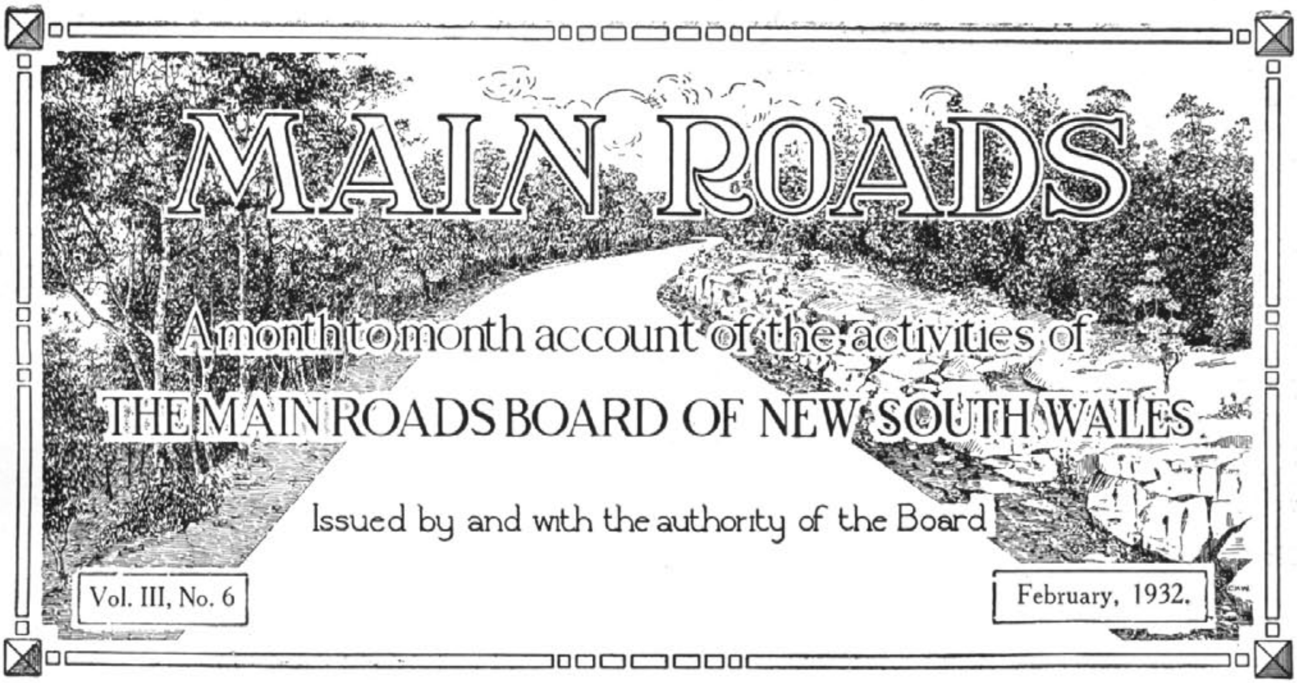


News of the Month.

Metropolitan Division.

One of the few remaining original milestones on the Windsor-road (No. 184), Municipality of Blacktown, is shown in the illustration below. These stones, 8 inches in diameter, were hewn from sandstone and erected during the construction of the road in the earliest days of settlement. The railing was erected by the maintenance patrol to preserve the stone from being snapped off by collision with vehicles travelling off the pavement, as has been the fate of the majority of these old relics of the pioneers.

An old milestone on the Windsor road.

A special grant for expenditure on unemployment relief work has enabled widening and other improvements to be carried out to a number of bends and narrow places on the Great Western Highway between Faulconbridge and Wentworth Falls, also at two points on the Prince's Highway between Helensburgh and Bulli Pass, and at Bald Hill on the Lower South Coast road (No. 185). Also, at the Devil's Elbow, on Bulli Pass (Prince's Highway), a safety ramp was constructed to check the speed of any vehicle which may get out of hand on the steep grade. Altogether 265 men were employed for a period of ten days prior to Christmas, and a further 176 for a similar period after.

Unemployment relief work on the Great Western Highway near Linden, in Blue Mountains Shire. The roadway is being widened to improve the visibility.

*81334

Outer Metropolitan Division.

The gravel pavement on the Pacific Highway for 6 miles south of Mooney Creek bridge has been reconditioned, and is now being tar surfaced by Messrs. Bryant and Buchanan, Ltd. Heavy traffic has caused this section in the past to be very dusty.

Nattai Shire Council has completed the resurfacing of 1 mile on the Bowral-Moss Vale road (No. 260).

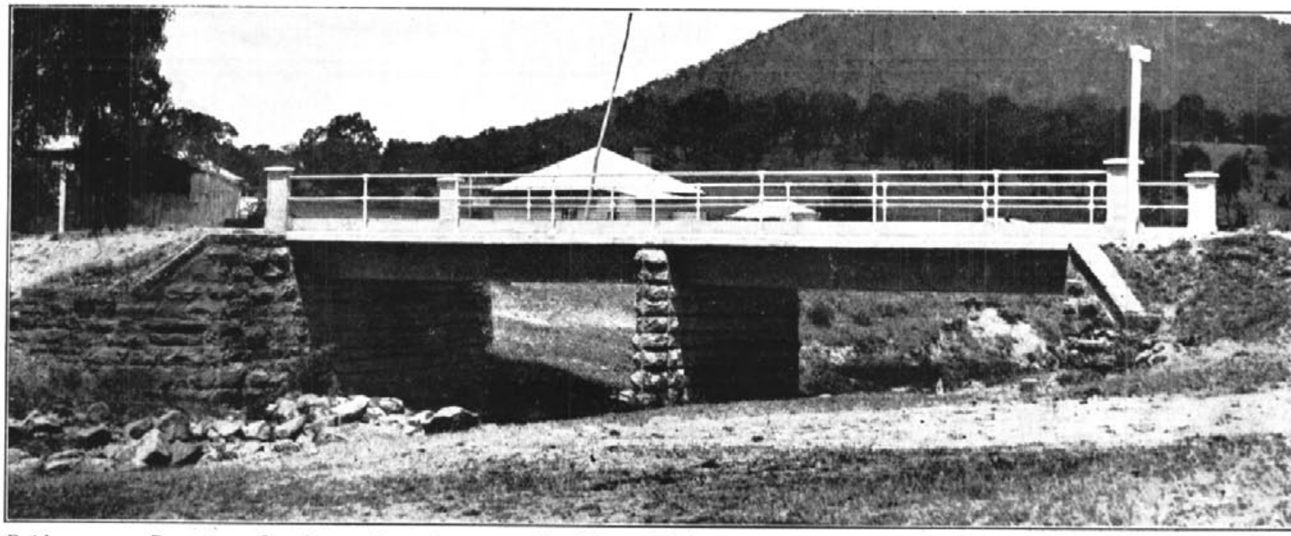
The reorganisation of Broadmeadow Junction, Hamilton (Pacific Highway), is now complete and is giving good service to traffic. The complete scheme was described in the August, 1931, issue of *Main Roads*.

Christmas unemployment relief funds were expended upon cutting back sharp corners on the Prince's Highway, south of Kiama, on the Great Western Highway at South Bowenfels (at Morrow's Corner, where several accidents have occurred), and on the Great Northern Highway between Branxton and Singleton.

Sandilands) on the Sandilands-Bonalbo-Woodenbong developmental road (No. 1,050), in Kyogle Shire. The construction of this section will give an all-weather road from Bonalbo to the Tenterfield-Casino trunk road (No. 64) at Sandilands.

Lower Northern Division.

With the tar surfacing of the two 10-foot strips (one on each side of the reserve for garden plots) in Marius-street, between Brisbane and White streets, and the central 20 feet between White and Roderick streets, there is now a continuous surfaced pavement on the Great Northern Highway in Tamworth, between the junction with the Oxley Highway and a point about half a mile beyond the power-house, a total distance of slightly more than 1½ miles. It is proposed to add to this length from time to time until the whole of the Highway within the municipality is surface-treated. The Oxley Highway is already bitumen-surfaced throughout the municipality.



Bridge over Bowning Creek, at Bowning, on the Hume Highway in Goodradigbee Shire. The centre pier was widened, and a concrete deck 20 feet wide built to replace a worn-out, narrow superstructure of steel girders and buckle plates. The bridge is 60 feet long.

Upper Northern Division.

On the Legume-Killarney (Queensland) road (No. 189), in the Shire of Tenterfield, Contractor A. J. B. Anderson has completed the construction of a 30-foot single span timber beam bridge over Acacia Creek. This bridge eliminates a ford which blocked the traffic during heavy rains. As this road is the outlet from the Legume district to the railhead at Killarney, in Queensland, the new bridge is of considerable benefit to the residents in the vicinity.

The funds allotted for Christmas unemployment relief work on the Pacific Highway in Orara Shire have been expended, under the direction of the Board's maintenance organisation, in widening narrow formations and improving the visibility at sharp turns by widening and benching between 19 miles and 25 miles from South Grafton towards Woolgoolga.

Work has commenced on the formation and base course of the last unconstructed section (between 6 m. 1,700 ft. and 7 m. 2,200 ft. from Bonalbo towards

Some minor improvement works have just been completed on the Great Northern Highway, north of Wallabadah, towards the Devil's Pinch. The work consisted of cutting back blind corners and widening embankments to improve visibility, and improving the grades by filling hollows and cutting down crests. Accidents on this and other roads draw attention to the need for work of this nature. Each year one or more short lengths of dangerous road are being eliminated out of maintenance funds. Larger sections cannot be treated in this way, but warning notices are being erected for the protection of traffic until funds permit of relocating the route.

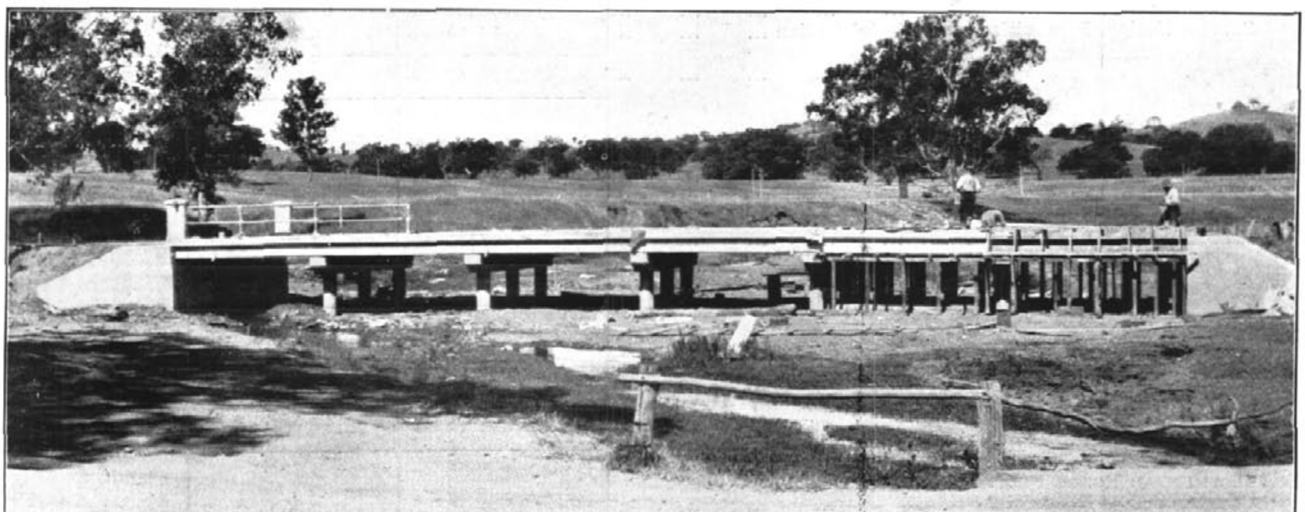
The bridge over the Manilla River in Barraba has recently been strengthened by the Board's bridge maintenance gang. White ants and rot had so weakened the lower chord of one of the timber trusses that less than half of it remained sound. As the bridge is 40 years old, and the deck and other important parts are also in need of extensive repairs, it was decided to

The Mt. Kosciusko road blocked by snow in mid-December. The Seaman hut (about 2 miles from the summit) in the background.

carry out temporary work only, pending complete renewal of the structure as soon as possible. The weak truss has been strengthened, and longitudinal running tracks have been fixed on the deck to reduce impact. The truss was strengthened by passing a pair of steel cables around cast iron saddles bolted at each end of the truss. The cables support four queen posts bearing against the underside of the chord, and were tightened by means of turn-buckles. This arrangement has greatly reduced the vibration of the bridge.

to its being put in use on the Highway at Bateman's Bay whilst the regular steam ferry vessel receives its annual overhaul.

On the Prince's Highway, in the Municipality of Nowra, 1 mile of tar surfacing is being constructed. As this portion of the Highway runs through a shopping area, the surfacing will alleviate the dust nuisance. Nowra Municipal Council is surfacing with tar the remainder of the pavement between kerbs at the same time as the Board is surfacing the central 20 feet.



Concrete bridge in course of construction over Sweetwater Creek, on the Hume Highway in Hume Shire.

Southern Division.

Contractors J. A. Jackson and Sons have completed the construction of a three-span concrete bridge over Oldmangunyah Creek, on the Goulburn-Burrowa road (No. 248) at the boundary of the Shires of Gunning and Murrungal.

Ferry vessel No. 41, which, prior to the opening of the Wagonga Inlet bridge, was in use on the Prince's Highway at Narooma, is now being overhauled prior

A short deviation of the Monaro Highway between Bega and Tathra, in the Municipality of Bega, is being constructed by the Bega Municipal Council. The deviation eliminates an undesirable right-angle turn.

Central Western Division.

Messrs. Model Homes, Ltd., have completed their contract for the reconstruction in tar penetration macadam of 2 miles of the Holmwood-Cowra section of the Mid-western Highway in Waugoola Shire. The completed work provides a first-class surface over a portion of the Highway which was previously very rough.

Topdressing with 6 inches of sandy loam has been carried out as Christmas unemployment relief work on sections between 0 m. and 6 m. north-east of Trangie, on the Oxley Highway. Twenty men were employed. The sections improved, amounting to a total length of 2 miles, were in black soil country which cuts up badly during wet weather.

Canobolas Shire Council is resuming work on the reconstruction of the North-western Highway for 1 mile 3,176 feet east of the Orange Municipal boundary. The work was suspended during the withholding of payment of Federal Aid funds. It consists of the reconstruction of the existing macadam as a base and the construction thereon of a 2-inch mixed-in-place tar macadam surface course. The latter is of an experimental nature, and is expected to assist materially in the standardization of this type of pavement for New South Wales conditions.

Riverina Division.

The Tumbarumba Shire Council has now completed the construction of the deviation, 3,815 feet long, in approach to the new concrete bridge over Paddy's River, on the Tumbarumba-Welaregang road (No. 282). The bridge replaces an old timber structure and the deviation considerably improves the alignment and gradients on the approaches.

Christmas unemployment relief funds were expended upon the Hume Highway between Lower Tarcutta and Tarcutta, in Kyeamba Shire. Here the road is in side-cutting. For half a mile south of Tarcutta, the formation was widened and the curves superelevated.

The section of the Wagga-Temora-Wyalong trunk road (No. 57) between Wagga and Old Junee is being improved by clearing, forming, draining and gravelling the worst of the unconstructed lengths. In Illabo Shire a total length of 3¼ miles, and in Mitchell Shire a total length of 1¾ miles, of this type of work is nearing completion.

Expenditure from 1st July, 1931, to 31st December, 1931.

	Expenditure from 1st July, 1931, to 30th November, 1931.	Expenditure for month of December, 1931.	Total Expenditure from 1st July, 1931, to 31st December, 1931.
	£ s. d.	£ s. d.	£ s. d.
County of Cumberland Main Roads Fund—			
Construction of Roads and Bridges ...	15,847 6 3	6,062 18 0	21,910 4 3
Cost of Land Resumptions ...	24,834 0 0	6,395 2 9	31,229 2 9
Maintenance of Roads and Bridges ...	80,582 2 2	19,388 13 4	99,970 15 6
Repayment of Loans ...	59,981 18 8	66,566 14 3	126,548 12 11
Survey, Design, Supervision and Administration ...	16,531 10 9	2,704 1 7	19,235 12 4
Totals ...	197,776 17 10	101,117 9 11	298,894 7 9
Country Main Roads Fund—			
Construction of Roads and Bridges, including Resumptions ...	52,031 15 9	5,500 2 11	57,531 18 8
Maintenance of Roads and Bridges ...	263,528 13 7	61,106 5 5	324,634 19 0
Repayment of Loans ...	19,519 3 6	23,146 16 6	42,666 0 0
Survey, Design, Supervision and Administration ...	39,393 4 2	7,530 7 7	46,923 11 9
Miscellaneous ...	7,998 15 10	1,191 5 2	9,190 1 0
Totals ...	382,471 12 10	98,474 17 7	480,946 10 5
Federal Aid Roads Fund—			
Construction of Roads and Bridges, including Resumptions ...	48,496 9 4	15,499 14 5	63,996 3 9
Miscellaneous ...	316 2 9	7 5 1	323 7 10
Totals ...	48,812 12 1	15,506 19 6	64,319 11 7
Developmental Roads Fund—			
Construction of Roads and Bridges ...	18,659 9 8	2,869 2 7	21,528 12 3
Survey, Design, Supervision and Administration ...	754 16 11	277 6 9	1,032 3 8
Miscellaneous ...	32 5 4	11 13 7	43 18 11
Totals ...	19,446 11 11	3,158 2 11	22,604 14 10
Summary, All Funds—			
Construction of Roads and Bridges, including Resumptions ...	159,869 1 0	36,327 0 8	196,196 1 8
Maintenance of Roads and Bridges ...	344,110 15 9	80,494 18 9	424,605 14 6
Repayment of Loans ...	79,501 2 2	89,713 10 9	169,214 12 11
Survey, Design, Supervision and Administration ...	56,679 11 10	10,511 15 11	67,191 7 9
Miscellaneous ...	8,347 3 11	1,210 3 10	9,557 7 9
Grand Totals ...	648,507 14 8	218,257 9 11	866,765 4 7

Murrumbidgee River Bridge, Taemas.

THE illustrations on this page show the new bridge over the Murrumbidgee River at Taemas, on the Yass-Tumut road, about 25 miles upstream from Burrinjuck Dam. The new crossing was first used by traffic late in June, 1931, and the last of the several works comprising the bridge and approaches were completed on 17th July, 1931.

The history of the crossing and the events leading to the construction of the present bridge have been given in an earlier issue of *Main Roads*.* In that article, the raising of the former bridge by the Water Conservation and Irrigation Commission, and its destruction by the record flood of 1925, were described, and the steps taken by the Public Works Department to maintain a connection for traffic were detailed. The latter Department selected a location for a new bridge about 2 miles upstream from the former site, and prepared the designs for the new structure. Financial responsibility for the work having passed meanwhile to the Board, contracts for the several parts were let, and the bridge and approaches have been completed under the supervision of the latter body. The works entailed, and their cost, are as follows:—

Work.	Contractor.	Contract Sum. £ s. d.	Final Cost. £ s. d.
Supply and delivery of Steelwork.	Tulloch's Phoenix Ironworks, Ltd.	14,857 3 8	14,874 7 2
Construction of piers and abutments, and erection of steelwork.	State Monier Pipe and Reinforced Concrete Works.	26,810 16 6	30,700 0 0†
Formation and gravelling of northern approach.	Gilroy and Robson, Ltd.	11,287 14 10	11,039 16 7
Formation and gravelling of southern approach.	,, ,, ...	4,174 3 8	4,281 9 10
		£ 57,129 18 8	60,895 13 7

* See *Main Roads*, February, 1930, p. 117.
† Subject to finalisation of accounts and slight adjustment.

The construction proceeded without incident, except some delay occasioned by the abnormally wet weather and floods occurring during May and June of last year. In constructing the foundations, rock was reached at the levels anticipated, but it proved to be shattered and uneven in contour, which necessitated extending the abutments and all the cylinders for the piers, except one, up to 11 feet deeper than provided for by the contract, in order to obtain uniform and level foundations. This is responsible for the major part of the extra cost of this part of the work, the balance occurring on account of a slight alteration in the alignment of the bridge to lessen the severity of the curve of the northern road approach, and several minor matters which cropped up during the progress of the work.

The approaches, amounting to an aggregate length of 3 miles 1,850 feet, traverse fairly heavy country, necessitating the excavation of 41,000 cubic yards of earth and rock to form a roadway 24 feet wide. The pavement is 16 feet wide, and consists of conglomerate gravel 6 inches thick.

Murrumbidgee River Bridge, Taemas.

Nepean River Bridge, Maldon.

The repairs to the suspension bridge over the Nepean River at Maldon, on the Maldon-Appin road (No. 179), in the Shire of Wollondilly, to which reference was made in the January issue of *Main Roads*, have been completed. The restriction upon the weight of loads passing over the bridge has been removed.

The Murrumbidgee River Bridge at Gundagai, 1865-1932.

BRIDGE-BUILDING in the sixties was more of an art than an exact science. Therefore it was no mean achievement for the pioneers who planned and constructed the bridge over the Murrumbidgee River at Gundagai to erect a structure of which part is now entering its third generation of usefulness. Though floods and time and traffic have taken their toll, and though the bridge will shortly be carrying its third complete suit of timber, the principal spans are the same in form as when erected in 1865.

Prior to the great flood of 1852, the township of Gundagai was located upon the half-mile wide flat upon the northern bank of the river, but, after this flood had destroyed Old Gundagai, inundating the flat to a depth of about 15 feet, with the loss of eighty-nine lives,* the

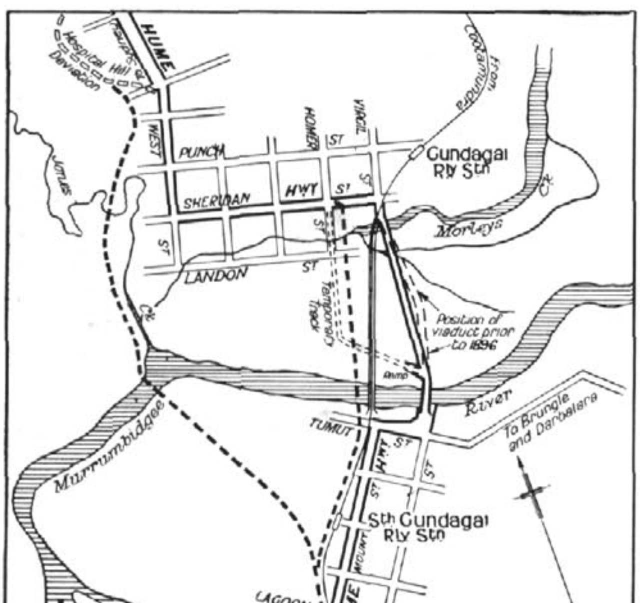


Fig. 1. Sketch plan showing the Murrumbidgee River at Gundagai. The dotted lines indicate alternative crossings.

settlement was transferred to the higher ground overlooking each bank, leading to the development of North Gundagai and South Gundagai as at present existing. One can visualise the importance in the eyes of the travellers following Hume and Hovell's route to the Riverina and Victoria, of the river crossing, and this is confirmed by the substantial nature, for those days, of the bridge as depicted in the old drawings and evidenced by the parts of the structure still in service.

The first bridge consisted of three wrought-iron girder spans of 103 feet each over the main channel of the river, adjacent to South Gundagai, as we know it to-day; south of the girder spans there were two timber beam spans, each of 30 feet, and on the north there were twenty-three timber beam spans, each of 30 feet, forming an approach on a grade of 1 in 30, much of which must have been submerged whenever a high flood occurred.

As the illustrations show, the iron trusses are of a unique type. Each top chord is continuous throughout the full length of the three spans, being supported by roller bearings on standards fixed to each pier. The lower chord and the inclined web members are pin-connected, the end pins of each truss (lower chord) passing, to allow for contraction and expansion, through slotted holes in brackets fixed to the standards at each pier. Each span is subdivided into ten panels, built-up iron cross girders being supported above each panel point of the lower chord. There being no overhead bracing, as the depth of the trusses is only 8 feet 9 inches, the top chord is supported at each panel point by standards bolted to each cross girder and bolted to the top chord. There are nine lines of 10-inch by 8-inch timber stringers, which originally supported two layers, each 2½ inches thick, of hardwood decking. The planks were laid diagonally, those in the lower layer being approximately at right angles to those of the upper layer, and the deck was finished with a light curved iron kerb. The original width of carriageway was 21 feet.

The superstructure of the principal spans is supported upon four piers, each consisting of a pair of cast-iron cylinders, built up of hollow sections 9 feet high, 6 feet in diameter, and having walls 1⅛ inch thick. Each section was cast in four pieces, and there are a pair of internal struts at each horizontal joint. All the joints are secured by bolts. The cylinders were sunk through alluvial deposits to a foundation in coarse gravel and detached pieces of rock, the deepest being founded about 30 feet below low-water level. The deck level of the bridge is approximately 40 feet above low water.

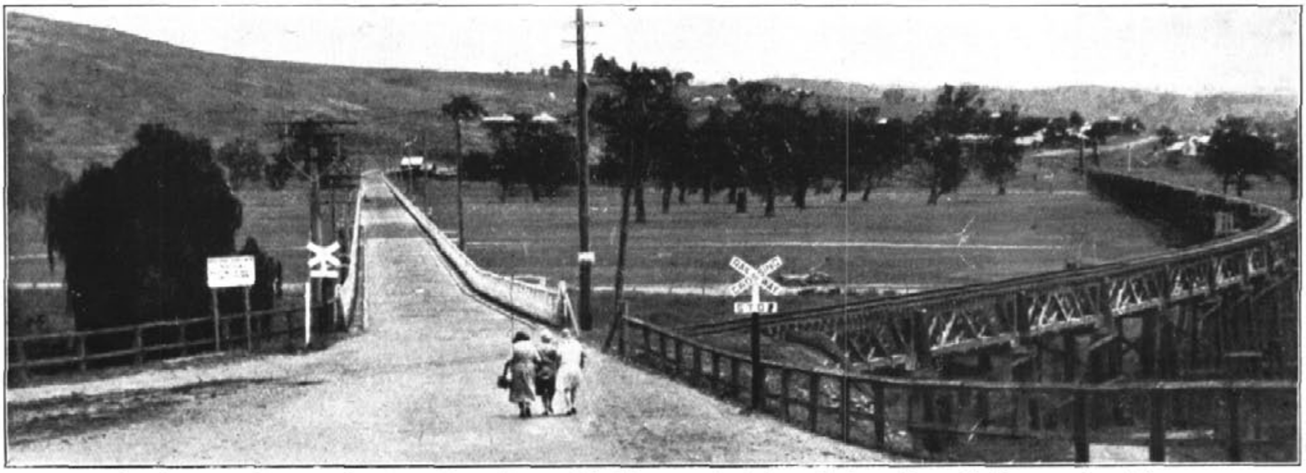
The original beam spans provided a carriage-way 21 feet wide between handrails, there being no kerbs. There were six lines of stringers, neatly notched and keyed over each pier, the latter having four braced piles in each bent. The decking was 4¼ inches thick, laid at right angles to the stringers, and having a camber of 3 inches. The latter feature is interesting in view of a present-day tendency to revert to cambered decking. All the timber was squared and the various members were trimmed and fitted in the careful and workmanlike fashion of the day.

The bridge, as built in 1865, was 1,030 feet long. As it commenced at the same point at South Gundagai as the present structure, it will be noted that it terminated nearly 2,000 feet short of the present abutment on the North Gundagai side, and, therefore, was put out of action whenever flood waters covered the flats on the north bank of the river.

*See article by Mr. H. H. Dare, Journal of the Institution of Engineers, Aust., July, 1931.

The old records are no longer available, but later drawings show that, by 1896, the original northern approach spans had been replaced by a high-level approach consisting of 105 timber beam spans of from 15 feet to 30 feet each. There is evidence, also, that Morley's Creek, the ana-branch which follows the northern limit of the river flat, and another smaller similar waterway, had developed during the intervening thirty years. The ramp leading from the bridge to the flats near the northern end of the girder spans was built in 1896, doubtless with a similar object in view then as during the past two years, viz., the diverting of traffic from the timber approaches on account of their state of wear and decay, pending action towards their restoration. The reconstruction of 1896 comprised the rebuilding of the southern timber approach, the two original spans being replaced with two beam spans of 35 feet and 28 feet respectively, the redecking of the girder spans in similar fashion to the original work, but using timber kerbs (thus subtracting 12 inches from the carriageway width), and the abandonment of the then existing northern timber approach (the 105 spans described above) and its replacement by a new approach. The approach abandoned in 1896 was in line with the truss spans for about half its distance, then it bent sharply to the west. (See Fig. 1.) The new approach gradually deviated westward from the alignment of the trusses over six spans to near the ramp, then went in a straight line for seventy spans (2,443 feet) to an abutment 20 feet west of and 40 feet short of the then existing abutment. The new northern approach consisted of seventy-five timber beam spans of 35 feet each and one span of 28 feet, and has remained unaltered, except for redecking and minor renewals, until the present comprehensive overhaul. The new spans were 20 feet 6 inches wide between kerbs, the superstructure consisting of five lines of girders (the outer line on each side only being squared) and decking 4 inches thick. The piers each consisted of four piles. The total length of the bridge after the 1896 reconstruction was therefore 3,025 feet.

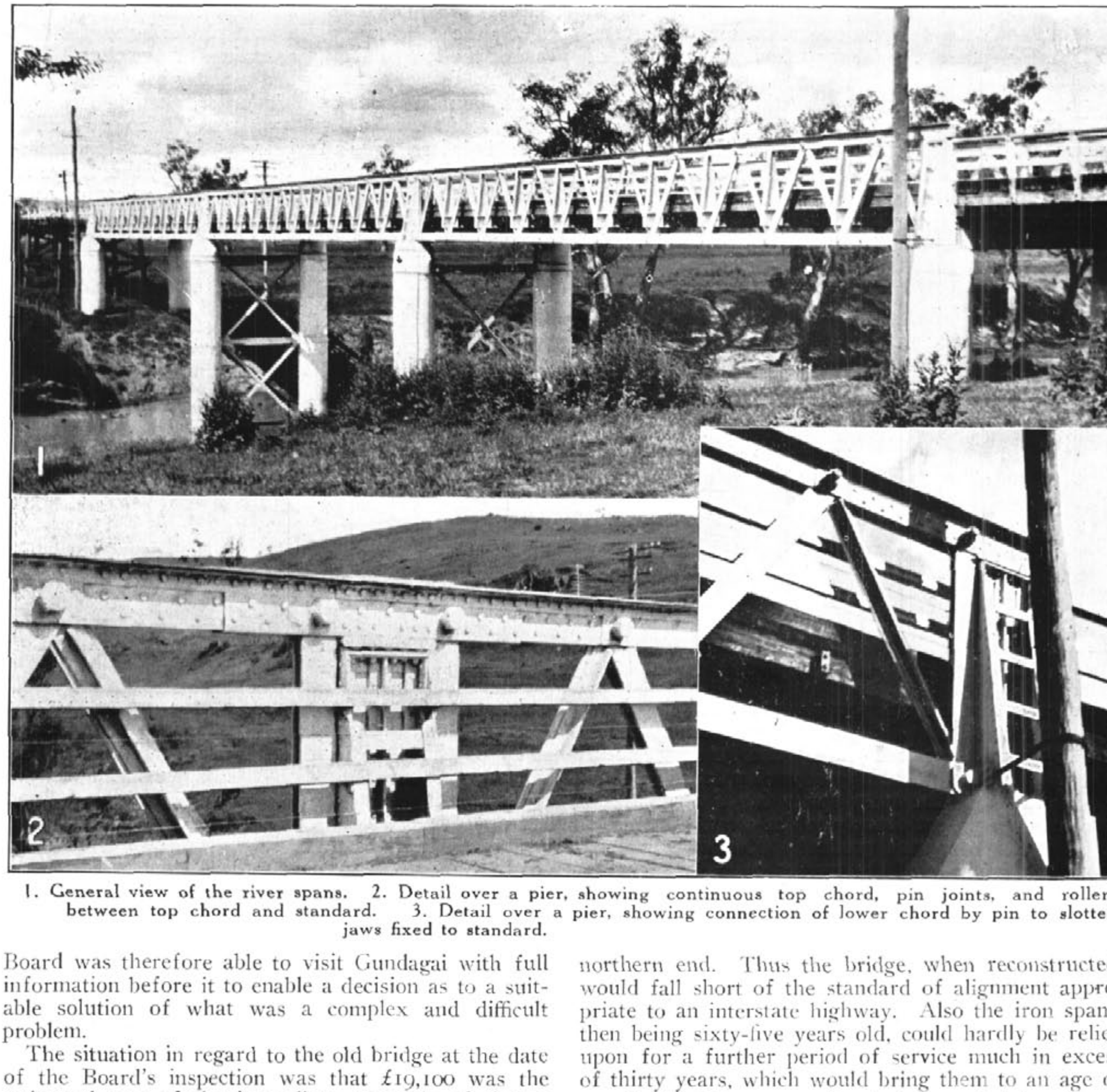
When the system of State Highways was instituted and the Riverina Division was organised, this bridge passed to the control of the Main Roads Board, and was taken over in February, 1929. By that time the timber portion of the bridge had again become in bad order, loose and broken decking, in particular, causing considerable complaint. For 607 feet from North Gundagai, light 2½-inch diagonal planking had been placed on the original decking, and a space of about 1 foot 6 inches on either side of this sheathing was filled by longitudinal timbers, the diagonal planks not being long enough to span the deck completely. Much of this light decking was loose and in a dangerous condition. Immediate steps were taken to bolt down tightly the ends of the diagonal planks by means of a line of the longitudinal planks fixed above them. The next 200 feet of the deck had recently been relaid with brush box and was in fair order, though loose on account of the spikes not having a satisfactory hold in the old girders. For a further 335 feet the planks were of mountain ash, and had become stringy through wear as well as being loose, and were therefore entirely unserviceable. For the remainder of the distance to the main spans (1,510 feet) much of the decking was in narrow planks, and much was split longitudinally, many of the planks having been turned over in an endeavour to secure a better running surface. On the main spans the upper layer of decking had been covered by planking laid at a slight angle to the cross girders (in a similar manner to the 607 feet at the North Gundagai end), with the spaces at each side likewise filled with longitudinals. This section was in bad order, and was given the same treatment as the similar section mentioned. The remaining decking on the two approach spans at South Gundagai was in a state requiring renewal.



Looking south over the river flats, the road bridge on the left and the railway bridge on the right.

The emergency repairs to the deck gave some immediate relief, and permitted the making of a more detailed examination of the whole structure. Outstanding features of the problem were the advanced age of the timber in the old approaches, and the heavy expenditure obviously inevitable, whether incurred in restoring the existing bridge or in building a new crossing elsewhere. Limiting speeds over the bridge to 10 miles per hour was attempted in June, 1929, but proved impracticable, and finally, at the end of the same year, the northern approach was closed. Traffic then descended from the bridge to the flats by the ramp on the northern bank of the river, and used a track to the west of the road viaduct, then passing under the adjacent railway viaduct and thence to North Gundagai. Meanwhile the portion of the bridge south of the ramp was kept in reasonable order by strictly emergency repairs.

By July, 1930, every timber in the old bridge had been examined, and surveys and tentative proposals for alternative crossings had been completed. The spent within a period of five years, to renew the balance of the old timber. It must be remembered that the bulk of the existing timber was then over thirty years old. In addition, the railway level crossings at the northern abutment of the bridge, and a short distance south of the southern abutment (see the sketch map on page 86) could not readily be replaced by either subways or overhead bridges, and there were also three right-angle bends in the existing road, two at the southern end of the bridge and one at the



1. General view of the river spans. 2. Detail over a pier, showing continuous top chord, pin joints, and rollers between top chord and standard. 3. Detail over a pier, showing connection of lower chord by pin to slotted jaws fixed to standard.

Board was therefore able to visit Gundagai with full information before it to enable a decision as to a suitable solution of what was a complex and difficult problem.

The situation in regard to the old bridge at the date of the Board's inspection was that £19,100 was the estimated cost of the immediate renewals of timber necessary to put the bridge into reasonable order. This figure covered the renewal of about 25 per cent. of the round timber (piles, girders, and corbels) and about 60 per cent. of the squared timber (decking, kerbs, bracing, and handrails). However, it was estimated also that a further £19,700 would need to be

northern end. Thus the bridge, when reconstructed, would fall short of the standard of alignment appropriate to an interstate highway. Also the iron spans, then being sixty-five years old, could hardly be relied upon for a further period of service much in excess of thirty years, which would bring them to an age of practically 100 years. Apart from not being heavy enough to carry the present-day standard bridge loading, old age had probably affected the iron and caused some loss of strength.

Proposals for a new bridge came under three headings. A new crossing could be built alongside the existing bridge, inheriting the defects in alignment of the present site; or it could be built just to the west of the railway viaduct, where it would render practicable the elimination of both the present level crossings without otherwise disturbing the existing facilities; or, finally, it could be built about a mile downstream from the present crossing, giving first-class alignment and grading, by-passing the highway traffic around the business areas, but increasing the distance for local traffic coming from south of the river and bound for (North) Gundagai Railway Station. At each of the three sites the cost of a steel and concrete bridge was estimated at from £90,000 to £100,000, with a reduction of about £18,000 in each of the several cases should timber be used for the viaduct leading to the main river spans.

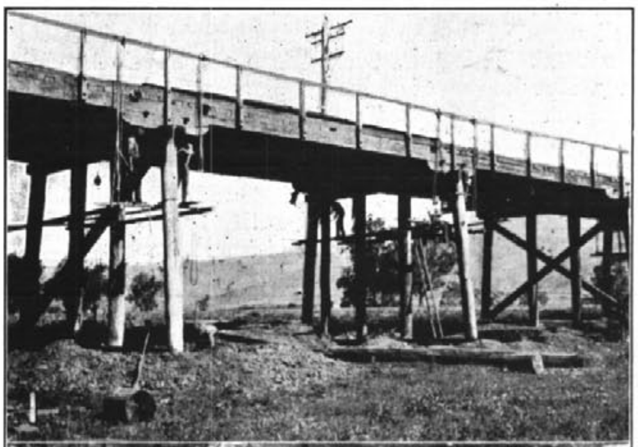
There was the further possibility that, had the bridge carrying the Cootamundra-Gundagai-Tumut-Batlow railway across the Murrumbidgee a few hundred yards downstream from the road bridge been due for renewal within a reasonable period, it might have been feasible to arrange for a dual traffic crossing. However, inquiry showed that the railway bridge had recently been strengthened and repaired, and the need for extensive work in the near future would therefore not occur. The construction of any new bridge of a dual road and rail type was therefore out of the question.

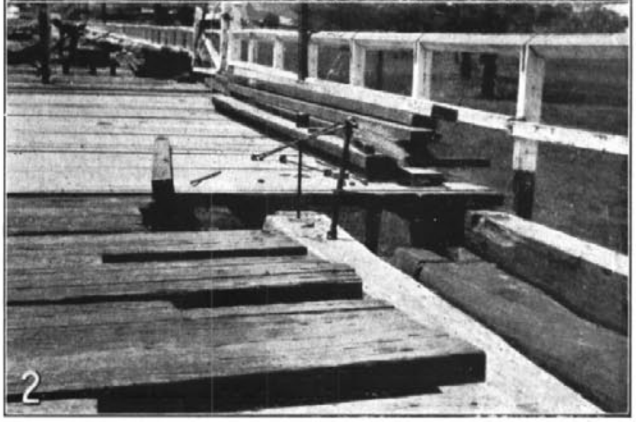
Because of the advantage for local traffic of any site in proximity to the present bridge, the Board decided that of the possible locations for a new bridge, it preferred that just west of the railway, but, as the traffic on the railway was only of a minor character, it could not regard the elimination of the level crossings as a major consideration to be urged against retaining the existing location for the present. It was plain that the existing iron trusses, though light and of unusual design, viewed from the aspect of modern structural practice, were in good order and were capable of rendering efficient service for the life of at least one more timber approach.

Reconditioning the existing structure at a rate commensurate with the available funds was therefore decided upon as the course to be followed, and, as the work to be done could not be exactly determined upon until the structure was partially dismantled, it was further decided that the reconditioning should proceed by day labour, under the direction of the officer who had made the detailed examination of the timbers.

Up to date, the most difficult portion of the reconditioning—the redecking and general repair of the two southern approach spans, the three truss spans, and the eight beam spans of the southern approach between South Gundagai and the ramp leading down to the flats north of the river—has been completed. This work was necessarily carried out under traffic, and therefore progress was somewhat hampered. Work is now proceeding on the remaining sixty-eight beam spans north of the ramp, of which thirteen have been dealt with. Vehicular traffic is using the track across the flats in lieu of this portion of the bridge, so that the work can proceed with less restriction than heretofore, although the whole bridge must be made available to vehicles up to 3 tons in weight whenever the river breaks its banks and renders the flats impassable.

The procedure in respect to the work now in progress is to dismantle and examine in detail several spans ahead of the one being repaired, noting all unserviceable timber. First, defective piles are replaced, then wales, braces, corbels, and girders, then the old deck is removed and new decking laid. Finally, the kerbs, posts, and handrails are replaced, or, if necessary, renewed. All the original piles examined to date have been found sound at 4-6 feet below the surface of the ground, although decayed above that level.





1. Repairs to timber substructure in progress.
2. Renewing decking on approach spans.

New pieces are spliced on to such piles. Spiking planks and waterproofing strips are being used between the decking and the girders, thereby strengthening and preserving any old girders retained, and ensuring maximum life to both old and new girders. Any sound sections of timbers unserviceable as girders or piles are cut into corbels.

On the section of the bridge at the southern end, which was repaired under traffic, only one gang, consisting of a foreman and twelve men, could be employed, but since the repair of the portion which can be closed to traffic has commenced, a second gang has been organised and nineteen men are now engaged. The cost of the work to 31st December, 1931, was £13,065. At the present rate of progress, and provided no contingency at present unforeseen affects the funds which are being devoted to the work, it is anticipated that the reconditioning will be completed before 30th June, 1932.

Highway Work in the United States.

BY H. M. SHERRARD, M.C.E., ASSOC, M. INST., C.E.

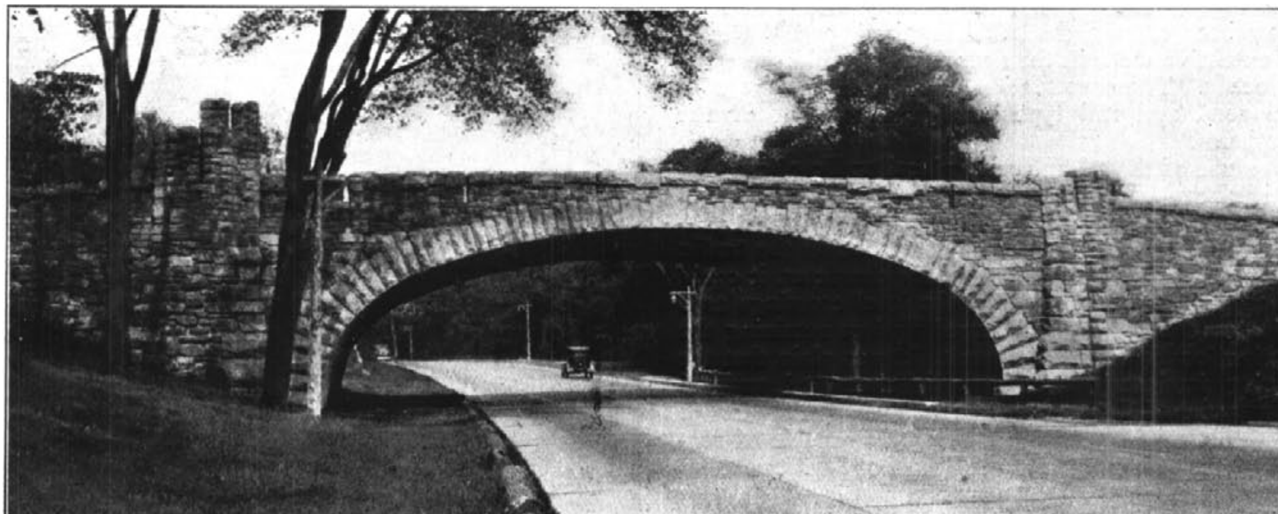
Assistant Chief Engineer.

Materials and Testing.

(*Continued from page 74, January, 1932.*)

Embankments.—For testing and compaction of embankments in California, a sample is obtained by a shell-auger. From its volume and weight, its density is calculated. It is then packed into a cylindrical mould (a 3 feet length of 3 inches diameter tube might be used), and compressed under a pressure of 2,000 lb. per square inch. From comparison with the density of banks known to be strongly compacted, a tentative value of 85 per cent. of the density obtainable by compression in the tube has been fixed as the minimum acceptable for banks to be paved immediately.

temperature variation, and their tendency to harden in time with exposure, they were best confined to work where not exposed directly to the atmosphere. The competition between asphalt and tar is keen, and there is also competition among the tar interests; this, no doubt, tends to keep the quality of tar products at a high level, regardless of the adequacy of the governing specifications. On inquiry, it was generally found that price was the factor that determined which material was used in a particular State. In Pennsylvania, where tar is used for surfacing, it was stated that, although asphalt is the same price there, tar is preferred because it is less slippery under the prevailing conditions of rain, oil drippings, and ice.



Reinforced concrete rigid frame bridge encased in stone, Westchester County Park, New York. This bridge carries an intersecting road over the parkway.

Testing Grader Blades.—In Iowa a sample piece 4 inches x 2 inches x ½ inch is placed on edge, and the force necessary to shear a V-shaped notch 0.05 inch deep off one side with a standard tool is measured. By performing the same test on a standard piece of cold rolled steel, a permanent basis of comparison is obtained. A value of about 1,700-1,800 lb. is obtained for the cold rolled steel, and about 4,000 lb. for first-class grader blades.*

Tars.—The greater part of the tar produced in the United States is from coke-ovens. It is usually sold to large distributing companies which market uniform products, often the result of blending materials from different sources. In general, tar conforming to standard specifications is regarded as the equal of asphalt for road purposes, although in some cases the view was expressed that, owing to the susceptibility of tars to

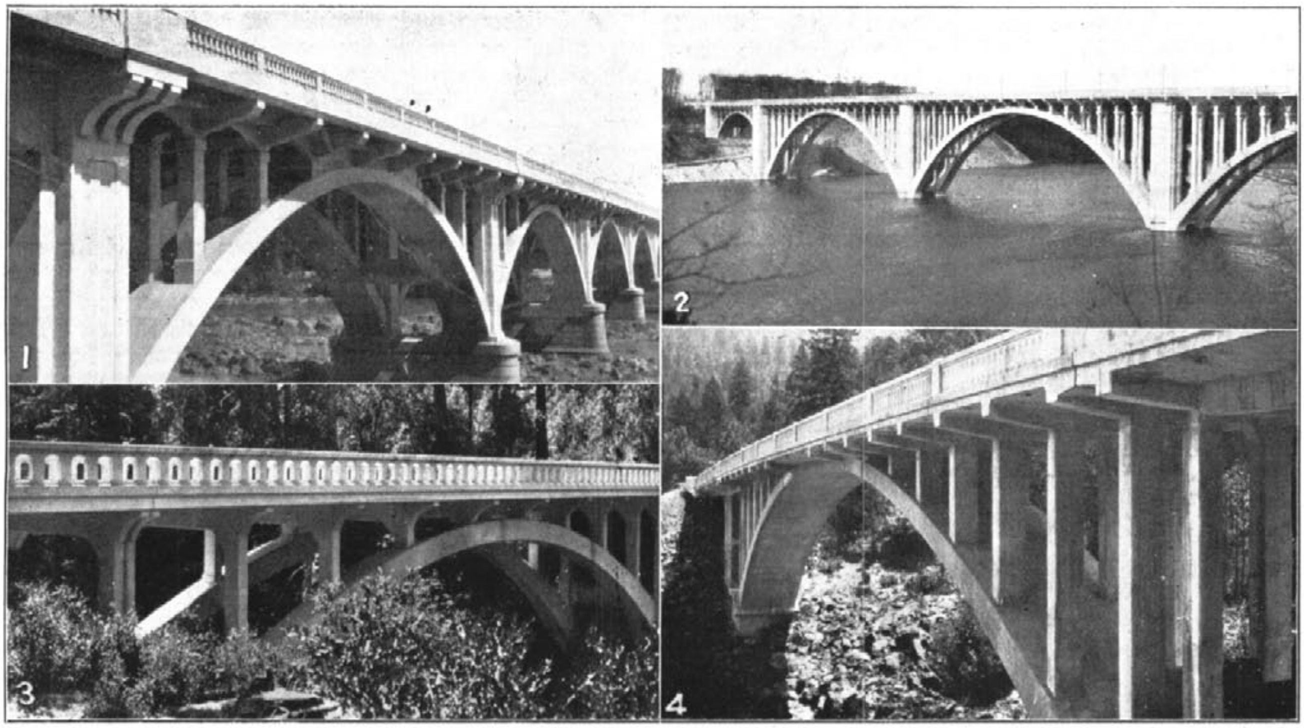
*The Board now tests grader by subjecting a disc of the material to the Dorry hardness test used for determining the hardness of broken stone for road use. The test is giving consistent results, and simulates closely the conditions under which the blades work.

The use of cold cut-back tars for surfacing, for patching, and for retread is perhaps, the greatest difference from New South Wales practice. The low viscosity and the high percentage of distillates are the characteristic features of cut-backs.

Bridges and Culverts.

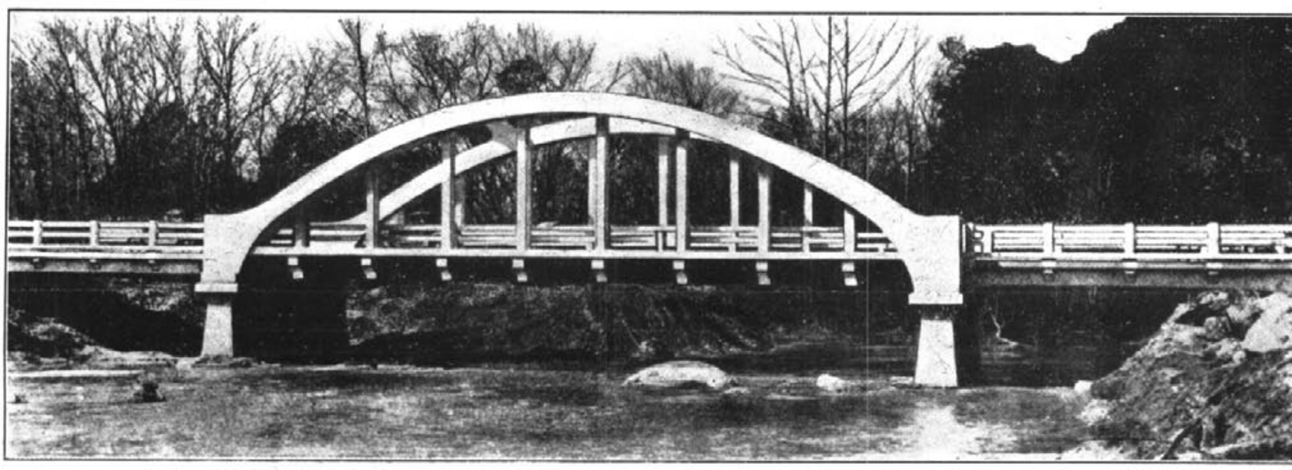
Practice in the United States varies among different States. Some, on account of easy topography and small or few streams, have little bridge work; others, *e.g.*, California and Oregon, build many large and beautiful bridges. That handsome bridges are admired by the American public is evident from the large number of picture post-cards of bridges on sale.

The tendency is for the road to dominate the location rather than the bridge, with the result that bridges forming part of super-elevated curves are not uncommon. For long spans, steel is generally used,



Reinforced concrete arch bridges.
1. In South Carolina. 2. In Minnesota. 3 and 4. In California.

although concrete arch bridges are often used when the site is suitable; in California, some redwood timber truss bridges are being built. In that State, steel bridges and pipe handrails are treated with aluminium paint, which not only improves their appearance, but is said to be very durable. A light-weight concrete (104 lb. per cubic foot), using a burnt clay aggregate (Haydite), has been developed for long span bridge decks.



Reinforced concrete bowstring arch bridge.

For moderate spans (up to 110 feet), concrete bowstring (or "rainbow") arches, or steel "pony" trusses are built. For spans of this length, the concrete bowstring arch is generally no more costly than a steel truss, and has advantages over it as regards maintenance.

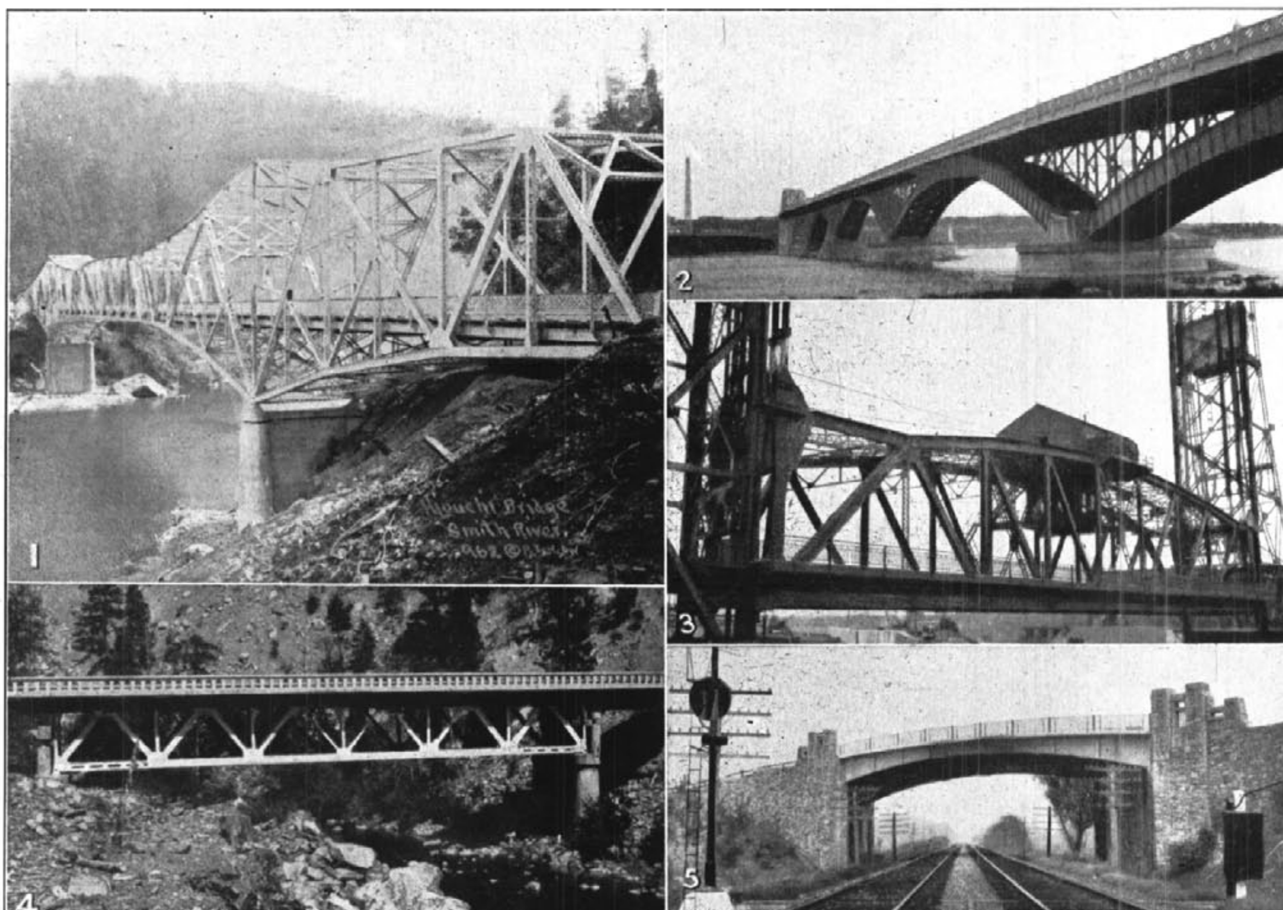
Designs for multiple span beam bridges are generally similar to those in use in New South Wales. Through bridges cannot be widened readily if traffic grows; this type is therefore falling into disuse. The construction of single and double span frame bridges has reached a high stage of development in Westchester County, New York State. These bridges are erected in the remarkable parkway system of this county (which abuts on New York City), generally as grade crossing elimination projects, either between two roads, or a road and a railway. Concrete is used for spans up to 80 feet, and steel for longer spans. The bridges invariably are encased in stonework involving architectural features, the general effect being very pleasing.

In similar fashion, all bridges erected by the Bureau of Public Roads in national parks are made to conform with their surroundings by suitable masking with stone or timber work; and the bridges being built by the United States Government on the Mount Vernon Memorial Highway in Virginia, near Washington, are being treated in the same way.

Bridges provide for the appropriate number of traffic lanes, each 10 feet wide, plus a margin, *e.g.*, 4 feet in California. Two-lane bridges in Ontario, Canada, will be 30 feet wide in future. Much of the United States being relatively closely settled, at least one footway is generally provided.

In California and Virginia, an additional thickness of an inch or two, of the same mixture as the rest of the slab, is provided to take the wear on concrete bridge decks. In Pennsylvania, a 4-inch thick renewable pavement of 1:2:3 mix concrete is provided on the bridge, separated from the structure by a bitumen paint coat. Concrete pavement slabs are generally built to rest on bridge abutments.

In California, rocker bearings are provided for concrete spans of over 40 feet. For shorter spans, unpolished bronze plates are used, the upper and lower plates being of slightly different composition. This feature, and the omission of polishing, are said to give easier sliding.



1. Modern steel cantilever highway bridge, California. 2. Long span steel arches, New York.
3. Lifting bridge, Ontario, Canada. 4. Moderate span deck bridge, California.
5. Steel rigid frame bridge, New York. (The vertical legs of the frame are hidden by the stone work.)

Bridge handrailing usually consists of a concrete balustrade, a concrete railing or a pipe railing. The concrete railing has advantages of cheapness and good appearance, and when used in conjunction with a high kerb, provides a satisfactory solution. A concrete balustrade was seen merely bolted in place, so that it could be moved out if the bridge is widened at a later date. Bridge end-posts are always sheathed in building paper to save them from being splashed during road spraying operations.

" Spill-through " abutments are used whenever the location is suitable, in order to obtain the resulting economy.

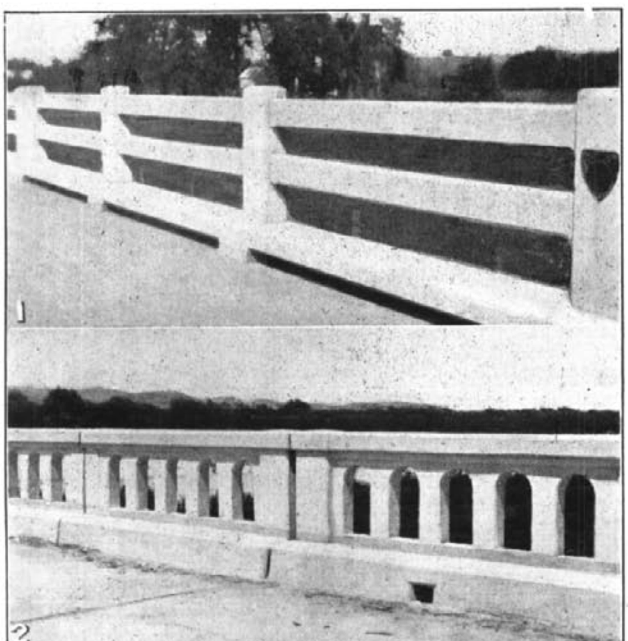
Very great care is given to surface finish, and little concrete work which I saw appeared other than first class. The fact that well-finished handrails appeal to the public has been previously mentioned. In obtaining a good surface finish, smooth, tight and unyielding forms are used, and any irregularities are removed by

A redwood truss bridge in California. Although not a strong timber, redwood is light, durable and fire-resisting.

carborundum. In some cases, it was noted that dressed lagging with rebated joints was in use.

Box culverts, generally, are of simpler design, but require greater quantities of material than those in use in New South Wales.

Pipe culverts are of corrugated iron, cast iron, or concrete. American concrete pipes are approximately twice as strong as those used in New South Wales. Corrugated iron pipes are cheap and are much used, except under permanent pavements. One testing engineer indicated that they are regarded from experience as having a thirty years' life. Although of reputedly non-corrodible iron, all have a spelter coating and, in addition, some have the invert dipped in bitumen, with a bitumen and sand mixture filling the invert corrugations. A corrugated pipe seen near Wellington, N.Z., five years old, carrying a constantly-flowing small mountain stream, and laid on a slope of about 1 in 6, was badly corroded in the invert. This was a severe test, however. In Virginia, it was stated that corrugated iron pipes appeared to have as long a life as concrete, provided they are not laid in coal districts (acid water) or tidal waters.



1. Concrete bridge handrailing, Virginia.
2. Concrete balustrade, California, made removable to facilitate future widening of bridge.

In California, headwalls are usually omitted from pipe culverts in rural areas. Culvert catch-basins are provided with a 6-inch diameter opening to provide an inlet for possible subsoil drains which may be built later.

(This article completes the series by Mr. Sherrard describing his visit to the United States in 1930.)

Sweetwater Creek Bridge, Hume Highway.

Contractor J. T. Taylor has completed the new reinforced concrete bridge over Sweetwater Creek, on the Hume Highway at Mullengandra, in Hume Shire, and is now constructing the approaches. The bridge is a flat slab structure of six 15-foot spans, founded upon concrete piles. Some of the concrete, consisting of 1 part of cement, 1¾ parts of local sand, and 2¾ parts of ¾-inch broken stone from Culcairn, gave compression test results as high as 6,220 lb. per square inch at twenty-eight days. The road has been deviated on either side of the bridge, for a total distance of 1,580 feet, in order to give good alignment, and will be paved with gravel 8 inches thick. The base course has been completed.

Maintenance Methods in the United States.

By S. L. Luker, B.Sc., Assoc. M.Inst.C.E.
Metropolitan Maintenance Engineer.

(Adapted from a report following a visit to the United States in 1930.)

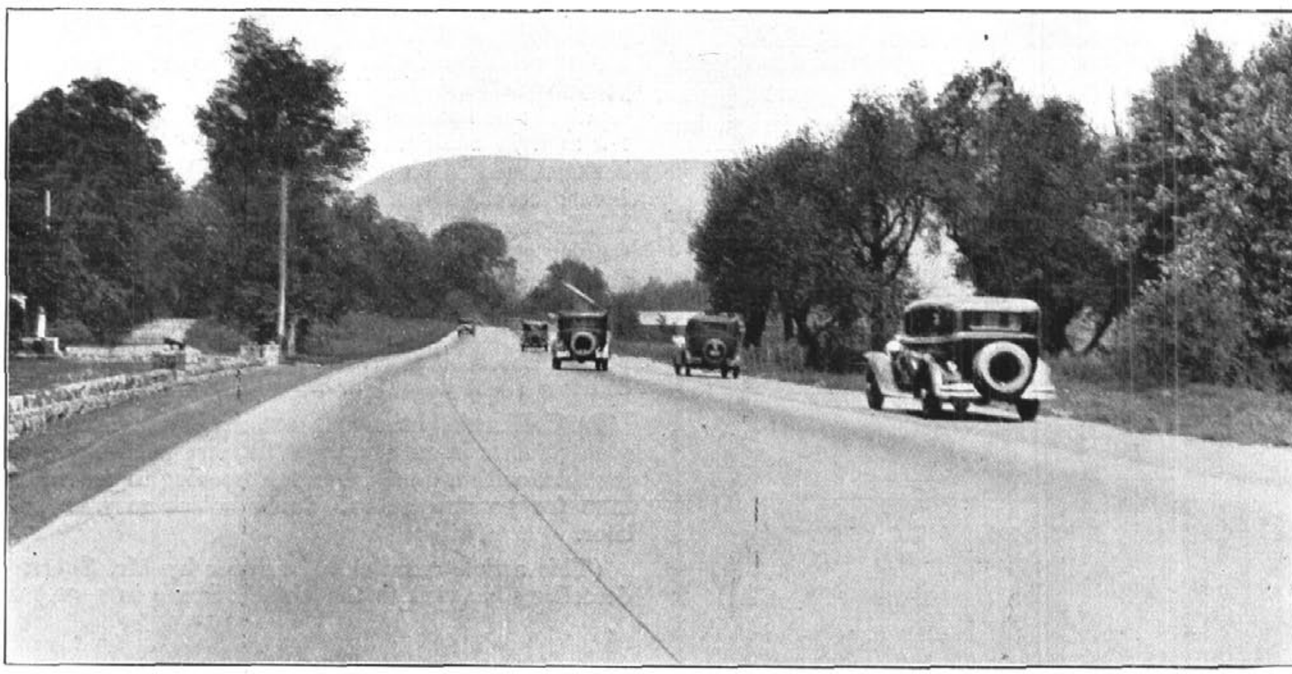
Patching and Minor Repairs of Tar and Asphaltic Roads.—In practically all State and county organisations, cold patching has superseded the older method of using hot material. In cities, however, portable hot-mixing plants are much used for patching. The usual practice by the States is to mix the material with a cut-back asphalt or a proper grade of tar at the district or sub-district depots, whence it is transported by truck and deposited in heaps along the road, or wherever required. The use of emulsions is increasing, but the relative cheapness of cut-back products is a bar to the very general use of emulsion. In England, however, emulsion is being extensively used, its peculiar advantage being the possibility of use during wet weather.

Cold or slightly heated materials for patching and reconditioning are generally mixed in an ordinary concrete mixer, arranged in conjunction with an elevated bin. Asphalt and tar are usually handled in bulk, tanks being installed at the mixing depot for holding a quantity to suit the method of delivery. Some form of modified heating arrangement is often installed to assist in the flow of material from these tanks.

A very efficient type of small, non-portable mixing plant was seen mixing a fine-graded pre-mixed macadam in Ohio. There was no screening or grading of the aggregates. The output was 100 tons per day and, with full mechanical handling of the material, it was possible to operate the plant with two men only (excluding unloading the stone from the railway trucks into the hopper). The cost of mixing (excluding materials) was 2s. per ton when the plant was in full operation.

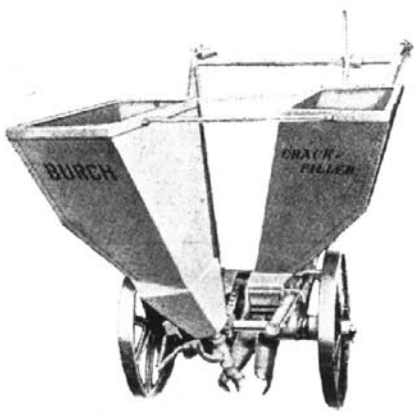
Salvaging and Reconditioning of Tar and Asphaltic Roads.—The most interesting salvaging work on bituminous roads seen was in Maryland, where concrete shoulders were being constructed and the old pavement resheeted with asphaltic concrete.

The bituminous work followed the usual practice in that asphaltic concrete (mixed by the State Highway Department) was used. Upon completion of the concrete strips on each side of the old pavement, a binder course of coarse-graded asphaltic concrete was laid to bring the surface to a uniform contour 2 inches below the finished surface level. Cement concrete, laid as part of the process of forming the concrete shoulder strip, was used to make good any weak or low spots along the edge of the existing foundations, the portion inside the shoulder line being levelled off 2 inches low to allow for the wearing course of asphaltic concrete. The advantage claimed for this, over the method of strengthening the foundation with the original material, was that adequate rolling of such areas was often impossible owing to the narrowness of the strip, and the work was expensive owing to the necessity of bringing material and a roller to do a small quantity of work, whereas concrete laid while the plant was working for the shoulder strips was relatively inexpensive. This method had been in successful use for several years.



An example of neatly filled joints in a concrete road,—a highway in Pennsylvania.

Light reconditioning, *i.e.*, the removal of unevenness, was usually effected by surface-treatment methods, a thin spreading of screenings being applied prior to the application of the bituminous material and dragged afterwards. In some States (Massachusetts and Connecticut) a light fluxing oil is applied (1/5 U.S. gall. per sq. yard) to a bituminous surfaced road and covered with sand, in order to soften the surface



A crack filling and covering machine for concrete roads.

and permit the removal of ripples by means of "honing" with a heavy drag. This is usually possible in about two days, after which an ordinary surface-treatment is given to the road. The extra cost of the softening and "honing" process is approximately ½d. per sq. yard.

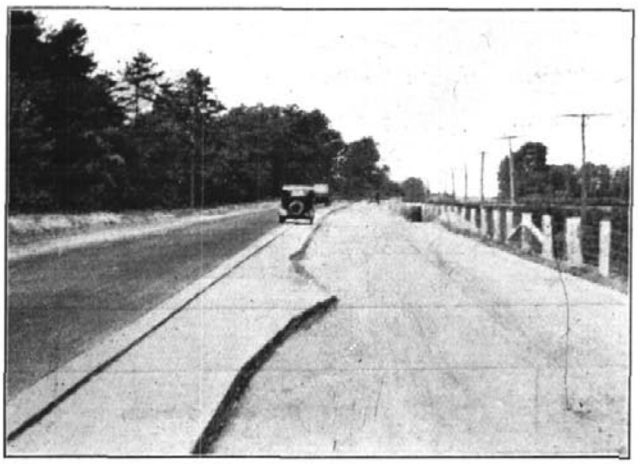
Cement Concrete Pavements.—The most striking impression given by a superficial inspection of cement concrete roads in the United States is the neatness of the joints and cracks. The thick strip of bituminous material extending out on each side of the joints, which is a conspicuous feature of concrete roads elsewhere, was usually absent, the joint-filling material being kept practically flush with the surface and extending out little more than the width of the joint or crack itself. As a result, practically no vibration could be felt from passing over joints. In many States, the longitudinal joint is masked by the traffic centre-line, which is most commonly marked in black. Edge-spalling at joints, even when the filling happened to be deficient, was absent, probably due to the negligible proportion of steel-tyred traffic. For the same reason, practically no surface wear of concrete pavements is experienced.

The main developments in the maintenance of concrete roads appear to be—

(i) The use of machines or specially designed appliances for attention to joints and cracks.
(ii) The organisation of the work to permit of the efficient use of these machines.
(iii) The use of the "hydraulic fill" method of raising sunken slabs.

Crack and Joint Filling.—The neat appearance mentioned above is due to the use in the construction of transverse joints of filling material which retains its ductility or "life" for a considerable time, and the use of thin-mouthed nozzles for pouring (either mechanically or by hand) the maintenance material into the joints. In the construction of the pavement, the transverse joint filler is cut off level, or only slightly above the surface, before the pavement is opened to traffic. The material squeezed up by the expansion of the slab is usually sufficient to keep the joint filled (at least on the surface) for one or two years after construction. Some authorities (notably Wayne Co., Michigan, which has developed concrete road maintenance to a very high standard) use a special crack-filling machine which directs a thin stream of filling material on to the joint, followed by a trickle of the covering material. Others have tried crack-filling machines, but, owing to the difficulty of filling irregular cracks, have resumed hand-pouring cans and, in most instances, use an ordinary coffee-pot. For the newer roads, with fewer irregular cracks and more straight joints, the scope was widening for the use of the joint-filling machine.

The material most commonly used for joint-filling is 85-100 pen. asphalt (which allows easier pouring than harder grades) or liquid asphalt, and sand, stone-dust or slag-dust (Wayne County) for covering the asphalt. Some States, however, do not sand their joints, while others mix mineral dust with the asphalt. No brushing of the material or spreading on each side of the joint was seen.



Widening the Washington-Baltimore boulevard, showing new asphaltic pavement on concrete base on the left. The concrete has been extended to junction with the old pavement on the right. The latter will be levelled with asphaltic mixture to bring it up to the concrete, and then the whole re-surfaced with asphalt. The step in the concrete to hold the top is shown parallel to the new work on the left.

Patching.—Repairs of fractured or subsided slabs occurring in Wayne County are effected temporarily with tar macadam made of ¾-inch gauge stone (crushed gravel) and a "cold-patch" grade of tar (Tarvia K.P.). This is mixed in an ordinary concrete mixer at the central depot and stored until required. Permanent repairs (which are carried out periodically when the volume of work justifies the sending out of a repair gang) are effected in cement concrete. Larger areas which have subsided slightly without serious fracture (such as the approaches to bridges) are resurfaced with Kyrock (Kentucky natural asphalt. Normally, the permanent patching of cement concrete pavements with other than cement concrete is not favoured.

(To be continued.)

Tenders and Quotations Accepted.

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

Work.			Name of Recommended Tenderer.	Amount of Recommended Tende
Shire or Municipality.	Road No.	Description.		
				£ s. d
Nymboida ...	12	Construction of reinforced concrete arch culvert over Frenchman's Creek.	Boulton and Caratti ...	947 0 0
Hay	6	Earth formation, 5,000 lin. ft.	W. J. Jackson ...	75 0 0
Coonabarabran ...	11	Clearing, forming, gravelling and culverts, Abbott's Gap deviation, 2 m. 1,140 ft.	Farley and Lewers ...	6,131 18 3
Manning	10	Construction of single-span timber bridge, Holey Flat ...	C. Fletcher	407 17 2
Tenterfield ...	138	Construction of seven-span low-level timber bridge over Mole River.	J. Gam	1,745 7 2

The following Tenders and Quotations were accepted by the Board during the month of December, 1931:—

Tenders.

Work.			Name of Sccessful Tenderer.	Amount of Accepted Tender.
Municipality or Shire.	Road No.	Description.		
				£ s. d.
Stockton	108	Re-surfacing with tar from Ross-street to Flint-street, 2,360 sq. yds.	B.H.P. By-Products Pty. Ltd.	72 17 0
Cobbora	7	Construction of a single span timber beam bridge over Pile Creek.	Wallace and McGee Ltd.	789 15 7
Erina	10	Supply and delivery between 8 m. and 12 m. of 3,000 cubic yards of gravel from the Erina Shire quarry.	J. Clayton	9s. 5d. per cubic yard.
Muswellbrook ...	9	Supply and delivery of 1,000 cubic yards of gravel, between Muswellbrook and Aberdeen.	T. H. Tucker	3s. 5d. per cubic yard.
Ryde	200	Delivery of coal from Ryde railway station to Ryde ferry for 12 months, as required.	G. E. Gill	2s. per ton.

Quotations.

No. of Quotation.	Description of Article.	Name of Successful Tenderer.	Amount of Accepted Quotation.
			£ s. d.
87	Coal, delivered at Coraki ferry, 68 tons	Excelsior Collieries and Coke Works, Ltd.	128 1 4
98	Tar, delivered in railway tank waggons in county of Cumberland, 36,900 gallons.	De Meric, Ltd.	960 18 9
	Tar, sprayed on Main Road No. 315, between Cook's River Bridge and Hurstville boundary, 6,000 gallons.	John Fowler (Aust.), Ltd.	200 0 0
100	Coal, delivered at Grafton ferry, 140 tons	Excelsior Collieries and Coke Works, Ltd.	253 3 4
102	Sand, f.o.r. Board's siding, Rosehill, 500 tons	A. Miller	129 3 4
103	Bridge timber, f.o.r. Inverell, decking, 4 in. thick, 8–10 in. wide, in lengths of 28 ft. 10 in., 4,500 super. feet.	H. Walters	71 2 6
104	Bridge timber, delivered to Hinton Bridge, 17 in.–19 in. dia. at small end, 33 ft.; 7–10 in. wide, 4 in. thick, 20 ft. lengths, 8,000 super feet. Delivered to Morpeth Bridge, 14 in. x 13 in., 212 ft.; 12 in. x 8 in., 684 ft.; 4 in. thick, in 19 ft. 6 in. lengths, 3,900 super feet.	Turner & Ebbeck	262 13 6
106	Tar, No. 2, sprayed on Pacific Highway near Gosford, 200 gallons.	Bryant & Buchanan, Ltd.	75 0 0
107	Tar, No. 2, sprayed on Pacific Highway north of Wyong, 3,080 gallons.	B.H.P. By-Products Pty., Ltd.	128 6 8
108	Slag, $\frac{3}{4}$ in. to $\frac{1}{4}$ in., 160 tons	B.H.P. By-Products Pty., Ltd.	44 0 0
109	Blue metal, $\frac{3}{4}$ in., 350 tons	State Metal Quarries	74 7 6
110	Blue metal, $\frac{3}{4}$ in., 400 tons; $\frac{5}{16}$ in., 450 tons	Emu & Prospect Gravel & Road Metal Co.	205 8 4
111	Tar, sprayed on Pacific Highway south of Mooney Creek Bridge, 18,000 gallons No. 2, 12,000 gallons priming tar.	Bryant & Buchanan, Ltd.	1,125 0 0
112	Bridge timber, delivered to Wharton's Creek Bridge, Bulli, 16 in. min. dia. at small end, 120 feet; 8 in. x 8 in., 48 feet; 5 in. thick, 8–10 in. wide, in 24 feet lengths, 2,880 super feet.	Eades & Co.	74 0 0
114	Crushed gravel, $\frac{3}{4}$ in., 378 tons; $\frac{5}{16}$ in. 252 tons...	Emu & Prospect Gravel & Road Metal Co.	152 5 0

Sydney: Alfred James Kent, I.S.O., Government Printer—1932.