrein Creek bridge were badly damaged, and the Moulamein-Nacurrie road (No. 1,146), where portions of the approaches to Murrein-Yarrein Creek bridge were washed away.

Tenders and Quotations Accepted.

The following Quotations were accepted by the Board during the month of September, 1931:—

Quotations.

No. of Quotation.	Description of Article.	Name of Successful Tenderer.	Amount of Accepted Quotation.
			£ s. d.
69	Shafting and gears for vehicular ferry punt No. 41	Gordon Marr & Co.	82 6 0
70	Unscreened coal, delivered to Hexham ferry as and when required, 300 tons.	A. Ralston	225 0 0
71A	Sand, f.o.r. Waterfall, 140 tons	Nepean Sand and Gravel Co.	51 18 4
72	Broken stone, ¾-in. gauge, 100 tons	Emu and Prospect Gravel Co.	27 18 4
73	Broken stone, ¾-in. gauge, 60 tons; 5/16-in. gauge, 140 tons ...	State Metal Quarries	52 10 0
74	No. 3 tar, f.o.r. Newcastle, 40 drums (1,680 gals.)	Australian Gas Light Company	57 15 0
75	Bridge timber, delivered to Nepean River Bridge, Maldon—10 in. x 5 in., 456 lin. ft.; 5 in. x 1 in., 200 lin. ft.; 5,760 sup. ft., 2 in. thick, in 20 ft. lengths.	Hargense and Sweeney	109 5 7
76	Bridge timber, f.o.r. Carcoar—18 in. dia., 115 ft.; 19 in. dia., 227 ft. 6 in.; 12 in. x 12 in., 199 ft.; 8 in. x 8 in., 334 ft.; 4 in. thick, 8 to 10 in. wide, in 21 ft. lengths, 14,028 sup. ft.; 1½ in. thick, 6 in. wide, in 11 ft. lengths, 200 sup. ft.	Joseph Reid, Ltd.	345 2 10
77	Screened coal, delivered to Taree ferry as required, 120 tons ...	Beatty Bros.	52 13 4
78	Standard cast-iron gully gratings and double frames, 13 off. ...	Gordon Marr and Sons, Ltd.	34 9 0
80	Steel reinforcement, 11 tons, 12 cwt. 2 qrs.	R. S. Morris & Co.	162 6 3

The acceptance by the respective Councils of the following Tenders has been approved by the Board during the month of September, 1931:—

Work.			Name of Recommended Tenderer.	Amount of Recommended Tender.
Shire or Municipality.	Road No.	Description.		
				£ s. d.
Nambucca ...	1075	Construction of two-span timber bridge over Thumb Creek	Gam and Jenkins ...	265 17 0
Boolooroo ...	12	Gravelling between 21 m. and 22 m., 50 chains	E. J. Steepe	435 0 0
Carrathool ...	254	Reforming, 40 chains	L. C. Billing	70 0 0
,, ...	207	Forming 60 chains and constructing two 18-in. dia. pipe culverts.	J. A. Alexander ...	153 16 0
,, ...	257	Forming 44 chains and constructing two 18-in. dia. pipe culverts.	J. A. Alexander ...	133 16 0
,, ...	321	Reforming 112 chains and constructing one 18-in. dia. pipe culvert.	J. Stokes	155 0 0
,, ...	254	Reforming 120 chains and constructing one 18-in. dia. pipe culvert.	J. A. Alexander ...	232 18 0

Sydney: Alfred James Kent, I.S.O., Government Printer—1931.