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

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Federal Aid Roads Agreement.

IF the decision of the Premier's Conference held at Canberra during February is ratified by the Commonwealth and State Parliaments, the Federal Aid Roads Agreement will shortly be amended so as to eliminate all clauses other than those which make for the distribution of £2,000,000 of Commonwealth revenues among the States on the basis of the present agreement, *i.e.*, three-fifths population and two-fifths area.

That some amendments would sooner or later be necessary has been recognised by the majority of the States for some time, and it required only the present financial stringency to make the alteration urgent.

The essential points of the present agreement, apart from that by which the Commonwealth allocates certain moneys to the States are:

(1) That the States shall contribute 15s. for each £1 granted by the Commonwealth, and

(2) That the combined moneys shall be expended on the reconstruction or construction of three types of road, *viz.*, arterial roads, main trunk roads and main developmental roads.

(3) That the States shall be responsible for the maintenance of the roads so constructed or reconstructed.

The remainder of the agreement consists of machinery clauses dealing with the administration of the expenditure.

It will be seen, then, that the agreement presupposes that each of the States requires a certain specified annual expenditure on the construction and reconstruction of certain of their main roads for ten years, and that their own revenues are or will be sufficient to maintain these as well as to finance any works on other roads under State control. Even when the agreement was entered into, this was considered a very doubtful premise, and subsequent experience has proved it to be so in a number of States, particularly in the case of those which, on account of their heavy liabilities for maintenance generally, are unable to provide their quotas under the agreement except as loan moneys. In New South Wales, owing to the late entry of this State into the agreement, and the prior commitment of its funds for other purposes at that time, the first two years' quotas had to be specially provided by the Government from loan. When the reclassification of the main roads into State highways, trunk roads and ordinary main roads, with its greater measures of assistance to country councils, was adopted on 1st July, 1928, this presupposed that New South Wales would continue to supply the bulk of its quota from loan, and in the absence of the ability to secure such moneys it becomes necessary to eliminate the quota.

In other States such as Victoria, whose road programme had been continued over a long period, the

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greater need is for maintenance rather than for construction and reconstruction, and their position could have been met by allowing portion of the combined State and Federal moneys to be used for the former purpose. By the removal of all restriction on the use of the Federal moneys and the elimination of the need of the State to provide any quota, the whole system will become more flexible and allow each State to expend the funds provided from all sources in the way most needed.

The fact that some of the bases of the agreement require review should not, however, be taken to indicate that it has not operated generally in a successful manner up to the present stage. So far as this State is concerned, it has produced very satisfactory results, and the dealings between the Board and the Federal Officers and between the Board and the Councils have been most harmonious and free from difficulty. So far as the Commonwealth generally is concerned, by its insistence on a comprehensive policy of improving certain groups of roads, many of which extend beyond the boundaries of one State, it has produced a wider and more liberal outlook on the establishment of road communications throughout the Commonwealth, which will continue indefinitely.

News of the Month.

METROPOLITAN DIVISION.

The new King's Falls Bridge near Appin, on the Bulli-Appin road, has been completed and opened to traffic. The site is adjacent to that of the old wooden bridge which it replaced and which structure has been demolished. The grading and alignment of the approaches have been considerably altered and improved and the new sections of road have been surfaced in gravel. The work was carried out by contract and supervised by the Wollondilly Shire Council.

The reconstruction of Babbage-road (Secondary Road No. 2009) in tar surfaced waterbound macadam between Moore-street and Roseville Bridge has been completed by the Ku-ring-gai Municipal Council. A feature of the work is the considerable improvement of the alignment at the bends near the bridge where the minimum radius is now 150 feet.

Concreting commenced on the 3rd March, 1930, at Fitzgerald-avenue, Maroubra, between Anzac-parade and Long Bay road. The regrading of Bunnerong-road between Smith-street and Nilson-street and the formation of Fitzgerald-avenue to junction with Bunnerong-road near Flint-street, is now being carried out by the Department of Lands. The concrete pavement will be laid on these sections of road by the Board when the formation is completed by the Lands Department.

The Woollahra Council has practically completed the construction of New South Head road between Lyne Park and Newcastle-street and has begun the widening of the concrete pavement to the new alignment between Manning-road and Bellevue-street, where the Board recently resumed a strip of land to enable the improvement of the bend to be effected.

On the Main South Coast road at Thirroul, Kennedy's Hill was steep and difficult to maintain in good condition. With a grant from the Board, the Bulli Shire Council has now completed the regrading of the hill and the construction of a pavement which will add considerably to the comfort of traffic at this point.

The level crossing at Morgan's Gates had long been a danger to road traffic and negotiations were entered into between the Board and the Railway Commissioners last year, which resulted in an agreement covering the construction of an overhead bridge, the cost being shared between the two parties. The Railway Commissioners built the bridge, which has a width of 36½ feet, and the Board undertook the construction of the approaches. The work is now completed and the bridge was thrown open to traffic on the 8th March.

OUTER METROPOLITAN DIVISION.

Considerable improvement has been made during the past few months in the condition of the Great Northern Highway between West Maitland and the Northern boundary of the Division at Aberdeen. This has been brought about by an intensive system of progressive maintenance and the use of modern plant.

The tar surfacing of 2 miles 1,500 feet of the Great Northern Highway near Hexham, in the Shire of Tarro, has been completed.

In the Municipality of Moss Vale, the construction of Old Argyle Road (No. 260), from the municipal boundary at Bong Bong Bridge to the junction with Robertson-road (No. 262), a length of 1 mile 1,187 feet, has been completed and opened to traffic. This road crosses the Moss Vale–Port Kembla railway line by an overbridge, and avoids the railway level crossing on Suttor-road which had been generally used by traffic between Bowral and Moss Vale prior to the reconstruction work now completed.

The reconstruction in pre-mixed bituminous macadam of the Hume Highway in the Municipality of Mittagong, between Pioneer-street and the municipal boundary, is nearing completion. A short length only of side track is in use. The work is being carried out by the Nattai Shire Council on behalf of the Board.

The reconstruction of the North-western and Mid-western Highways in the Municipality of Bathurst, a length of 2 miles, has been completed by the Council on behalf of the Board.

Contractors Cox and McNiven are making good progress with the formation and loaming of 5 miles 446 feet required to complete the construction of the Stockton-Nelson's Bay road (No. 108), in the Shire of Port Stephens. The formation has been completed and 2½ miles have been loamed.

Approximately 2 miles of the Abermain-Kurri Kurri road (No. 218), in the Shire of Kearsley, are being reconstructed by contract; 1¾ miles of cement concrete have been completed, and the balance, about ¼-mile of tar penetration macadam, is in progress. The supply of materials has been hampered somewhat by the stoppage of the South Maitland railway service.

UPPER NORTHERN DIVISION.

The construction of 1 mile 1,420 feet of gravel pavement on the Tullymorgan Developmental Road (No. 1049), in the Shire of Harwood, has been completed by Contractors McCosker and Cavanough.

There has also been completed by Contractors Addison and McGregor the construction of 1 mile 2,190 feet of waterbound macadam pavement on the Auburn Vale Developmental Road (No. 1119), in the Shire of Bannockburn.

The construction of 1 mile 700 feet of waterbound macadam pavement on the Edenville Developmental Road (No. 1046), in the Shire of Tomki, has been completed by Contractors O'Connor and McDonald.

LOWER NORTHERN DIVISION.

In Warrah Shire, the Council's staff has effected very considerable improvement to the Great Northern Highway over a distance of 6 miles between Kankool (2 miles north of Ardglen) and Willowtree. The work, which is nearly complete, consists of widening the pavement throughout to 18 feet, building shoulders 4 feet wide on each side and reconditioning and strengthening the pavement. On completion, the whole of the Highway in this Shire, with the exception of the portion between Murrurundi and Kankool (6 miles), will have been brought to standard width and shape.

Perrot's Pinch Deviation, on the Dorrigo-Tyringham road (No. 119), near its junction with the Armidale-Grafton road (No. 120). Left, the old road. Right, portion of new deviation, 1¾ miles long, with water-bound macadam pavement.

The contractors, Messrs. A. M. Black & Co. Ltd., have finished the construction of 2 miles of cement concrete pavement and three reinforced concrete box culverts on the North Coast Highway between Murwillumbah and Tweed Heads, in the Shire of Tweed.

A further section, comprising 2,812 feet of water-bound macadam pavement, on the Cedar Point-Bentley Developmental Road (No. 1047), in the Shire of Tomki, has been completed by Contractor P. J. Gooley.

The reconstruction in bitumen penetration of 1,650 feet in Through-street (No. 117) and 800 feet in Skinner-street (No. 151), in the Municipality of South Grafton, has been completed.

A length of 1 mile 1,050 feet of gravel pavement on the King's Plains Developmental Road (No. 1002), in the Municipality of Inverell, is now completed, the contractors being Messrs. Addison and McGregor.

On the Kendall-Comboyne Developmental Road (No. 1056), in Hastings Shire, a length of 3,880 feet of broken stone roadway has been completed by contract. This work was in continuation of a length carried out last year and there is now a good road for 2¼ miles beyond Kendall. The old road from this town was impassable in wet weather, so that the new work will afford relief to the road users carrying dairy produce and timber to the factory and mills at Kendall.

In the Municipality of Gunnedah, 1,850 feet of tar surfacing have been completed in the main street, which is part of the Oxley Highway. The work has greatly improved the appearance of the street and entirely eliminated the dust nuisance at a very reasonable cost. Municipalities are now calling for surfaced streets and, in the past twelve months, the Board has assisted six Municipalities in this Division, namely, Aberdeen,

Scone, Murrurundi, Uralla, Armidale and Gunnedah, to surface, wholly or in part, those portions of State Highways which pass through the towns; while arrangements have been made for treating this year portions of the Highways in Taree, Kempsey, Tamworth, Armidale and Coonabarabran.

Very considerable improvement of the North Coast Highway in Gloucester and Manning Shires, between Ward's River and Taree, has resulted from the Councils' maintenance operations during the past year. The Highway has been widened and straightened in many places where alignment was bad, a number of concrete pipe and timber culverts have been built and the pavement has been strengthened and reconditioned. Reconditioning work on the same Highway in Hastings Shire has been carried out by the Board during the past three months between John's River and Port Macquarie, using three road machine units. This section is now in very fair travelling order.

In Dumaresq Shire, the Great Northern Highway climbs to the Upper New England Tableland about 14 miles north of Armidale, the ascent (Devil's Pinch) being about 4 miles long in sidling and hitherto badly aligned. Arrangements were made recently with the Shire Council to improve the alignment by cutting back twenty-four sharp curves on bends between 15 and 17 miles. The material removed from the bends was used to widen the road in other places and to make up superelevation. Work has now been completed and as a result the road has been made much safer for traffic. The importance of having a well-aligned ascent or descent is great in this case for the reason that, for some miles on each side of the Pinch, the Highway is easily graded and well aligned. Thus, on reaching the Pinch, traffic is normally travelling at a fast rate.

CENTRAL WESTERN DIVISION.

The construction of gravel pavement between 5 miles 2,900 feet and 6 miles 3,800 feet, with culverts, has been completed on the Goolma-Gollan-Murrumbong Developmental Road (No. 1004), in Cobbora Shire. Messrs. Smith and Stevens, of Wellington, were the contractors.

A single span reinforced concrete bridge over Sandy Creek, near Yeoval, on the Parkes-Wellington road (No. 233), in Amaroo Shire, has been completed and opened to traffic. The new bridge replaces a very old and unsafe timber structure and, in addition, a considerable improvement has been made in the alignment of the road. The temporary crossing used during construction has been retained for convenience in watering stock.

Extensive re-decking work is being carried out on the bridge over the Lachlan River on the Mid-Western Highway at Cowra.

The construction of 2 miles 700 feet of formation and gravel pavement on the Oxley Highway between Gilgandra and Collie, in the Shire of Gilgandra, has been completed and the road opened to traffic. This work provides a pavement over a length of black soil which hitherto had been impassable after rain.

The construction of three reinforced concrete box culverts on the Larras Lee-Bolderogery road (No. 234), in the Shire of Amaroo, has been completed. These culverts eliminate three open crossings.

A commencement has been made by the Boree Shire Council with the reconditioning of 24 miles and the bitumen surfacing of 2 miles of gravel pavement. This work will place the greater length of main roads in the Shire in good order.

The construction of 1 mile 3,200 feet of tar penetration macadam pavement has been commenced on the North-western Highway, in the Municipality of Dubbo. When this section has been completed, the Highway will be in good condition throughout its length within the Municipality.

SOUTHERN DIVISION.

On the Monaro Highway, between Bega and Tathra, in the Shire of Imlay, 2 miles of bitumen surfaced macadam road have been completed by Contractor Armstrong.

Messrs. McLean Construction Co. have completed a concrete bridge over Stewart's Creek, on the Prince's Highway south of Tomerong, in the Shire of Clyde. A temporary gravel surface has been provided on the approaches and the bridge opened to traffic.

On the Prince's Highway-Huskisson-road (No. 312), in the Shire of Clyde, 3 miles of gravel pavement have been completed by Contractor De la Torre under contract to the Shire Council.

On the Queanbeyan-Hoskingtown road (No. 270), in the Shire of Yarrowlumla, a low level concrete bridge over the Molonglo River has been completed under the supervision of the Shire Council.

Two sharp right-angled turns have been eliminated on the Queanbeyan-Cooma Trunk Road (No. 52) north of Bredbo by the construction of a short deviation by the Monaro Shire Council.

Five miles of bituminous surfaced pavement have been recently completed and opened to traffic on the Hume Highway between Bowning and Bookham.

The Monaro Shire Council has completed and opened to traffic the Bald Hill deviation on the Cooma-Countegany Developmental Road (No. 1042).

Two and a half miles of gravel road have been completed by Contractors McGann and Edwards on the Reid's Flat-Wattamondara Developmental Road (No. 1058), in the Shire of Murrungal.

RIVERINA DIVISION.

A cloudburst which resulted in 8 inches of rain falling in twenty minutes occurred at Murrumburrah on the 13th February. Houses and shops in the vicinity of the Murrumboola Creek were flooded and considerable damage caused to private property. The waters in the creek rose with unprecedented rapidity, and reached a maximum height of 4 feet above the deck level of the seven-span timber beam bridge which connects Harden and Murrumburrah. The flood attained a high velocity, resulting in considerable scour to the banks of the creek, while one of the piers supporting

the central span subsided 4 feet at its upstream end. It became necessary to close the bridge to vehicular traffic which, however, was subjected to a minimum of delay, the Murrumburrah Municipal Council making arrangements for directing traffic over a temporary crossing near the site of the bridge.

The 2-mile length of gravel construction and culverts being carried out by the Chas. Hardy Contracting Company Ltd. on the Mundowey-Lockhart Trunk Road (No. 59) crossing Bullenbong Plain, in Mitchell Shire, is nearing completion, and good progress is being made with a further length of half a mile of similar construction undertaken as an extension to the contract. When opened to traffic this will make available a total of 5 miles of newly-constructed gravel pavement crossing the Plain.

Messrs. Harrington, Son and Bourke's contract for the construction of 2 miles of gravel pavement, with culverts, on the Lockhart-Urana Trunk Road (No. 59) crossing Brookong Plain is nearing completion.

By the use of modern plant, notable improvements have been effected to the main roads in the Jindalee Shire Council's area. Curves have been widened and superelevated, concrete culverts constructed, and the pavements scarified, re-graded and rolled.

Good progress is being made by Contractor C. Snell with the construction of a semi-penetrated bitumen surface course on 1 mile of the Moama-Hay Trunk Road (No. 60) between Morran's Bridge and Cressey-street, Deniliquin. A length of 3,000 feet has been treated and the remainder will be sealed as completed.

Expenditure from 1st July, 1929, to 28th February, 1930.

	Expenditure to 31st January, 1930.	Expenditure for month of February.	Total Expenditure to 28th February, 1930.
	£ s. d.	£ s. d.	£ s. d.
County of Cumberland Main Roads Fund—			
Construction of Roads and Bridges	299,180 7 3	45,428 0 3	344,608 7 6
Cost of Land Resumptions	99,089 8 1	9,570 4 10	108,659 12 11
Maintenance of Roads and Bridges	162,921 16 11	14,647 14 2	177,569 11 1
Repayment of Loans	145,501 12 7	11,532 15 7	157,034 8 2
Survey, Design, Supervision, and Administration	64,289 3 7	*27,725 8 4	36,563 15 3
Purchase of Stock and Assets	15,164 15 7	*435 9 6	14,729 6 1
Miscellaneous	9,080 7 2	*1,101 13 2	7,978 14 0
Totals	795,227 11 2	51,916 3 10	847,143 15 0
Country Main Roads Fund—			
Construction of Roads and Bridges, including Resumptions	537,737 16 8	51,903 4 10	589,641 1 6
Maintenance of Roads and Bridges	651,451 8 10	83,426 10 8	734,877 19 6
Repayment of Loans	18,020 13 1	.....	18,020 13 1
Survey, Design, Supervision, and Administration	51,878 0 4	38,768 5 3	90,646 5 7
Purchase of Stock and Assets	*23,119 8 0	*5,843 17 11	*28,963 5 11
Miscellaneous	26,171 11 2	781 6 11	26,952 18 1
Totals	1,262,140 2 1	169,035 9 9	1,431,175 11 10
Federal Aid Roads Fund—			
Construction of Roads and Bridges, including Resumptions	606,572 11 6	78,853 8 2	685,425 19 8
Purchase of Stock and Assets	12,109 19 4	1 6 3	12,111 5 7
Miscellaneous	6,685 9 3	*465 6 9	6,220 2 6
Totals	625,368 0 1	78,389 7 8	703,757 7 9
Developmental Roads Fund—			
Construction of Roads and Bridges	170,852 13 1	16,173 13 0	187,026 6 1
Survey, Design, Supervision, and Administration	265 19 3	2,699 16 4	2,965 15 7
Miscellaneous	6,575 12 2	*296 7 4	6,279 4 10
Totals	177,694 4 6	18,577 2 0	196,271 6 6
SUMMARY, ALL FUNDS.			
Construction of Roads and Bridges, including Resumptions	1,713,432 16 7	201,928 11 1	1,915,361 7 8
Maintenance of Roads and Bridges	814,373 5 9	98,074 4 10	912,447 10 7
Repayment of Loans	163,522 5 8	11,532 15 7	175,055 1 3
Survey, Design, Supervision, and Administration	116,433 3 2	13,742 13 3	130,175 16 5
Purchase of Stock and Assets	4,155 6 11	*6,278 1 2	*2,122 14 3
Miscellaneous	48,512 19 9	*1,082 0 4	47,430 19 5
Grand Totals	**2,860,429 17 10**	**317,918 3 3**	**3,178,348 1 1**

* Credit.

The Main Road System as Affected on the South Side of the Harbour by the Sydney Harbour Bridge.

By T. H. Upton, M.C.E., M.Inst.C.E.

In the second report of the Commissioners of the City of Sydney an account is given of the deliberations of a Traffic Committee (of which Mr. H. H. Newell, Deputy President, and Mr. T. H. Upton, of the Main Roads Board, were members) presided over by the Minister for Local Government in connection with the development of a plan of arterial roads for the City of Sydney, and a map, of which that shown opposite is a copy, is given illustrating the scheme arrived at. Those portions marked in full black line indicate the scheme as it affects the City of Sydney, and the dotted portions represent the proposals as they affect areas outside the City of Sydney, and therefore are the concern of the Main Roads Board. The general scheme is described by the Civic Commissioners as follows:—

"The principles which were adopted by the conference to guide it in the preparation of this plan were that the construction of the North Shore Bridge will attract to itself the whole of the traffic which now passes between the north and south sides of the Harbour by means of the vehicular ferries from Blue's Point to Dawes Point, and from Milson's Point to Fort Macquarie. The bridge will also, by its freedom from delays and from tolls, create fresh traffic. It will also attract to itself some of the traffic which now goes round the "five bridges" route. Apart from this, the traffic will increase greatly by reason of the increase of population and trade in the Metropolis. The traffic over the bridge will consist of several streams: (*a*) The stream of through traffic to and from the eastern suburbs; (*b*) the stream of through traffic to and from the South Sydney and Illawarra suburbs; (*c*) the stream of through traffic to and from the western suburbs, the Great Southern road, and the Great Western road; (*d*) the stream of City traffic to and from the "commercial" district, that is to say, the City proper. The conference regarded it as a cardinal principle that these streams of traffic should be enabled to separate from one another and take separate routes as soon as possible after they cross from the north to the south sides of the Harbour —and conversely, that they should be kept separate from one another as long as possible before they actually enter the bridge avenue on the way to cross from south to north. Unless some alteration is made, the present arrangement of streets is such that the natural tendency of through traffic will be to run from the bridge down York-street to the Town Hall and there to flow into George-street and Park-street—throwing the great mass of traffic on to this one intersection. This would cause so much congestion that through traffic would be forced to turn off into the cross streets (Grosvenor-street, Wynyard-street, Barrack-street, King-street, and Market-street) and attempt to flow through the congested business district in order to reach the east and south sides of the City and get out to Elizabeth-street, William-street, and Oxford-street, and on the way there it would further congest Pitt-street and Castlereagh-street. The streets in the business district of the City are already inadequate properly to care for their own local shopping and commercial traffic, without having to carry the cross-city through traffic as well. Therefore it is desirable, and, indeed, essential, that means be provided for each great traffic stream to take a separate route, and to get across and out of the City with the least amount of crossing or interference with the business district streets. The tentative plan which has been adopted for consideration will, it is believed, if carried out, achieve that purpose.

"Upon reference to the plan it will be seen that the eastern suburbs traffic will, immediately it leaves the bridge, turn down a new street to be provided to lead on to the viaduct which it is proposed shall be constructed upon the top of the City Railway viaduct where it crosses Circular Quay. By this means it would cross over from the west side to the east side of the City without having to pass through the business district at all, and would have the fewest possible intersections or interruptions to the steady flow of traffic. After crossing the viaduct it would flow up Macquarie-street to the District Court, round that corner past St. Mary's Cathedral and thence by a viaduct to be constructed above the middle of Cathedral-street at a high level to Darlinghurst, through Darlinghurst to Roslyn-street, which would need to be widened, and down Roslyn-street to Bayswater-road. By this route the eastern suburbs traffic would by-pass the City proper, it would by-pass the congestion at King-street or Park-street (which it would otherwise have to negotiate), it would by-pass William-street, which at present is very congested at the "peak" hours, it would by-pass King's Cross, one of the worst intersections, and it would by-pass the upper portion of Bayswater-road.

[Illustration by Courtesy of the Civic Commissioners.]

"The second stream of traffic, that to the south-eastern suburbs (Randwick, Waverley, Kensington, &c.), would follow the same route as far as St. Mary's Cathedral, but from that point would proceed via College-street and Oxford-street.

The third stream of traffic, that to the southern suburbs and the Illawarra district, would cross by the Circular Quay viaduct to the east side of the City and proceed down Macquarie-street to join Elizabeth-street (either via St. James road or via College-street and Wentworth-avenue). The conference, however, desired to keep as much traffic as possible out of Macquarie-street, and for that reason gave consideration to schemes for providing a branch viaduct either at Young-street or at Phillip-street to carry this stream of traffic more directly into Elizabeth-street and attract it away from Macquarie-street. On this point the views expressed were not unanimous, and probably the subject will receive further consideration. The plan shows the Young-street scheme, and needs correction to that extent.

The fourth stream of traffic would be that desiring to do business in the City proper. It would flow straight along York-street, which would need to be widened, and turn off into the business district at whatever cross street suited its convenience.

"The fifth stream of traffic would be that desiring to get out to the west and south of the City, via the Parramatta-road. For this traffic it is proposed to provide another route, leaving the bridge avenue immediately south of the bridge, then dropping down to Kent-street, then from Kent-street across Napoleon-street to Sussex-street, and along Sussex-street to Day-street by an overhead viaduct. At this point the Harbour Trust will require to construct a viaduct to give a high-level roadway approach to the new wharfage accommodation which it is intended to construct here; and by widening the Harbour Trust viaduct it can be made to provide two separate roadways, one for the wharfage traffic and the other for the through highway traffic now under discussion. From Day-street the traffic will proceed to Bathurst-street, and thence across the Darling Harbour railway lines overhead to Fig-street, Pyrmont; then along Fig-street, and across Wentworth Park by overhead viaduct, then drive a new road through cheap property to join up with Pyrmont Bridge road (in Glebe Municipality) which would need to be treated then as a main road, thence along Pyrmont Bridge road to the point where it discharges into Parramatta-road, not far from Stanmore. By this route, reference to the map will show that the Western and Great Southern traffic would by-pass the City proper; it would by-pass the Park-street intersection, the great congestion and confusion at Central Railway square, and the congestion at Grace Brothers' corner.

The conference scheme also provides a first instalment of improved cross routes across the City from east to west. One of these would be by William-street, Park-street, and Druitt-street to join up with the Day-street and Darling Harbour viaduct on the western route described above. Both William-street and Park-street have already been widened, but it would be necessary to widen Druitt-street to complete the route. The other cross-city route included in the scheme is by the widening of Goulburn-street and, at a much later time, its extension across the Darling Harbour Railway Yards to McArthur-street, Pyrmont, and thence on to and through Derby-place out to Parramatta-road. The third cross-city route suggested is via Cleveland-street across Victoria Park to Parramatta-road.

These schemes have, as has been said, been temporarily adopted for consideration and submission to the proper authorities. The next step is to make an estimate of the cost of construction, and consider the ways and means of finance. The conference has appointed a sub-committee to consider and report upon those aspects of the matter."

This is the stage at which the matter rests at present. The proposals, as they affect the area outside the City of Sydney and require expenditure to put them into effect, are—

(1) The carrying through in the Municipality of Glebe of Bridge-road via Lyndhurst-street across Wentworth Park to connect with Fig-street in the City of Sydney, and the general widening of the route to 84 feet. Bridge-road is already a secondary road (No. 2,002), 53 feet wide, of which the length from Parramatta-road to Ross-street, was constructed by the council prior to the operations of the Main Roads Act, and from Ross-street to Taylor-street during 1927 by the Board and the council in conjunction. The works immediately involved to open the route to traffic would be the widening by direct resumption of Lyndhurst-street between Brougham-street and Wentworth Park, and the construction, across Wentworth Park, of a viaduct 40 feet wide. This work would be useless without the other works described by the Civic Commissioners being done in the City of Sydney, and its initiation is, therefore, dependent upon a suitable scheme of finance being arranged, at least for that portion of the route within the City. The general widening of the road from Brougham-street westwards to the City boundary would be by realignment.

(2) The cutting of a new road from the northern end of the proposed new City Council road through Victoria Park to connect with the suggested extension of Goulburn-street to form a circumferential cross connection. This is not one of the urgent works; its commencement is also dependent upon the undertaking of that portion of the route within the City of Sydney.

(3) The widening of Cleveland-street to 84 feet. This road is partly in the City of Sydney and partly in the Municipalities of Redfern and Darlington. That portion within the Municipalities of Redfern and Darlington has been declared a secondary road (No. 2,003), and

has been reconstructed by the Board and the councils in conjunction, to its present width (66 feet). Proposals for the widening of the road to 84 feet are now under discussion between the Civic Commissioners and the councils of the Municipalities of Redfern and Darlington and the Board.

(4) The making effective, as a by-pass to City-road and its extension southward, of a series of existing roads connecting Cleveland-street and King-street, Newtown, viz., George-street from Cleveland-street to Wells-street (66 feet wide), Wells-street from George-street to Eveleigh-street (30 feet or 50 feet wide), Eveleigh-street from Wells-street to Ivy-lane (33 feet wide), Wilson-street from Eveleigh-street to King-street (66 feet or 33 feet wide). This route could be improved without waiting for the proposed connection from the northern end of George-street to Chalmers-street in the City of Sydney. The various roads which comprise it vary in width as indicated and would require to be widened uniformly to 66 feet.

(5) The improvement of Elizabeth-street from Cleveland-street to Bourke-street.

Of the other three roads shown dotted, viz., Henderson-road and Erskineville-road from Botany-road to King-street, Newtown, Mitchell-road from Henderson-road to St. Peters Railway Station, and Bourke and Lachlan streets from Botany road to Moore Park, the first is already a Main Road (No. 193), whilst the second and third are secondary roads (Nos. 2,005 and 2,008). Henderson-road has been widened by the Board and the Alexandria Council in conjunction to 84 feet between Botany-road and Garden-street, and a scheme of widening between Garden-street and Phillip-street by realignment has been prepared. Henderson-road from Botany-road to Phillip-street, and Mitchell-road from Phillip-street to St. Peters Railway Station have been reconstructed during the year 1928-29 together with Erskineville-road from King-street, Newtown, to Erskineville Railway Station, where the present width of the road is generally 36 feet. A scheme of widening to 80 feet by realignment of Erskineville-road, between the limits mentioned, has also been prepared. Bourke-street from Botany-road to Lachlan-street was reconstructed by the Waterloo Council and the Board in conjunction during 1929, and Lachlan-street will be undertaken as soon as a new large size watermain has been laid by the Metropolitan Water, Sewerage, and Drainage Board.

It will therefore be understood how, with such large size works to be undertaken—possibly in the near future—together with other major works which are required on the north side of the Harbour, also as the result of the reorganisation of traffic brought about by the Harbour Bridge, and with the general growth of traffic throughout the metropolis, the Board does not deem it to be advisable to reduce at present the rate of contribution by Metropolitan Councils to the County of Cumberland Main Roads Fund (½d. in the £ on the Unimproved Capital Value of lands in council's area) as has been suggested by some councils.

*41788—B

U.S.A. Experience as a Practical Guide to the Width of Road Pavements.

(Extract from Highway Engineer and Contractor, April, 1929.)

THE Bureau of Public Roads, U.S.A., marked off pavements into 1 foot sections and by watching the right rear wheels of passing vehicles, find that on straight and level roads of various widths from 14 to 24 feet, with shoulders in fair condition, passenger car drivers habitually maintain a distance of from 1½ to 4 feet between the outer wheel and the edge of the pavement. Truck drivers operate somewhat nearer the edge, but prefer not to approach closer than 1½ feet. Drivers will sacrifice clearance between their own and passing vehicles rather than drive closer to the edge than they instinctively feel is safe.

The Bureau's observations indicate that pavements less than 18 feet wide are decidely too narrow since they provide no clearance for passenger cars or trucks operating in the usual paths. While the 18 feet width is apparently great enough for passenger cars in two lane traffic, it is not quite wide enough for trucks. The 20 feet width gives ample clearance for trucks and is not excessive for automobiles.

In moving downhill on light grades, traffic moves slightly towards the centre of the road. Light down grades do not suggest reduction of speed, hence traffic takes the precaution of moving slightly away from the edge of the pavement. No such tendency was observed on heavy grades where the speed is reduced, and the instinctive fear of the pavement's edge is lessened.

In rounding horizontal curves, traffic, in general, shifts toward the inside edge, but the trucks shift their courses toward the inside of the curve less than passenger vehicles. Under all circumstances, truck drivers are found to adhere more closely to the edges of the pavement than operators of passenger vehicles.

Traffic moving on the outside of the curve shifts its course farther in the direction of the inside than traffic moving in the opposite direction, which is limited in its choice of a course by the proximity of the edge of the pavement. Unless, therefore, the pavement is widened on the curves, the normal straight road clearance between the two lines of vehicles is reduced.

The used width of a pavement may frequently be considered less than its apparent width, the observations disclosed. On straight roads, as well as on curves, the outer foot of the surfaced section is sometimes totally ineffective because of a bad shoulder. A closely set guard-rail, a steep crown, a bad gutter, or an uneven, bumpy condition of the surface near the edge, will cause the driver instinctively to seek the centre of the road. In one case, a 24-foot pavement was found to have an effective width of not more than 20 feet because of the abutments of an overhead railroad bridge which were crowded close to the edge of the pavement.

Smooth, white concrete shoulders at the edge of a black surface seem to lure the traffic toward the side. Centre lines on straight roads, as well as on curves, exert a marked separatory influence.

Developmental Roads Policy.

IN the March issue of "Main Roads" reference was made to the Board's proposals for an investigation to be made with a view to determining, so far as it is practicable, the economic result of the expenditure of State funds on Developmental Roads since the commencement of its operations. To assist in this direction, statements of expenditure on the various roads assisted will be published in this and succeeding issues of "Main Roads." The following table deals with the Developmental Roads in the Upper Northern Division.

UPPER NORTHERN DIVISION.

STATEMENT of Works undertaken and completed from 1st July, 1923, to 28th February, 1930, and expenditure of Developmental Roads Funds to 30th June, 1929.

Dev. Road No.	Date of Proclamation.	Shire or Municipality.	Location of Work. At	Location of Work. From	Class of Work.	Length.	Amount of Grant.	Source of Funds.	Completed Cost. Council's Contribution.	Completed Cost. Total.	Expenditure to 30th June, 1929.
						m. ft.	£ s. d.		£ s. d.	£ s. d.	£ s. d.
1001	22/1/26	Ashford ..	0 to 157 ch. West, and 0 to 38 ch. East.	Strathbogie ...	W.B.M. and culverts.	2 2,376	5,000 0 0	C.C.S. 1925–26	441 1 11	5,441 1 11	5,000 0 0
1002	19/3/29	Inverell...	2 m. 2,000 ft. to 3 m. 3,050 ft.	Inverell Railway Station - Swanbrook-road.	Gravel and culverts.	1 50	2,500 0 0	Vote 1928–29	.....	.....	.....
	22/1/26	Macintyre	10 m. and 12 m. ...	Inverell municipal boundary.	W.B.M. ...	1 3,720	2,500 0 0	C.C.S. 1925–26	200 18 11	2,700 18 11	2,500 0 0
		Severn ...	2 m. 660 ft. to 2 m. 3,300 ft. and 5 m. 2,600 ft. to 6 m.	Bridge at Glen Innes boundary, 2 m. 660 ft.	W.B.M. and culverts.	1 132	2,500 0 0	C.C.S. 1925–26	168 10 8	2,668 10 8	2,500 0 0
		,, ...	5 m. 300 ft. to 5 m. 3,800 ft. and 6 m. to 6 m. 3,100 ft.	,, ...	W.B.M. ...	1 330	2,408 0 0	Vote 1925–26	370 12 1	2,778 12 1	2,408 0 0
		,, ...	7 m. 4,180 ft. to 8 m. 3,700 ft. and 9 m. 2,440 ft. to 9 m. 4,210 ft.	,, ...	Gravel ...	1 528	5,000 0 0	Vote 1926–27	29 2 7	5,029 2 7	5,000 0 0
						5 4,760	14,908 0 0		769 4 3	13,177 4 3	12,408 0 0
43	22/1/26	Byron ...	6 m. to 7¼ m.	Mullumbimby Railway Station.	(a) W.B.M. (b) Gravel... (c) Formation.	0 4,554 0 3,102 0 594	2,600 0 0	C.C.S. 1925–26	1,901 16 0	4,501 16 0	3,500 0 0
						1 2,970					
1046	22/1/26	Tomki ...	0 ch. to 95 ch. ...	Junction with M.R. 140.	Formation ..	1 990	1,842 15 0	C.C.S. 1923–24	822 10 7	2,665 5 7	1,842 15 0
		,, ...	0 ch. to 56 ch.		W.B.M. ...	1 330	2,000 0 0	C.C.S. 1925–26	33 5 10	2,033 5 10	2,000 0 0
		,, ...	147 ch. to 204 ch. 36 ft.		,, ...	...	2,000 0 0	Vote 1926–27	47 16 11	2,047 16 11	2,000 0 0
		,, ...	56 ch. to 147 ch.		,, ...	1 713	5,000 0 0	Vote 1928–29	.....	.....	1,500 0 0
		Kyogle ...	To Dyraaba Butter Factory.	Eden Creek Bridge.	Gravel ...	0 3,762	3,996 8 4	Vote 1926–27	.....	3,996 8 4	3,996 8 4
						4 515	14,839 3 4		903 13 4	10,742 16 8	11,339 3 4
1047	22/1/26	Tomki ...	0 ch. to 55 ch. ...	Bentley Railway Siding.	W.B.M. and gravel.	0 2,574	2,000 0 0	C.C.S. 1925–26	187 13 11	2,187 13 11	2,000 0 0
		,, ...	55 ch. to 80 ch., 81 ch. to 94 ch.	,, ...	,, ...	0 3,234	2,000 0 0	Vote 1926–27	75 0 1	2,075 0 1	2,000 0 0
		,, ...	94 ch. to 137 ch. ...	,, ...	,, ...	0 2,800	3,500 0 0	Vote 1928–29	.....	.....	1,000 0 0
Extd.	29/6/28 12/4/29	Kyogle	7,200 ft.	1¾ M.P. from Cedar Pt. Railway Station.	W.B.M. ...	0 7,200	7,000 0 0	Vote 1928–29	.....	.....	.....
						2 5,248	14,500 0 0		262 14 0	4,262 14 0	5,000 0 0
1049	22/1/26	Harwood	6 m. 68 ch. to 7 m. 2 ch. 8 m. 28 ch. to 8 m. 58 ch., 9 m. 20 ch. to 9 m. 48 ch.	Punt at Maclean	Gravel ...	0 4,752	2,500 0 0	C.C.S. 1925–26	8 5 8	2,508 5 8	2,500 0 0
		,, ...	.....	.....	.....	...	3,150 0 0	Vote 1928–29	.....	.....	.....
						0 4,752	5,650 0 0				
1050	3/2/28	Copmanhurst.	0 m. to 2 m. 132 ft. ...	Baryulgil P.O. at M.R. 150.	Gravel, 5 bridges.	2 132	10,000 0 0	Vote 1926–27	14 10 6	10,014 10 6	9,800 0 0
		,, ...	2 m. 132 ft. to 5 m. 3,758 ft.	,, ...	W.B.M. and gravel.	7 1,320	23,708 0 0	Fed. Aid Grant, 1926–27, £15,000 Fed. Aid Grant, 1929–30, £8,708.	.....	.....	13,920 0 0
		,, ...	5 m. 63¾ ch. to 6 m. 37¾ ch. and 6 m. 65¾ ch. to 7 m. 9¼ ch.	,, ...	Formation and culverts.	1 198	2,000 0 0	C.C.S. 1925–26	1,649 8 10	3,649 8 10	2,000 0 0
	22/1/26	Kyogle ...	34 m. 4,205 ft. to 35 m. 2,922 ft.	Sandilands, 29 m. 17 ch. from Casino, along T.Rd. 64.	W.B.M. and bridge.	0 3,897	51,350 0 0	Fed. Aid Grant, 1926–27, £5,000, 1927–28, £2,100, 1928–29, £34,250, 1929–30, £10,000.	.....	.....	8,230 0 0

UPPER NORTHERN DIVISION—*continued.*

Dev. Road No.	Date of Proclamation.	Shire or Municipality.	Location of Work. At	Location of Work. From	Class of Work.	Length.	Amount of Grant.	Source of Funds.	Completed Cost. Council's Contribution.	Completed Cost. Total.	Expenditure to 30th June, 1929.
						m. ft.	£ s. d.		£ s. d.	£ s. d.	£ s. d.
1050 —*cont.* Extd.	3/2/28	Kyogle ...	36 m. to 38 m. ...	Sandilands, 29 m. 17 ch. from Casino, along T. Rd. 64.	W.B.M. and culverts.	2 1,716	7,071 18 11	C.C.S. 1924–25 £7,000 ; C.C.S. 1925–26 £71 18 11.	63 11 6	7,135 10 5	7,071 18 11
		,, ...	38 m. 77 ch. to 39 m. 67 ch.	,, ...	,, ...	0 4,620	3,928 1 1	C.C.S. 1925–26	.....	3,928 1 1	3,928 1 1
		,, ...	39 m. 67 ch. to 40 m. 51 ch.	,, ...	,, ...	0 4,158	4,000 0 0	Vote 1926–27	449 18 11	4,449 18 11	4,000 0 0
		,, ...	Heathwood Hill, 1,900 ft. to Old Bonalbo.	Bonalbo ...	,, ...	0 1,914	1,000 0 0	Vote 1926–27	1,059 16 7	2,059 16 7	1,000 0 0
						15 2,115	103,058 0 0		3,237 6 4	31,237 16 4	49,950 10 0
1055	3/2/28	Tenterfield.	Koreelah Creek to Urbenville.	.....	Deviations W.B.M.	7 5,154	25,000 0 0	Special Unemployment Vote 1928–29.	.....	.....	2,913 13 10
1076	5/8/27	Dorrigo ..	0 ft. to 7,300 ft., 7,409 ft. to 9,375 ft.	Brooklana, at 16 m. on M.R. No. 120.	Gravel and culverts.	1 3,486	5,000 0 0	Vote 1926–27	94 3 9	5,094 3 9	5,000 0 0
1079	5/8/27	Dorrigo ..	Over length approx. 2 m	9 M.P. on M.R. 120 to Lowanna.	W.B.M. and culverts.	1 1,820	8,000 0 0	Vote 1926–27	.....	7,919 9 0	7,900 0 0
1082	30/9/27	Bannockburn.	0 m. to 1 m. 1,452 ft....	Graman-road, at shire boundary.	Gravel ...	1 1,452	1,400 0 0	C.C.S. 1924–25	1,199 7 0	2,599 7 0	1,400 0 0
		,, ...	2 m. 2,112 ft. to 3 m. 2,800 ft.	Delungra ...	Gravel and causeways.	1 1,320	2,044 2 0	Vote 1926–27	.....	2,044 2 0	2,044 2 0
		,, ...	3 m. 2,800 ft. to 4 m. 73 ft. and 4 m. 5,100 ft.	,, ...	Gravel ...	1 3,480	5,230 0 0	Vote 1928–29	.....	.....	2,000 0 0
						4 972	8,674 2 0		1,199 7 0	4,643 9 0	5,444 2 0
1085	3/2/28	Terania...	150 ft. to 10,050 ft. (2nd Section).	Wongavale Public School.	,, ...	1 4,620	3,000 0 0	Vote 1929–30	.....	.....	.....
		,, ...	10,050 ft. to 15,050 ft. (1st Section).	,, ...	Gravel and bridges and culverts.	0 5,000	4,000 0 0 4,741 9 6	Vote 1928–29 Vote 1926–27	.....	3,020 9 8* 1,690 11 11†	3,970 0 0
						2 4,340	11,741 9 6		.....	4,711 1 7	3,970 0 0
1088	6/7/28	Tweed ...	.....	M.R. 148 ...	.....	6 0	3,000 0 0	Vote 1928–29	.....	.....	.....
1089	3/2/28	Dorrigo ..	0 ft. to 2,045 ft. ...	3 m. along M.R. 120 from Dorrigo.	Forming, metalling and draining ; culverts.	0 2,045	1,722 16 0	Vote 1926–27	.....	1,722 16 0	1,500 0 0
		,, ...	1,845 ft. to 8,050 ft. ...	,, ...	,, ...	1 925	4,866 19 0	Fed. Aid Grant, 1926–27.	.....	4,866 19 0	2,500 0 0
						1 2,970	6,589 15 0		.....	6,589 15 0	4,000 0 0
1099	6/7/28	Glen Innes.	34 ft. to 1 m. 600 ft. ...	Railway bridge	Formation and W.B.M.	1 566	3,259 18 3	Fed. Aid Grant' 1926–27.	.....	3,259 18 3	3,259 18 3
		,, ...	1 m. 600 ft. to 2 m. 1,630 ft.	,, ...	,, ...	1 1,030	3,000 0 0	Vote 1929–30	.....	.....	.....
						2 1,596	6,259 18 3		.....	3,259 18 3	3,259 18 3
1119	14/12/28	Inverell...	0 m. to 79 ch., shire boundary.	64 ch. from Inverell P.O., on M.R. 123.	Gravel ...	0 5,208	3,000 0 0	Vote 1928–29	.....	.....	.....
		Bannockburn.	0 m. to 1 m. 72 ch. (2nd Section).	Inverell Shire boundary.	Gravel construction & causeways.	0 3,498	1,000 0 0	C.C.S. 1924–25	111 11 5	1,111 11 5	1,000 0 0
		,, ...	3 m. 3,010 ft. to 4 m. 5,200 ft. (3rd Section).	,, ...	W.B.M. ...	1 2,190	5,000 0 0	Vote 1928–29	.....	.....	2,000 0 0
		,, ...	Proposed to 6 m. 200 ft. (4th Section).	,, ...	,, ...	...	3,000 0 0	Vote 1929–30	.....	.....	.....
						3 336	12,000 0 0		111 11 5	1,111 11 5	3,000 0 0
1122	14/12/28	Nymboida	30½ M.P. to 31 m. 10 ch.	Grafton, *via* Towallum.	Formation & causeways.	0 3,234	500 0 0	C.C.S. 1923–24	.....	412 10 0	500 0 0
1125	8/2/29	Tomki ...	.....	.....	.....	...	3,000 0 0	Vote 1928–29	.....	.....	.....
1127	12/4/29	Byron ...	9 m. 400 ft., 9 m. 1,500 ft., 9 m. 2,300 ft., 9 m. 2,800 ft., 9 m. 4,700 ft., 10 m., 10 m. 320 ft., 10 m. 920 ft., 10 m. 2,075 ft., 10 m. 2,735 ft., 11 m. 2,405 ft., 11 m. 2,900 ft., 11 m. 3,200 ft.	9 m. from Mullimbimby, at Chinaman's Hill.	13 concrete crossings.	...	6,000 0 0	Vote 1928–29	.....	.....	.....
1129	8/2/29	Kyogle ...	0 m. to 1 m 4,030 ft. ...	Dyraaba Butter Factory.	Formation..	1 4,030	5,000 0 0	Vote 1928–29	.....	.....	.....
1132	12/4/29	Tomki ...	.....	.....	.....	...	2,000 0 0	Vote 1929–30	.....	.....	.....
1141	7/6/29	Kyogle ...	.....	.....	.....	...	3,000 0 0	Vote 1929–30	.....	.....	.....

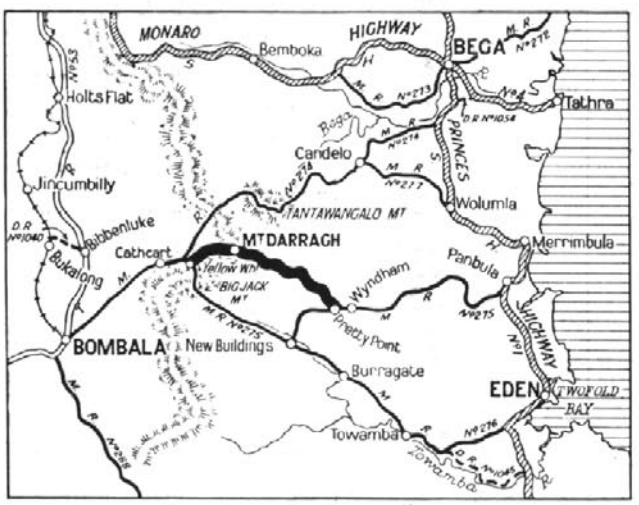
* Construction. † Bridge.

The Mount Darragh Deviation.

By A. E. Marshall.

Resident Engineer.

In the extreme south-eastern district of the State, the Great Dividing Range, which forms the eastern boundary of the Monaro Tableland, is the outstanding natural feature. Principal communication between the tableland and the coast has been esablished by the Monaro Highway, which descends from the Tableland at Brown Mountain and links Cooma, Nimmitabel and Bega. Tathra is the port towards which this road tends. Further south the tableland is connected with the coast by two roads of lesser importance. Each touches Bombala and Cathcart. One, the more northerly, negotiates the Dividing Range at Tantawangalo Mountain, and continues through Candelo to alternative outlet ports at Tathra and Merimbula. The other traverses Big Jack Mountain, leading to New Buildings, whence alternative



Locality Sketch.

routes are available to Merimbula and Eden respectively. The general lay of the country and its road facilities are shown on the accompanying map.

The desirability of providing improved road facilities between the tableland area centred upon Bombala, and the coastal region embracing Merimbula and Eden was first urged upon the Board by the Imlay Shire Council at Eden in May, 1925. The council's representations were, in effect, that the steep grades of the roads over Tantawangalo and Big Jack Mountains rendered satisfactory maintenance of the road surface financially impracticable, while the grades, curvature, and widths in the mountain sections were unsafe for motor vehicles, but that it was believed possible to secure an improved route by following a line from Yellow Water Hole to Mount Darragh, thence descending the range, and linking up with the existing road at Pretty Point, near Wyndham. The council asked the Board to consider the feasibility of this proposed route, with a view to it being adopted as a main road, on the understanding that, in the latter event, the two existing main roads over Tantawangalo and Big Jack Mountains respectively would be deproclaimed as such. The grade of the road over Big Jack is excessively steep, and the road over Tantawangalo is equally unsatisfactory in the light of present-day requirements.

The developmental aspect of the proposed new road was also brought under notice. Proposals for the construction of a local service road from Wyndham towards Mount Darragh had been made between 1917 and 1923, which had for their object the opening to settlement of limited areas of rich volcanic country on the eastern slopes of Mount Darragh. Possible development alone had not then been considered sufficient to warrant expenditure upon road construction, but was a factor to be taken into account in connection with the proposed rearrangement of through roads in the area.

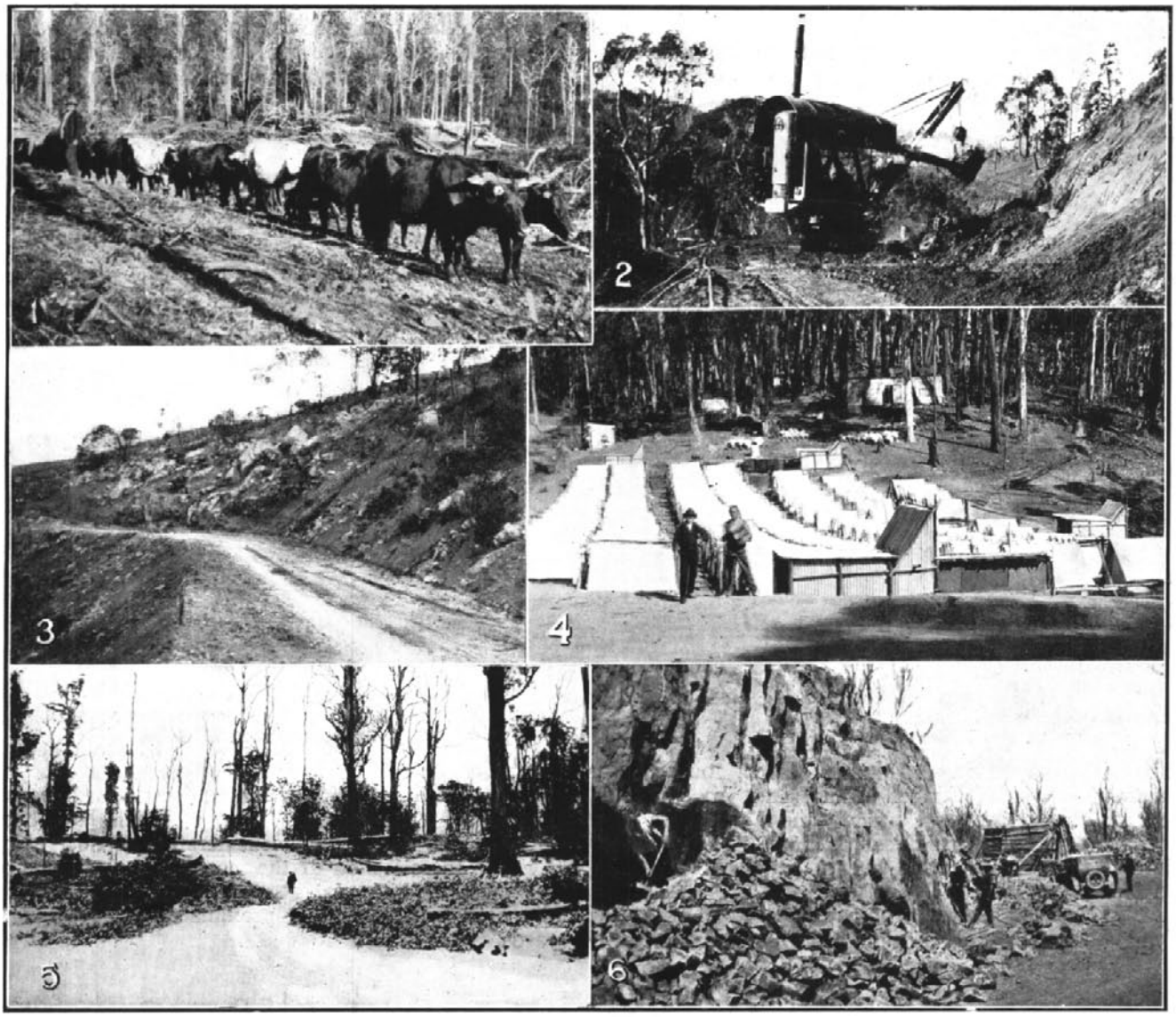
Preliminary investigations of the Mount Darragh proposal were undertaken by the councils interested, leading to the Board meeting in conference, in May, 1926, representatives of the Bibbenluke and Imlay Shire Councils, supported by delegates from local bodies. As a consequence of this, the Board agreed to depute a surveyor to conduct a detailed survey of the new line, the cost of which was to be shared with the councils, and the latter agreed to the deproclamation as main roads of the existing roads between Yellow Water Hole and Burragate, Pretty Point and New Buildings, and Yellow Water Hole and Candelo, should the new route be adopted. The results of the survey were entirely satisfactory, and demonstrated the practicability and advantages of the Yellow Water Hole-Mount Darragh-Pretty Point deviation. The deviation was proclaimed a developmental road during March, 1928, on the understanding that upon completion of construction, and the deproclamation of the abovementioned roads, the deviation would be reclassified as a main road. Funds were provided from unemployed relief allocations, and the earthworks were commenced by day labour during April, 1928.

For the first 2½ miles, between Yellow Water Hole and Mount Darragh, the route follows an existing track, but the remaining 14¼ miles traverse the Cathcart State Forest, and various private holdings at Mount Darragh and Wyndham. At the Mount Darragh end, the country consists of basalt overlying granite, and is covered with rich volcanic soil. It is heavily timbered with mountain ash, gum, stringybark, messmate and other coastal hardwoods, with dense undergrowth. Lower down the forest is more open, the basalt disappears, and decomposed granite outcrops. This class of country, which is intersected with felsite and quartz-porphyry dykes and bands of mica

schist, continues to Wyndham. Dairying is the principal industry where access is available at either end of the road line.

The road follows easy country from Yellow Water Hole to Mount Darragh, rising slightly to attain its maximum altitude of 3,005 feet above sea-level at a point 3¾ miles from Yellow Water Hole. The grade then falls steadily until Pretty Point is reached, at an elevation of 980 feet. The grade seldom exceeds 5.50 per cent., and then only for very short distances. The maximum grade is 6.25 per cent., which obtains over a length of 300 feet only. The rugged country and steep side slopes have influenced the curvature of the road considerably, and it has been necessary to reduce the minimum radius of curvature aimed at generally, viz., 150 feet, at eight points. The sharpest curve has a radius of 100 feet. The width of pavement has been fixed at 16 feet, and of formation, 24 feet.

The principal construction depot was established near Mount Darragh. Early work included clearing the exceptionally heavy timber and undergrowth, preparing the service tracks, installing a field telephone and water supply, and building camps suitable to the extreme conditions of winter rains and snow, and summer bushfires, which are to be expected in this district. The excavation of earth, boulders, and solid rock for the roadway was undertaken by a combination of hand and mechanical methods. Approximately one-seventh of the total quantity was taken out by a ¾ cubic yard steam shovel, while the remainder was undertaken with horses and drays and scoops. The draining of the roadway involved the construction of 10,000 lineal feet of pipe culverts, the excavation of 6,300 cubic yards in catch drains, 1,500 cubic yards of rubble drains and two concrete arch culverts of 10 feet and 6 feet span, respectively. The maximum



1. Bullock team engaged in clearing.
2. Steam shovel operating at 10½ miles.
3. Boulders at 12½ miles.
4. Camp at 5 miles.
5. Snow scene at Mount Darragh.
6. Quarrying basalt at the roadside near 2 miles.

number of men employed was 460, with an average of 250. The earthworks and culverts are now practically complete, the expenditure to date being approximately £142,000. The quantities and unit rates, including all local overhead charges, for the principal item of earthworks, are as follows:—

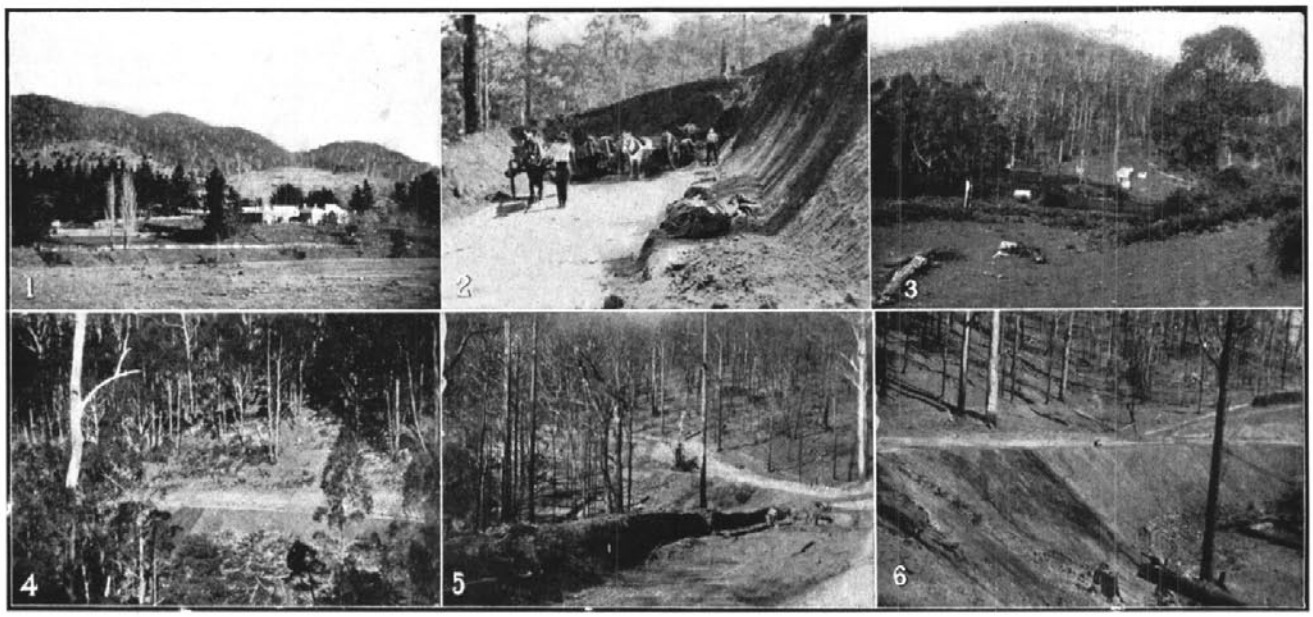
Excavation, steam shovel, 41,000 cubic yards, at 3s. 10d.

Excavation, other than by steam shovel, 251,000 cubic yards, at 6s. 2d.

Upon the section of existing road between Yellow Water Hole and Mount Darragh, a length of reconstruction has been undertaken, also by day labour.

bridge 140 feet long, and 20 feet wide between kerbs, has been erected under contract by Mr. W. D. McDonald. The contract price is £3,537. Work was commenced during August, 1929, and the bridge is now practically complete.

At Jones Creek, which crosses the deviation about 1½ miles from the Wyndham end, a three-span concrete bridge 100 feet long, and 20 feet wide between kerbs, will be erected. The tender of Mr. G. P. H. White, in the amount of £2,299 has been accepted for the work. The bridge will be complete before the remainder of the deviation is paved and available for traffic.



1. Farm near junction of old and new roads at Pretty Point.
2. Cutting at 12 miles.
3. Site of No. 7 Camp.
4. Looking across a curve at 11½ miles.
5. View taken at 8½ miles after bush-fire.
6. A high embankment at 8¾ miles.

This work was commenced during March, 1929, and completed during November of the same year. The road has been formed and drained, and a gravel pavement of 7 inches consolidated thickness and 16 feet width has been constructed over a length of 1 mile 300 feet, at a total cost of £3,250.

At Mataganah Creek, within half a mile of the Wyndham end of the deviation, a three-span concrete

During an extensive investigation of sources of local materials, deposits of basalt, decomposed granite and gravel were located. These materials have been sampled and tested, and consideration is now being given to the selection of the most economical type of pavement for the several sections of the deviation. The area to be paved is approximately 150,000 square yards.

Testing of Tar for Road Use.

By A. C. Mack, B.E.,
Testing Officer.

When coal is heated beyond its decomposition point without access of air, three products are obtained, viz., solid residue, evolved gases, and condensed distillate. The last separates into two layers—one consisting of water, either previously existing in the coal or produced during the destructive distillation, and holding a small portion of the distillate in solution; the other being a viscid, dark coloured, oily liquid, which is coal tar in the crude state.

Sometimes crude tar is used in pavements, especially as a primer, but it is very fluid, and on account of the presence of certain substances, is lacking in adhesiveness and other qualities requisite in a binder for macadam roads.

To prepare it for pavement purposes, and to obtain the desired consistency, it must be refined. This is done by distillation, during which process several by-products, unnecessary to preserve the quality of the tar but otherwise of commercial value, are extracted.

Refined tar, apart from the free carbon, resembles bitumen insomuch that it consists almost wholly of hydrocarbons which are soluble in carbon bisulphide, and like bitumen, possesses a chemical composition too complicated to test by ordinary chemical analysis.

The tests to which tar for road use is subjected have been formulated with the object of establishing its identity and source rather than of measuring any specific properties. They consist of the determination of specific gravity, free carbon, distillates at fixed temperatures, residue of pitch and its softening point.

(1) Specific gravity is a general test applied to most substances, and, in the case of tar, is embodied in the specification for the purpose of identification. Being a ratio expressing the connection between weight and volume, its practical use is in estimating correct proportions and measuring quantities of materials.

(2) Free Carbon.—During the destructive distillation of coal, finely divided carbon is carried over with the vapours and, after the refining distillation, is found in the pitch residue. All the ingredients of coal tar are soluble in carbon bisulphide, except free carbon, which is therefore determined by dissolving the tar in this liquid and filtering off the residue from the solution and weighing it. The free carbon present should lie within well defined limits and a knowledge of the proportion in a tar, allied with other tests, affords an indication of the composition of the material.

(3) Distillation.—This test is in parallel with the method of manufacture, and the results, besides assisting identification, afford information concerning the process to which a crude tar has been subjected during its preparation. It consists of heating the tar and measuring the fractions of distillate at temperatures of 170 degrees C., 230 degrees C., and 300 degrees C. These distillates comprise the more fluid constituents of tar. The relative proportion of each present, therefore, controls the viscosity, and divides the tar into the various grades.

(4) Pitch residue and its softening point.—The pitch residue is the residue remaining after the tar is distilled up to 300 degrees C. When tar is prepared in the usual way from normal coal, the residue should have a softening point lying within a limited range. This is determined by the ring and ball method in which a sample of the pitch is cast within a standard brass ring which is supported at a constant depth in a water bath. A standard steel ball of slightly smaller dimensions than the ring is placed centrally upon the surface of the pitch and the temperature of the bath raised at the rate of 9 degrees F. per minute. The temperature at which the pitch softens to allow the ball to pass down through a distance of about 1 inch is recorded as the softening point.

Pitch supplies the tar with "body," from which it derives its resiliency, adhesion, and wear-resisting properties, and from a road-making point of view is the most valuable ingredient in the tar.

The characteristics of the various grades of tar allowed under the Board's specifications are:—

	Coke Oven Tar.				Gas Works Tar.			
	Priming.	No. 1.	No. 2.	No. 3.	Priming.	No. 1.	No. 2.	No. 3.
Specific Gravity at 77° F.	Min. 1·165	Min. 1·185	Min. 1·195	Min. 1·21	1·05–1·12	1·10–1·16	1·11–1·17	1·14–1·19
Free Carbon Per cent. (by weight)	8–12	9–13	12–17	16–22	5–10	8–14	9–14	10–16
Distillation—								
Light Tar Oils, 0–170° C. Per cent. not more than ... (by volume).	5	2	2	Nil	5	2	2	Nil
Medium Tar Oils, 170°–230° C. not more than ... ... ,,	.....	12	7	2	.....	11	8	5
Heavy Tar Oils, 230°–300° C. at least ,,	.....	14	12	7	.....	18	14	9
Total Oils ... ... ,,	35–42	24–30	19–25	8–12	35–45	26–34	18–26	10–18
Pitch Residue ... ... ,,	58–65	70–76	75–81	88–92	35–65	66–74	74–82	82–90
Softening Point	140°F.	140°F.	140°F.	140°F.	110°F.	110°F.	110°F.	110°F.

Priming tar is a very fluid grade and is intended for use as a priming coat on waterbound macadam or gravel roads. On account of its fluid nature, it penetrates into the structure of the road and so establishes a bond for subsequent surfacing. It is not intended for use as a binder in premixed work.

Nos. 1, 2, and 3 are binder tars, the first being the most fluid, and the last the most viscous.

The principal uses of No. 1 tar are:—

(1) As a binder in premixed macadam (cold process) when the broken stone or gravel contains fine material.
(2) As a binder and seal coat in the construction and surfacing of footpaths.
(3) For top-dressing or tar-surfacing where circumstances do not permit the use of No. 2 grade.

The principal uses of No. 2 tar are:—

(1) For general tar surfacing. For this purpose, the covering material should be clean stone chips, preferably rolled with a power roller after spreading.
(2) As a binder in premixed tar macadam (cold mixing) where the broken stone is of uniform gauge and free from fine material.
(3) As a seal coat to penetration macadam.
(4) For patching and maintenance work.

The principal uses of No. 3 tar are:—

(1) As a penetrating medium in penetration macadam.
(2) As a binder in premixed tar macadam and tar concrete (hot mixing).

Standards of Road Location.

By J. James. B.C.E,

Engineer.

(*Continued from p.* 113, *February Number.*)

(2.) Grading.

THE main considerations affecting the grading of a road were outlined in the preliminary discussion of the factors affecting road location published in the September and February numbers of *Main Roads*. They centre, briefly, upon the approximately uniform tractive effort of the animal team, as opposed to the variable tractive effort available to the motor vehicle through the agency of gearing, and the fact that the latter vehicle by reason of its comparatively high speed, has stored within it energy which may be utilised to overcome the added resistance on short, isolated grades steeper than the ruling maximum. The ruling maximum grade of a road and the allowable lengths of grades steeper than this ruling maximum are fixed by economic investigation; the value of the grade on the isolated steep sections is fixed by the character of the pavement, the necessity of guarding against washing and scour, and by considerations of

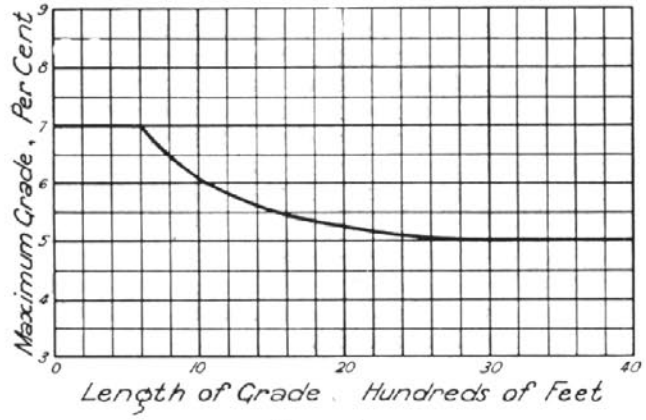


Figure 3.

the convenience of any remaining animal traction. The whole question has received comprehensive theoretical and practical investigation over a period of years by highly skilled engineers in the United States, and the curve shown in Figure 3 has been adapted by the Board as a basis of practice from the work of Professor T. R. Agg.

In accordance with this, the ruling grade for commercial vehicles is fixed at 5 per cent. (1 in 20). The steepest allowable grade for any length, however short, is 7 per cent. (1 in 14.25), but the length of this grade may not exceed 600 feet, and a length of grade of 5 per cent. or less must be provided at either end of this steep section. Similarly, the maximum length of a 6 per cent. grade is 1,000 feet, and of a 5½ per cent. grade, 1,500 feet. No two sections of grade steeper than 5 per cent. may adjoin, and the minimum lengths of intermediate grades which may be used to separate such steep sections are as follows:—

3 per cent. or less	400 feet.
Over 3 per cent. and not greater than 3½ per cent.	450 ,,
Over 3½ per cent. and not greater than 4 per cent.	500 ,,
Over 4 per cent. and not greater than 4½ per cent.	550 ,,
Over 4½ per cent. and not greater than 5 per cent.	600 ,,

These lengths must be measured between the intersection points of straight grade lines, *i.e.*, vertical curves are ignored.

The lowest possible grade is perfectly level. Such a grade will not be satisfactory for drainage unless a suitable crossfall is given to the pavement and formation, and properly arranged side ditches are excavated. This, however, is generally quite practicable.

Vertical curves are necessary to ensure smooth riding at grade junctions and to ensure visibility at summits in the grade line.

The Board's standard lengths of vertical curve, the grade differences to which they relate, and the sight distances which they provide at summits, are shown in Figure 4. Vehicles will approach each other at slower relative speeds at the larger grade differences, since at least one side of the junction will be on a steep grade. It follows, then, that decreasing the sight distance as the differences increase will provide an approximately equal measure of safety throughout the scale.

At sags, the length of vertical curve is governed solely by the necessity of providing smooth riding.

From measurement of existing causeways it has been possible to estimate the maximum rate of change of grade which will not cause shock or roughness of riding to vehicles travelling at speeds up to 50 m.p.h. For a smooth surface, *e.g.*, the carefully maintained invert of a causeway, a grade change of 1 per cent. in each 8 feet causes no discomfort. This corresponds to a vertical curve of 800 feet radius, and would be satisfactory for such a situation as a paved causeway where the length of the dip in the grade line must be kept a minimum for a given depth, and the smoothness of the pavement would be assured; but, if the surface of a short radius vertical curve contains even minor irregularities, smoothness of running is easily upset. In general, it may be taken that vertical curves at sags in a grade line should not be shorter than 1,500 feet radius to ensure that their running qualities are not dependent upon their maintenance in a smooth condition. Where the earthworks on a grade line may be cheapened thereby, it is sound practice to reduce the lengths of vertical curves at sags below the standard values, but not below the length obtained by applying a curve of 1,500 feet radius to the grade intersection.

Minimum theoretical lengths of vertical curves at sags, calculated on this basis, are shown on Figure 4, and it will be noticed that these may be applied practically by halving the standard values for summits. This series is suitable for use at sags in undulating country and at ramps over culverts in flat country. Shorter curves still, of radius not less than 800 feet, are permissible at causeways only.

A circle, with a short transition at either end wherein vehicles would gradually acquire the angular motion necessary to change their direction from one grade to the adjoining grade would be the ideal form of vertical curve. All reasonable practical requirements are met, however, by the adoption of the parabola, which for the lengths used, varies little from a circle, and has the additional merit of facilitating grade line calculations and setting out. The vertical curves described represent minimum lengths for the various conditions. If it is possible to do so without increasing the cost of construction of a road, greater lengths of curve may be used to advantage.

(3.) Drainage.

Drainage must receive due attention in location. Unless very special conditions prevail the grade line should be above flood level, and should enable a free outfall to be obtained to all culverts, table drains, and subgrade drains. Grades must not be so steep as to cause washing or scouring of the formation. Hillside locations should be chosen, where possible, so that the road is not in shadow, but will be open to the sun. Moisture-retaining clay subgrades should be avoided in favour of free-draining loam or gravel. Where a grade line cuts the natural drainage lines of an area, the road and subsidiary works must be arranged so as to disturb the natural drainage conditions as little as possible.

The table drains must necessarily follow the grade line fairly closely, and the limiting conditions for their satisfactory functioning must be considered in designing the centre-line grade. A table drain does not operate satisfactorily at grades flatter than .5 per cent. (1 in 200)—silting may occur and the low velocity of the water involves a small carrying capacity, unless the drains are made so large as to constitute a hazard to traffic. On grades steeper than 5 per cent. (1 in 20) scouring will occur in many materials, but this may be obviated by pitching the table drains where suitable stone is available. On lengthy side cuttings, where the table drains must discharge into pipe culverts crossing underneath the pavement to the lower side of the road, the distance between pipe culverts must be short enough to obviate any danger of scouring, or building up a body of water sufficient to encroach upon the pavement during heavy rains. A suitable distance between culverts in such situations will usually lie between 300 and 500 feet.

Pipe culverts are best located, as to line and grade of invert, so as to reproduce the natural drainage facilities of the area. The invert grade should be uniform throughout the culvert, and not below the level of the stream bed at either end. A break of grade or a bend in the alignment of a culvert may cause blockage and is not allowable. To ensure a self-cleansing velocity, and a reasonable discharge at low heads, pipe culverts should not be constructed with invert grades of less than 1 per cent. (1 in 100). With steeper grades, a better discharge is secured, but the liability to scour at the lower end must be considered. In a suitable location, a grade of 10 per cent. (1 in 10) is not objectionable, and in very solid and steep country, steeper grades than this are permissible if the culvert be founded upon a stepped base. Very often, in heavy work, length of culvert, and height of fill over invert, may be reduced by the use of a skew culvert. For concrete

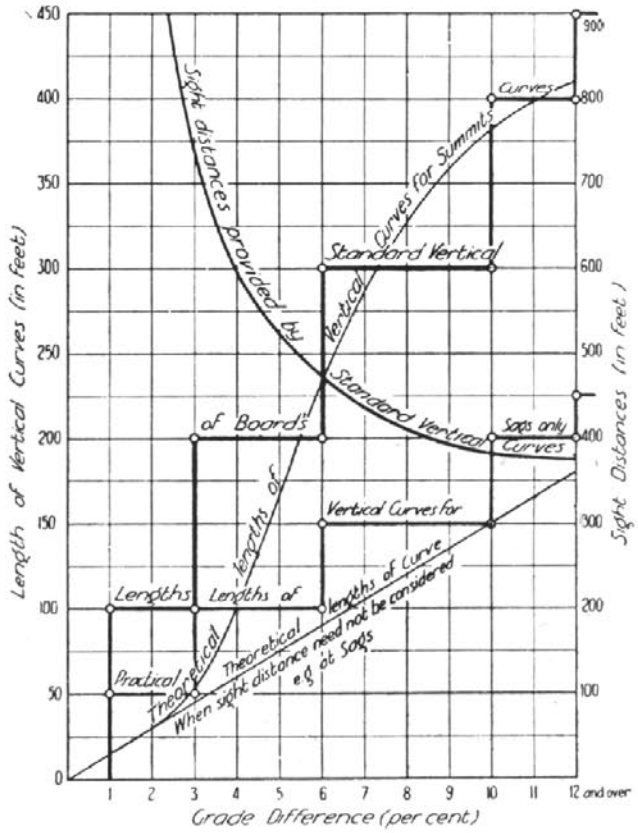


Figure 4.

pipes complying with the Board's standard specification, the height of fill above invert should not exceed 20 feet. In flat country, modifications of the grade line may be necessary in order to obtain the prescribed cover over a culvert or to obviate a sag in the table drain upon the inside of a super-elevated curve.

(4.) Economy of Construction.

The general location of a lengthy highway is fixed by considerations outside the scope of the highway engineer. National necessities would dictate that such a highway should connect certain centres of population, or tap specified areas of country. Thus, the major control points are fixed quite independently of the engineer. Between these points, the route must serve the lesser population centres, and smaller areas of productive activity, so far as engineering limitations allow —the engineering aspect would begin to assume importance. The shorter the unit length of commercial

highway under consideration, the more rigidly is its location fixed by purely engineering considerations, and these require that the total cost of establishing the road, maintaining it in a condition appropriate to the traffic which it will be called upon to carry, and operating that traffic over the section, shall be a minimum.

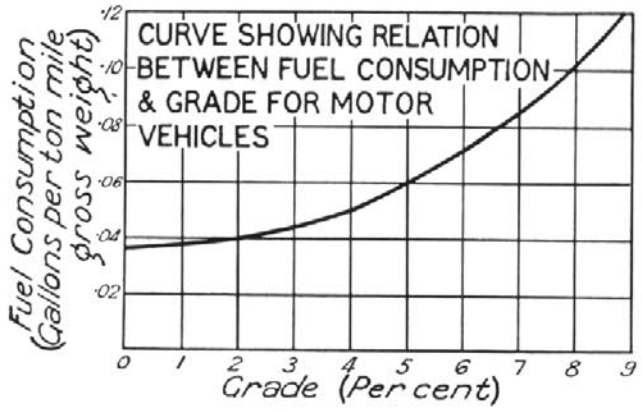


Figure 5.

In respect to alignment, it becomes evident that there can be no justification for expenditure in reducing curvature (either by designing heavier earthworks or increasing the length of the road) below the standards enunciated. Such a reduction would increase the capital cost of the road, without causing a corresponding decrease in vehicle operating costs, and is therefore unsound.

In respect to grading, experimental work has indicated that operating costs are affected only slightly by small reductions below the ruling grades. This is illustrated in Figure 5, which indicates how the petrol consumption of a truck, per ton mile of gross weight, varies with the grade of the road. It is therefore unsound to increase earthworks or extend the grade line in order to reduce a grade below the economic maximum enunciated in 2 above, or to reduce the safety of the alignment with the same object. By reason of the momentum of vehicles, short adverse grades have little effect on operating costs, and are therefore permissible if, by their use, economies in construction or safer alignment should be rendered possible. It is sound practice to ease a grade slightly on sharp curves, firstly, on account of the increased tractive resistance, and secondly, to guard against steepening of the grade should future work, by increasing the radius of the curve, shorten the distance. On a lengthy ascent at maximum grades towards a fixed point, altitude, once gained, should not be lost. Avoidable adverse grades needlessly increase the length of the road, but short lengths only of adverse grade are allowable in the circumstances set out above. Rise and fall at grades less than, say, 3 per cent. has little effect on operating costs, as may be observed from Figure 5, which applies only to fuel, but also indicates approximately the variation of other operating expenses, *e.g.*, wear and tear of vehicle, with grade. Expenditure in reducing rise and fall is justifiable only if the benefits by way of reduced operating expenses outweigh the increase in capital cost of the road.

Earthworks may be held at a minimum by designing a grade line which fits the natural surface as closely as possible, while complying with the standards of alignment, grading, and drainage. The "railroad" type of grading, *i.e.*, long stretches of uniform grade which ignore the minor rises and falls of the natural surface, is seldom economical, nor is it pleasing in appearance.

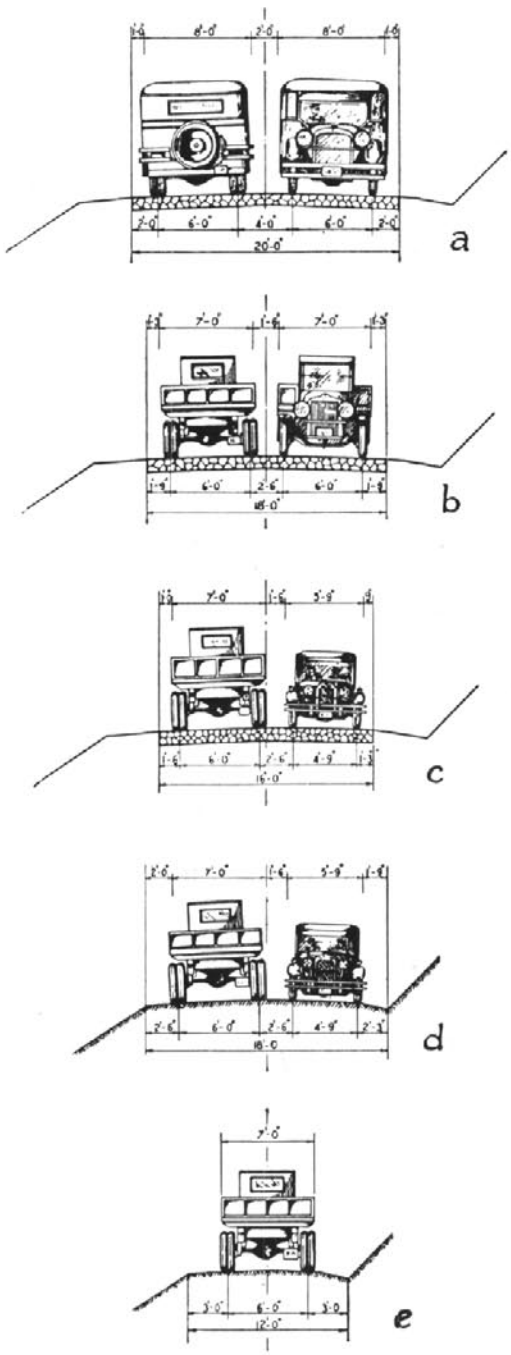


Figure 6.

The "rolling" grade, which adjusts itself closely to the natural surface and takes full advantage of the allowable variations in grade, and in lengths of vertical curves, will generally prove to be the most economical, and is the type of grade recommended.

For economy, the width of formation must be a minimum, consistent with the use to which the road will be put. The normal roadway consists of a central pavement, flanked by earth shoulders, which, when associated with a hard surface pavement, support the pavement and facilitate parking clear of the main stream of traffic. In bank, the shoulders may carry protection fencing and, in cutting, must provide room for the table drain. The minimum width of shoulder which will meet these requirements is 4 feet, and this is the Board's standard shoulder width.

The function of the pavement is to carry two separate streams of moving vehicles, and to provide sufficient width for the passing of vehicles. An undesirable hazard is introduced if passing vehicles are required to move from a hard surface pavement partly on to a shoulder. Pavement widths follow from a consideration of vehicle types and traffic volume. Experience, and measurements on many roads, have shown that the drivers of vehicles such as fast motor coaches do not care to approach closer than 2 feet from the pavement edge. On narrow pavements, rather than reduce this distance, drivers prefer to reduce the clearance between passing vehicles to a dangerous limit. The minimum desirable clearance between such vehicles when passing, ascertained in a similar manner to the edge distance, is found to be 2 feet also. Thus, it follows that a pavement to regularly and safely carry coaches approaching the legal limit in width (8 feet) should be 20 feet wide. This is illustrated in Figure 6 (*a*) which represents the Board's standard width of pavement for a main highway between important centres, and the traffic which it is designed to carry. For a motor lorry, the minimum edge distance is 1 foot 9 inches, and the clearance between vehicles 1 foot 6 inches. For motor cars, the corresponding figures are 1 foot 3 inches and 1 foot 6 inches respectively. By using these values in conjunction with average values of the principal dimensions of the vehicles, and referring again to Figure 6, it is seen that the correct pavement width for a highway not extensively used by motor coaches is 18 feet, and for roads of lesser importance, where motor lorry traffic is light in proportion to car traffic, the economical width is 16 feet.

On local service roads, which are not provided with a hard surface pavement, use may be made of the shoulders by passing vehicles, and this is illustrated in Figure 6 (*d*). The width of a single track road, Figure 6 (*e*), is sufficient to provide adequate clearance for one vehicle only. In flat country, formation widths are dependent only on the nature of the soil and the methods of construction adopted. The widths of pavements, where provided, are fixed by the same considerations as those set out above.

In connection with the location of a new road or the reorganisation of an existing location, it should be stressed that, while pavements and formations can be economically improved and widened, step by step, as traffic needs increase, the location should be chosen for all time. The location is a standing asset—if properly chosen, it will not waste in value as will the pavement—so that it is economical to fix a grade and alignment which will suffice, with minor amendments only, and without future sacrifice of consolidated roadbed and serviceable pavement, for all anticipated needs.

New Main Roads.

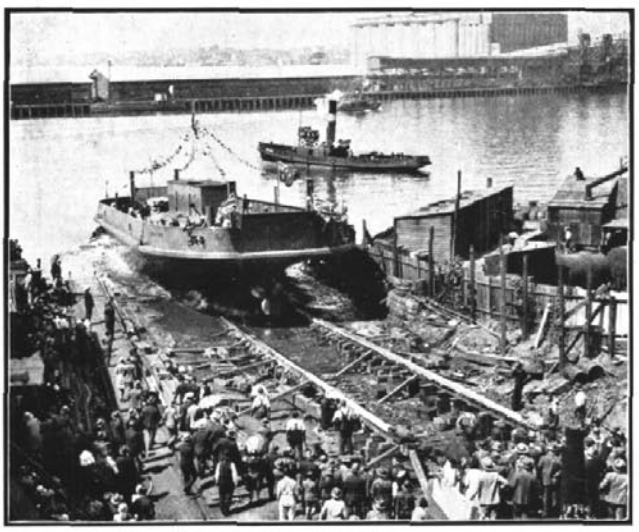
The following new main roads have been proclaimed:—

Main Road No. 322.—From the Young-Murrumburrah Road (M.R. No. 239), at Wombat, to the Murrumburrah-Cootamundra Road (M.R. No. 243), at Wallendbeen

Main Roads Nos. 217 and 223.—The routes of these roads were amended by deproclaiming the section of M.R. 223, between Avondale and its junction with the Cessnock-Toronto Road (M.R. No. 220), near Freeman's Waterholes, and that portion of M.R. No. 217 between its junction with M.R. No. 220, near Palmer's Creek and the point known as "Four Corners," where it joins the road from Cockle Creek to Wallsend, and proclaiming the section between Avondale, via Dora Creek, Toronto, Cockle Creek, Four Corners, and Cardiff to the Minmi-Newcastle Road, M.R. No. 107, at New Lambton, as part of M.R. No. 223.

The Launching of the "George Peat."

THE first of the two ferries which will ply across the Hawkesbury River between Kangaroo Point and Mooney Point was launched from the yards of Messrs. Poole and Steel, Balmain, on Saturday, 15th February, 1930. Mrs. John Garlick, the wife of the



The "George Peat" taking the water.

Chief Civic Commissioner, performed the ceremony, giving to the boat the name of "George Peat," after the pioneer settler who originally installed a ferry where this one will ply.

Parramatta Road, Ashfield

PARRAMATTA-ROAD between Wolseley and Lang streets in the Municipalities of Ashfield and Drummoyne will shortly be reconstructed in concrete. In common with the general scheme for this highway, the new pavement will be 56 feet wide between kerbs. Portion of the existing bitumen pavement will be retained where its condition is good and the levels are suitable. A new concrete bridge over Iron Cove Creek is included in the programme and the junction with the Great North road will be greatly improved by rounding off the western corner.

Maryland River and Koreelah Creek Bridges.

By F. Laws, B.E.

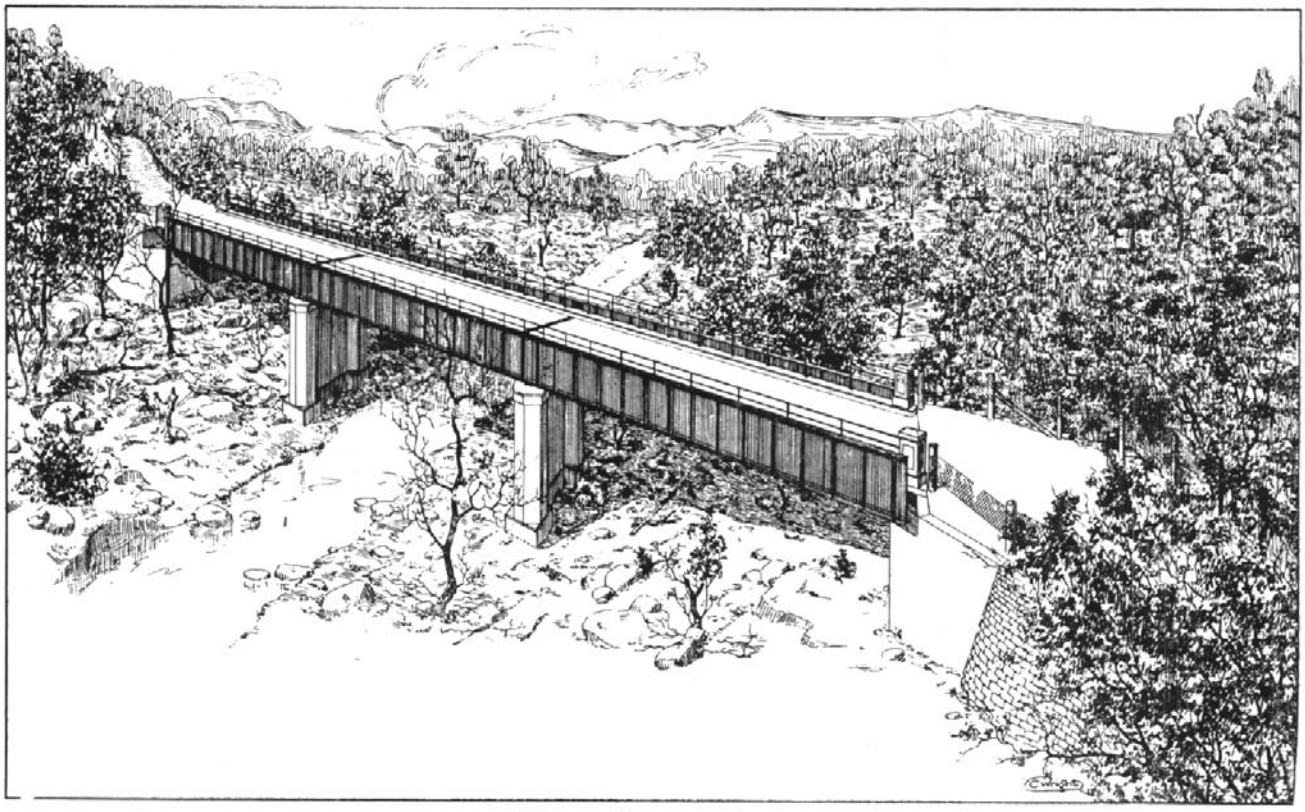
Assistant Designing Engineer.

THE original main northern route giving access from the tablelands of New South Wales to Queensland crossed the border at Wallangarra. Later, a variation of this route, crossing the border between Amosfield and Stanthorpe instead of at Wallangarra was adopted, and this, at the present time, carries the bulk of the interstate traffic on the tablelands. This route, however, gives indirect connection to Brisbane, while the sections over the Darling Downs are difficult in wet weather. Consequently the Queensland Main Roads Commission has concentrated upon the improvement of a direct route from Brisbane to the border at Mount Lindesay and, to connect with this, the Great Northern Highway on the New South Wales side has been continued northwards from Amosfield, through Legume and Woodenbong, linking with the Queensland work at Mt. Lindesay.

The works required to fit the Amosfield-Mt. Lindesay road for interstate through traffic include reconstruction and deviation of portions of the existing road (which works are in progress), the construction or reconstruction of several minor bridges, and the construction of important bridges at Maryland River and Koreelah Creek.

Maryland River Bridge.

Rough country at the Maryland River crossing necessitated bridging the river on a skew of 34 degrees in order to obtain a satisfactory road alignment. The rise of the river in flood time is considerable, the maximum recorded height being 24 feet 6 inches above normal water level in 1928. This flood overtopped the old bridge by about 10 feet, carried it down-stream for about 200 yards and deposited it upside down on the bank. Heavy drift is brought down by the flood waters and, to obviate any jamming of this timber, clear openings of at least 50 feet were necessary in the new design. Owing to the skew, the minimum length of main girders to provide this unobstructed waterway is approximately 70 feet. The length of the crossing required a lay-out of three 70-feet spans.



Maryland River Bridge.

Borings along the centre line of the bridge indicated rock surface at depths not greater than 10 feet below the natural surface, the over-lying material consisting mainly of large boulders. The substructure consists of reinforced concrete octagonal columns connected by curtain walls, and reinforced concrete abutments with wing walls, the piers and abutments being established on the rock foundation.

The superstructure consists of through steel plate girder spans, 68 ft. 8¼ in. centre to centre of bearings and 72 inches deep, placed 24 feet apart, with cross girders at 17 ft. 6 in. centres. There are five lines of stringers at 4 ft. 6 in. centres framed into the cross girders. A "semi-through" type of bridge was chosen in preference to a "deck" bridge to reduce the deck level of the structure and the consequent cost of approaches. Provision has been made for a reinforced concrete slab deck 20 feet wide between kerbs, with a 3-inch. concrete wearing surface.

The side slopes on the approaches are very heavy and it has been necessary to include 175 lineal feet of rubble retaining wall in the northern approach and a further 80 lineal feet in the southern approach. The approaches, which are 600 feet long, are to be paved with gravel.

The work has been divided into two contracts:—

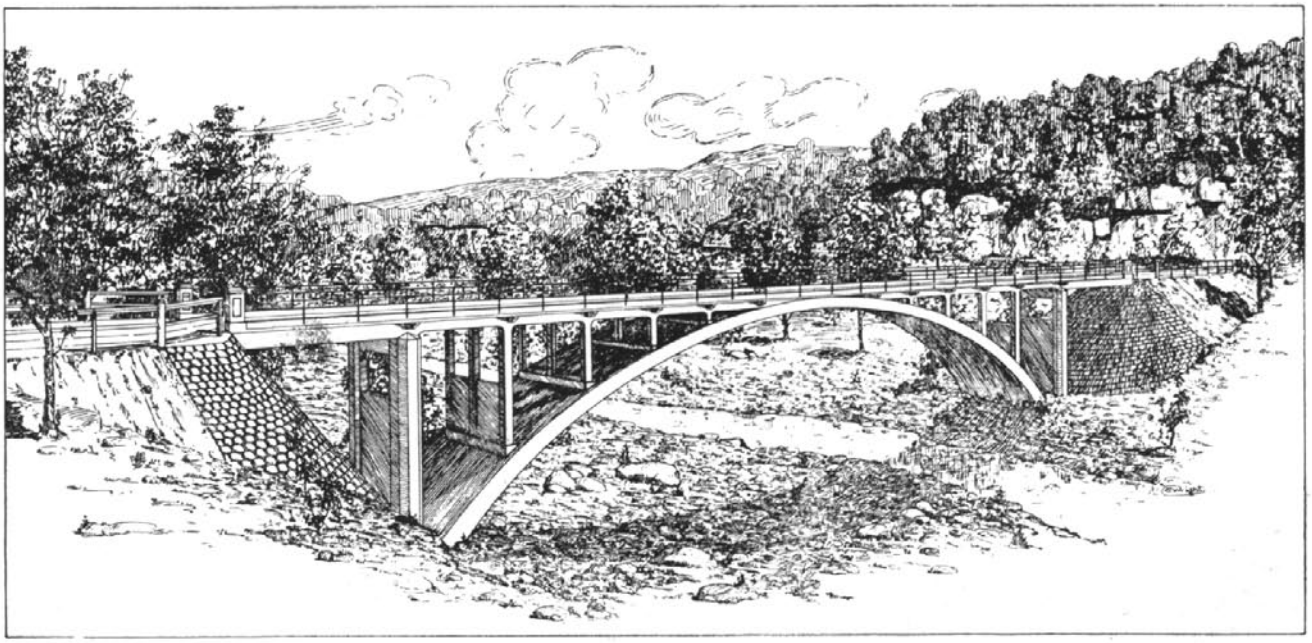
(a) Supply and delivery of steelwork f.o.r. Tenterfield.

(b) Construction of bridge and approaches.

A contract for (a) has been placed with Messrs. A. Goninan & Co., the contract price being £2,795 19s.

Messrs. M. R. Hornibrook & Co. Ltd. were the successful tenderers for (b) at a lump sum price of £11,393.

The contract date of completion falls during July, 1930.



Koreelah Creek Bridge.

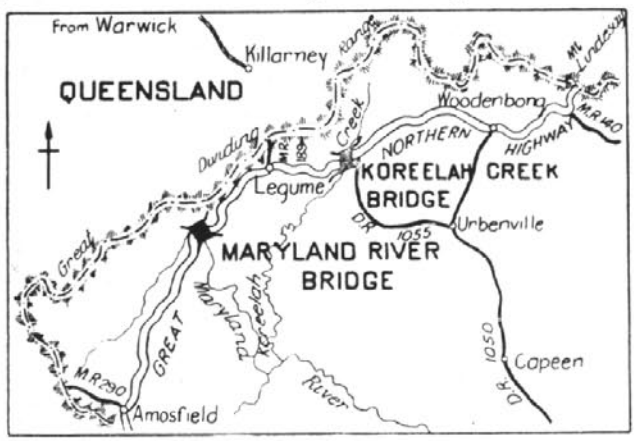
Koreelah Creek Bridge.

The present crossing at Koreelah Creek is a ford, with steep approaches, and is frequently blocked for long periods.

The new high level bridge has a total length of 211 ft. 6 in. and a width of roadway between kerbs of 20 feet, and is to be constructed entirely of reinforced concrete. It consists of a 160-feet barrel arch span with open spandrels, and an approach span 25 ft. 9 in. long at either end. The latter are of the usual deck girder type, resting at one end on a trestle buried in the earthwork of the approaches and carried down to rock, and, at the other, on a pier carried down to the abutment of the arch.

The rapidity of the flood waters and the very large drift brought down thereby necessitated the use of a single span for the central portion of the structure, while the inaccessibility of the locality and the consequent high price of steel delivered to the bridge site were contributing factors in the decision to use a concrete arch, for which the foundations and the general situation as regards elevation of roadway were ideal.

The superstructure has been designed to be as light in weight as possible and consists of deck girders supported on columns. The girders are spaced at 8 feet centres and have a span of 12 ft. 2 in. centre to centre of columns. In order to reduce secondary stresses in the arch ring from the columns, the footings of the short columns will be hinged. A 1-inch bituminous expansion joint will be provided at the junction of the approach spans of the superstructure and the arch.



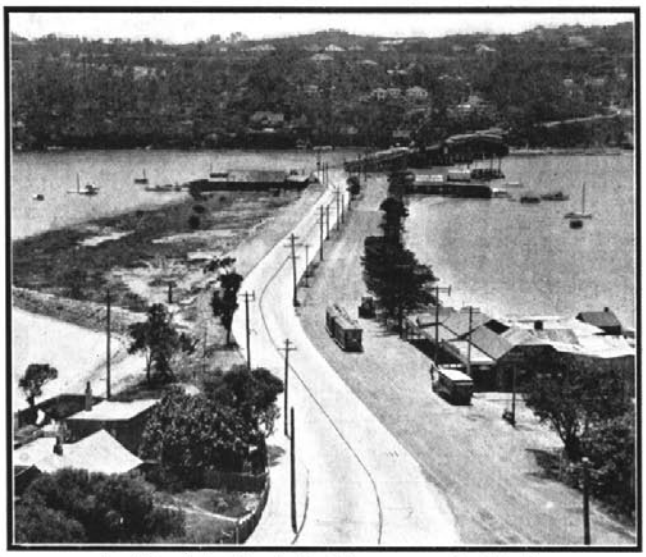
Locality Sketch.

(*Concluded on page 167.*)

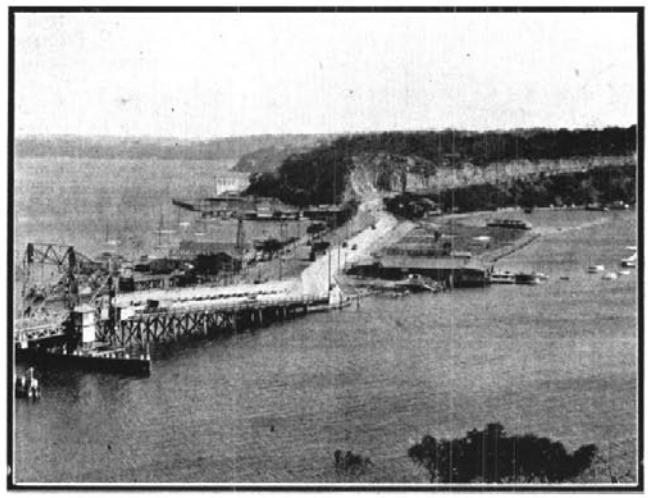
The Spit Road, Mosman.

THE accompanying photographs illustrate the work which was completed by the Mosman Council in December, 1929, which had for its objective the proper connection of the Upper Spit Road with the Spit Bridge. Originally the route of the main road ran along the tramlines shown in the photographs, and climbed the hill towards Mosman along Parriwi Road (shown by the line of power poles to the left of the bluff in photograph No. 2). In 1923 and 1924 the Council, with a view to avoiding the tramtracks, constructed a new road from the landward end of the Spit to the top of the hill. This road, which is called "Upper Spit Road," is shown clearly by the cutting in photograph No. 2. From the foot of this new road to the commencement of the Spit Bridge, the old road remained unaltered and traffic proceeding over this length had to cross or pass along the tramtracks. When, therefore, the improvement of the road at this point was referred to the Board, it advised that the road shoud be re-arranged in such manner as to avoid the necessity for road vehicles having to use or cross the tramlines, and suggested that this be done by keeping the road pavement entirely to the west of them. This is the arrangement illustrated.

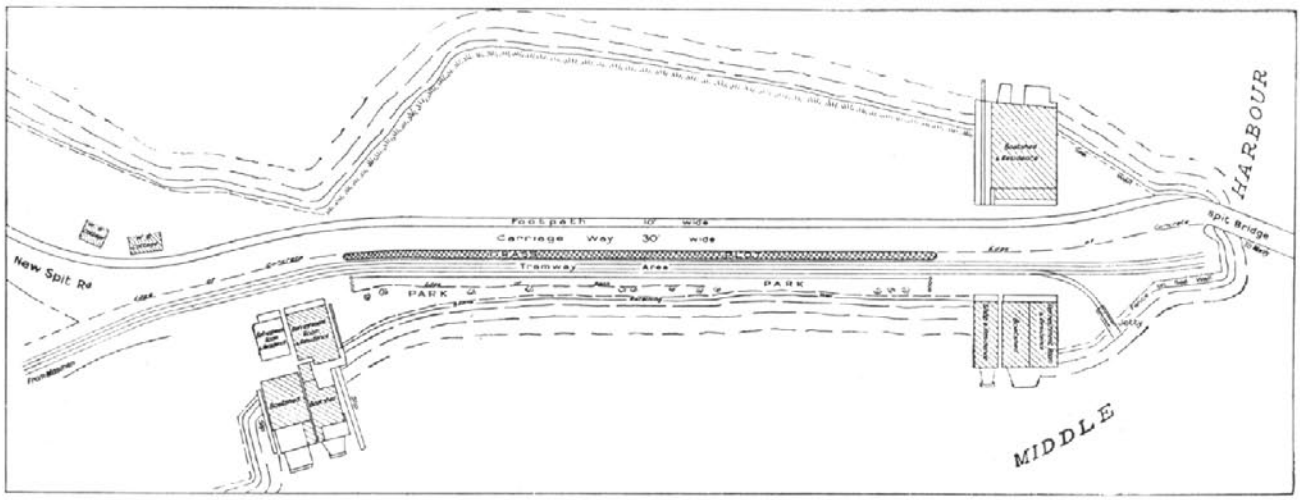
A 30 ft. width of cement concrete pavement has been laid, with wide curves at bends. At the immediate approach to the bridge, rapid hardening cement was used, and the work carried out in sections, so that cessation of traffic was avoided at this vital point during the road operations, the full width of the approach being reconstructed and opened within a few days. It is anticipated that in due course the Council will proceed with the beautification of the road somewhat in the manner indicated in the accompanying sketch. It is the Board's objective to design main roads wherever it is practicable, so that they will be not only fully efficient as media of transport, but also



1. The Spit Road, looking towards Manly.



2. The Spit Road, looking towards Mosman.



Sketch showing the new lay-out of the Spit Road.

that they can be so improved as to make travelling along them pleasurable.

The actual construction work was carried out by the Council under the direction of its Engineer, Mr. A. J. Dee, at a cost of approximately £5,700, of which about £230 is being borne by the Council as its contribution towards kerbing and guttering and footpath, works which were carried out simultaneously with the works for the improvement of the carriageway.

Maryland River and Koreelah Creek Bridges.

(*Continued from page* 165.)

All columns exposed to flood will be strengthened by a cross wall extending to a height of 2 feet above high flood level.

The arch will be 160 feet between springings, with a rise of 31 feet, giving a ratio of length to rise of 5.17, The barrel of the arch will have a uniform width of 20 feet, with a thickness at the crown of 22 inches, and at the springing 36 inches. The arch ring has been shaped to conform with the line of pressure from dead load only and, consequently, the only bending stresses from dead load result from arch shortening. The live load stresses for various sections were derived from the consideration of influence lines. The maximum temperature range was assumed at plus or minus 30 degrees Fahrenheit. No stresses due to shrinkage were included, as the method specified for the construction of the arch, viz., by sections in a prescribed order, should reduce shrinkage to a minimum. The slenderness of the arch barrel tends to reduce temperature stress, but increases the tendency to buckling. It is, therefore, specified that the superstructure shall be completed before the formwork under the arch is lowered.

The abutments of the arch are to be carried down to hard sandstone. The maximum foundation pressure will be 9½ tons per square foot and the maximum stress in the arch ring will not exceed 650 lb. per square inch. The lowest point of the foundation will be 13 ft. 6 in. under normal water level. The highest flood level will be 17 feet above the springings and 16 feet under the deck level at the crown. The total amount of concrete will be 750 cubic yards and of steel 44½ tons.

Mr. W. L. Jemison is the contractor for the work at the lump sum price of £8,729. The date of completion, according to the contract, is 22nd September, 1930.

On completion, this bridge will include the longest concrete arch span in New South Wales. With its height and situation, it should present a fine appearance and become an interesting example of aesthetic design.

Great Northern Highway, Hawkesbury River—Gosford.

THE construction of the Great Northern Highway between the Hawkesbury River and Gosford is nearing completion. The bridge over Mooney Creek and approaches will be completed within the next few weeks. The pavement is of local gravel throughout, and will be surfaced with bitumen between Mooney Creek and Gosford, a length of 8 miles. This length is being treated, in three sections, with bitumen on a tar primer, one section with 175-225 penetration bitumen, one with 100-120 penetration bitumen and one with 85/80 liquid bitumen. A contract has been let for the work, which will be commenced almost immediately. South of Mooney Creek bridge, the gravel is not suitable for surfacing in its present condition, and a 2-mile section is being treated with an application of sand, which will be worked into the surface of the gravel pavement.

Tenders and Quotations Accepted.

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

Work.			Name of Recommended Tenderer.	Amount of Recommended Tender.
Municipality or Shire.	Road No.	Description.		£ s. d.
Lockhart	59	Construction of gravel pavement between 17 m. 3,940 ft. and 19 m. 909 ft.	C. Hardy Contracting Co.	2,162 13 0
Eurobodalla	1133	Gravel pavement between 2,051 ft.	L. De La Torre ...	1,059 12 0
Orara	10	Gravelling between 20 m. 230 ft. and 22 m.	H. N. Gibbins	3,745 6 0
Narraburra	1013	Clearing, formation and gravelling 2,490 lin. ft.	Sutton Bros.	772 7 0
Do	1013	Clearing, formation and gravelling 3,200 lin. ft.	S. J. Noonan	552 12 3
Do	1013	Clearing, formation and gravelling 3,300 lin. ft.	C. Bray	561 7 6
Do	1013	Clearing, formation and gravelling 5,420 lin. ft.	T. J. Murphy	974 18 9
Nundle	106	Earthworks and gravel pavement on deviation between 10¼ m. and 13 m.	T. Bowen	6,200 18 6
Do	106	Deviation between 15 m. and 16 m., including earthworks and gravel pavement.	W. R. Osborne and Son	708 12 10
Gloucester	1043	Gravel road construction between 12 m. 3,600 ft. and 14 m. 3,000 ft.	J. P. Shedden, Ltd. ...	4,099 0 0
Talbragar	56	Formation and gravel pavement, 2 m. 200 ft.	J. E. Puckeridge ...	5,494 1 11
Amaroo	1009	Construction of two culverts	J. T. Butterworth ...	295 10 0
Gunning	251	Construction of 2-span concrete bridge over Hume Creek..	L. De La Torre ...	2,235 17 11
Bellingen	1136	Construction of 6-span low-level timber bridge over Moody's Creek.	W. Bailey	1,990 6 0
Bannockburn ...	1119	5,560 lin. ft. gravel road construction	F. Bakon	2,558 18 3

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

TENDERS.

Work.			Name of Successful Tenderer.	Amount of Accepted Tender.
Municipality or Shire.	Road No.	Description.		£ s. d.
Yass	2	Reconstruction of 2 m. of the Hume Highway from Yass to Trunk Road No. 56, bitumen penetration macadam.	N. H. Jones & Co. ...	9,996 12 2
North Sydney ...	164	Laying of bituminous concrete wearing course on existing cement concrete base, with hardwood edge bars, on Main Road No. 164 (Falcon-street and Military-road) between Miller-street and Merlin-street; Merlin-street and tram sheds; and between Waters-road and Winnie-street.	W. B. Carr Construction, Ltd.	2,537 5 6
Waterloo	170	Laying of bituminous concrete wearing course on existing cement concrete base, with hardwood edge bars, on Botany-road, between Raglan-street and John-street, Waterloo.	W. B. Carr Construction, Ltd.	1,592 3 6
Lithgow	5	Earthwork, including culverts and subsidiary works, between 3 m. 2,882 ft. and 3 m. 3,950 ft. on the Bowenfels subway deviation.	J. McNulty	2,887 4 0
Nymboida	121	Construction of a steel and timber bridge over the Nymboida River at Nymboida (Contract No. 2).	Balgue Construction Co.	16,742 0 0
Mumbulla	1	Construction of a 4-span concrete bridge over Alsop's Creek and paved earthwork approaches.	J. Dunton	6,785 0 0
Nyngan	7	Construction of a 9-span timber beam bridge and approaches over the Bogan River at Nyngan.	H. Woodward	4,450 10 0
Imlay	1041	Construction of a 3-span reinforced concrete bridge over Jones Creek.	G. P. H. White ...	2,298 18 8
Hastings	11	Supply and delivery of steelwork for bridge over Ralfe's Creek (Contract 1).	Sydney Steel Co. ...	1,090 0 0
Hastings	11	Construction of a bridge over Ralfe's Creek (Contract 2)...	Balgue Construction Co.	2,916 0 0
Stroud	10	Construction of a concrete box culvert and paved earthwork approaches at 14 Mile Creek.	J. Shaw	1,513 1 0
Shellharbour ...	1	Haulage of 5,400 cu. yds. of 2½ in. blue metal from the B.M.Q., Ltd., Dunmore and the N.S.W. Associated Quarries, Ltd., Bass Point, to Board's construction works between Macquarie Rivulet and Oak Flats.	C. Munro	@ 5s. 6d. (from Bass Point).
			G. E. Aiken	@ 6s. 9d. (from Dunmore).
Hornsby	9	Haulage of 17,350 tons of materials from Kuring-gai or Berowra railway stations to Board's dumps between Mt. Colah and Berowra.	M. J. Bourke	@ 1s. 3d. per ton.
Do	9	Supply and delivery between Mt. Colah and Berowra of 4,620 cu. yds. of sand (suitable for sub-base use).	M. J. Gilroy	@ 3s. 11d. (2,310 cu. yds.).
			W. J. Donovan ...	@ 3s. 11d. (2,310 cu. yds.).
Campbelltown ...	177	Unloading, haulage and delivery of 620 cu. yds. of sandstone ballast from Board's quarry near Leumeah to overbridge at Morgan's Gates.	A. Farrow	@ 1s. 9d. per cu. yd.

QUOTATIONS.

No. of Quotation.	Description of Article.	Name of Successful Tenderer.	Amount of Accepted Quotation.
			£ s. d.
765	One wooden library cabinet	Brien and Tompsett	7 13 9
764	Bridge timber:— Girders, 208 ft., 14 in. x 12 in.; 6 ft., 12 in. x 12 in.; 57 ft., 12 in. x 11 in.; 603 ft., 12 in. x 6 in.; 364 ft., 10 in. x 6 in. Kerbs—640 ft., 8 in. x 8 in. Decking—2,500 sup. ft., 19 ft. x 4 in., 6 in. to 10 in. wide; 1,050 sup. ft., 15 ft. 6 in. x 4 in., 6 in. to 10 in. wide. Girders, round—2, 33 ft. x 12 in. diameter.	R. J. White & Co.	301 8 10
769	Blue metal, 70 tons, ¾ in.; 40 tons, 1½ in.	Blue Metal Quarries, Ltd.	33 1 8
771	Gully gratings and frames, 14 only, c.i., double type	Taylor and Wearing	56 0 0
770	Blue metal, 2,000 tons, 1½ in.; 500 tons, 5/16 in.	State Metal Quarries	662 10 0
772	Barrier road lamps, 24 only	Kavanagh and English, Ltd.	10 16 5
773	One steel plan cabinet, 6 drawer	Wormald Bros.	19 0 0
774	Bridge wire netting, 207 ft., 8 in. x 5 ft.; 207 ft., 8 in. x 4 ft. 2 in.; galvanised, 10 gauge, 2 in. mesh.	H. Clarke and Sons	17 12 6
775	Deformed metallic jointing, 9,500 lin. ft., 18 gauge, g.i., in 6 ft. lengths.	F. G. Kerr & Co., Ltd.	165 0 0
777	Mastic jointing, ⅜ in., 400 pieces, type "A"; 500 pieces, type "B."	Ormonoid Roofing and Asphalts Co. ...	49 19 1
767	5,840 tons sand, f.o.r. Berowra	Georges River Sand Co.	2,385 0 0

Sydney: Alfred James Kent, I.S.O., Government Printer—1930.