1959-60

VICTORIA

COUNTRY ROADS BOARD

FORTY-SIXTH ANNUAL REPORT

FOR YEAR ENDED 30TH JUNE, 1959

PRESENTED TO BOTH HOUSES OF PARLIAMENT PURSUANT TO ACT No. 6229.

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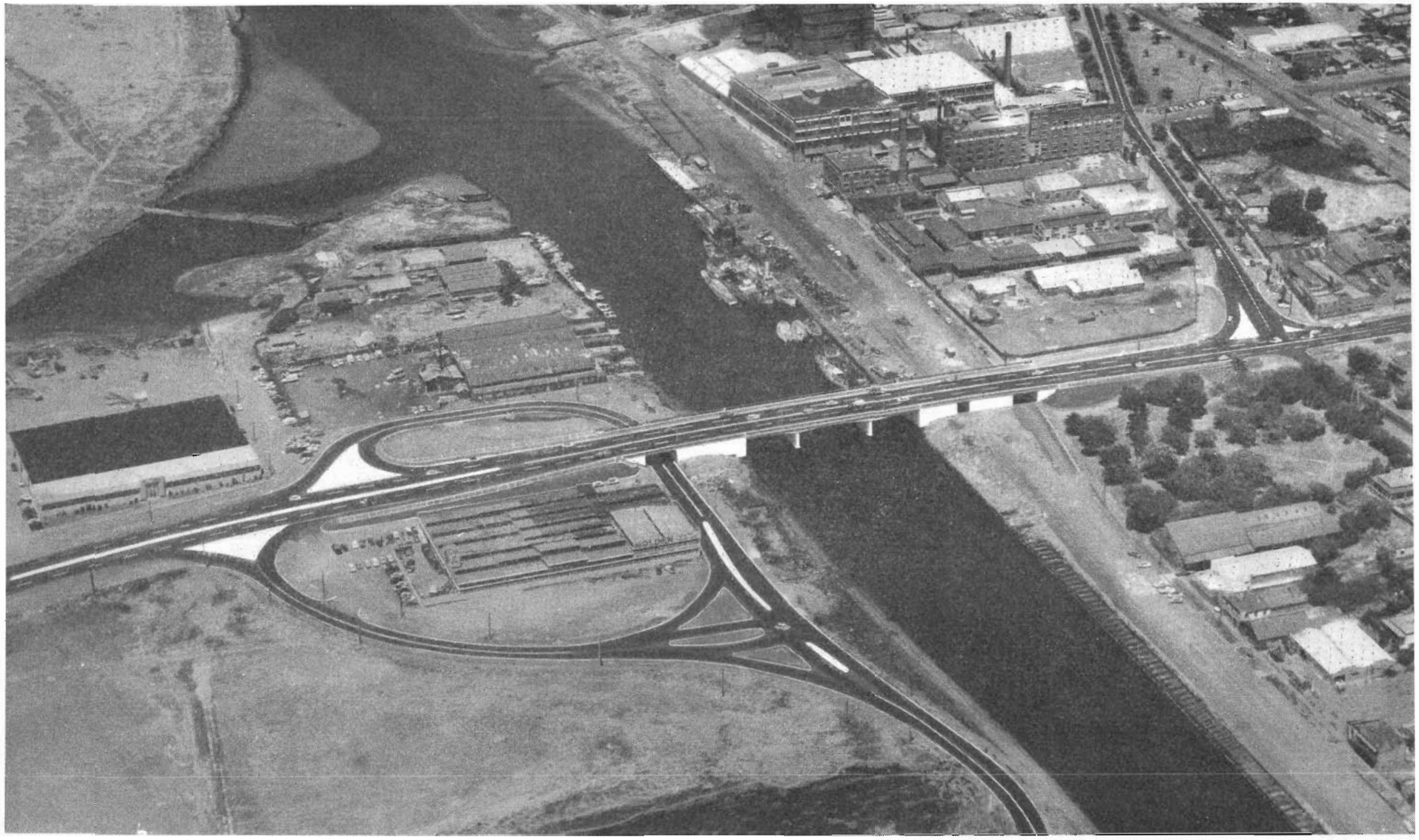

FRONTISPIECE : Napier Street Bridge over Maribyrnong River.—Cities of Melbourne and Footscray.

[**COVER :** Eildon–Jamieson Road under construction. Scarifying rock].

COUNTRY ROADS BOARD

FORTY-SIXTH ANNUAL REPORT, 1958-59

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COUNTRY ROADS BOARD

FORTY-SIXTH ANNUAL REPORT

Exhibition Building,
Carlton, N.3.
27th November, 1959.

The Honorable Sir Thomas Maltby, E.D., M.L.A.,
Minister of Public Works,
State Public Offices,
Melbourne, C.2.

SIR,

In accordance with the requirements of Section 128 of the *Country Roads Act* 1958, No. 6229, the Board has the honour to submit to you for presentation to Parliament, a report of its proceedings for the year ended 30th June, 1959.

1. PROGRESS SINCE 1913.

Roads in Victoria in 1913, when the Country Roads Board began as the State Road Authority, were very different from the facilities for road transport existing in Victoria to-day.

When introducing the first Country Roads Bill into the Legislative Assembly in 1912, the Hon. H. McKenzie stated with reference to the Board: "Its first duty will be to make a thorough investigation into existing highways so that it may have the materials on which to ensure sound judgment." The Board's early Annual Reports set out how these investigations formed the basis of a considered plan for the road system of the State. To-day Victoria's declared road network of 3,845 miles of State highways, 9,754 miles of main roads, 415 miles of tourists' roads and 378 miles of forest roads attracts one-third of Australia's motor traffic. These primary roads together with the 80,000 miles of subsidiary roads and streets are used by 760,000 motor vehicles registered in Victoria as well as by increasing numbers from other States.

In 1913 there were no bituminous surfaced rural roads and few even in urban areas. Now, largely due to the Board's concentrated effort in providing special mobile spraying equipment, the State has 14,775 miles of sealed road surfaces. More than 5,000 bridges have been erected under the Board's jurisdiction. Many hundreds of miles of developmental roads have been constructed to open up Crown Lands or effect re-settlement or closer settlement of alienated lands. Whilst early efforts were directed to the provision of local roads leading from the farm to the market or to the nearest railway station the necessity for linking roads within wider regions was very quickly realized, so that to-day the network of roads as a whole is available for use by private owners and tourists, by transport organizations, and by primary and secondary industrial enterprises.

In the more recent post-war period, during which factory industries in Victoria have expanded so as to produce something like forty-two per cent. of Australia's manufactured goods, the quota of industrial traffic over the Board's declared roads as well as on many subsidiary roads has increased to a degree necessitating substantial and costly reconstruction of many sections. The volumes of traffic concentrated on such sections result in very serious congestion of the old two-lane pavements so that two additional lanes have to be provided or in some cases the entire road must be reconstructed or a new road built in a new location.

PRINCES HIGHWAY EAST.

Plate 1.—Princes Highway East at Oakleigh. Duplicated Pavement with Median.

Plate 2.—Princes Highway East. Intersection with Springvale Road.

Projects of this type take time to plan and construct. In many cases the purchase of land to widen the road is a necessary preliminary step. It has not been possible to make progress with this class of project at the rate envisaged in the Board's ten-year " target " plan, but the stages of duplication effected on the Princes Highway between Oakleigh and Dandenong (Plates 1 and 2) and on the sections of divided four-lane road totalling 20 miles now in use between Footscray and Norlane (Plates 3, 4 and 5) serve to demonstrate to all road users the kind of road facilities which it is so necessary to build for to-day's traffic. The Clifton Hill railway overbridge on the main Heidelberg Road at the intersection with Hoddle Street, including two special turning ramps, provides another object lesson indicating the kind of intersection treatment which has to be built into a modern high-capacity freeway (Plate 6). Similar provision is also being incorporated in the Maribyrnong River Bridge at the intersection of Napier Street and Sims Street.

While these concrete examples of up-to-date treatments are all too restricted in extent a good deal of progress is being made in planning further examples which should materialize in the next five years. As the urban areas affected by industrial development are spread throughout the State and not confined to the metropolitan area there are many instances where in the post war period the Board in conjunction with the councils concerned has undertaken extensive reconstruction of inadequate streets of various categories. A notable example is the reconstruction of the section of the Hume Highway in High Street, Wodonga, and the commencement of the costly duplication of the two-mile section of bridges and embankments connecting Wodonga and Albury.

Plate 7 is a reproduction of a photograph which appeared in the Board's First Annual Report showing sections of the Melbourne to Geelong Road. One of the early tasks undertaken was the complete reconstruction of this road as a permanent work at a cost of approximately £100,000. After forty years of service it became necessary to duplicate the carriageway, a project which, including the new four-lane by-pass of Werribee, is scheduled for completion in 1962. It is instructive to compare Plate 7 with Plates 3, 4 and 5 showing sections of the road after conversion from the single carriageway of two lanes to a modern four-lane divided roadway catering for a traffic density exceeding 5,000 vehicles a day.

Traffic exceeding 20,000 vehicles a day is accommodated on the duplicated roadway between Oakleigh and Dandenong, a section which has now grown to be the most heavily trafficked State highway in the State. The traffic has nearly trebled in seven years. It has in fact become necessary to put in hand an extension of the duplication to the new industrial area of Doveton. Similar urgent projects are also being undertaken progressively on sections of other State highways and numerous main roads.

It is well that some progress on these lines can be reported. Meanwhile, however, the community is relying more and more on road transport, chiefly of short-haul character, but including an increasing quota involving longer journeys. Studies of present traffic trends make it quite clear that duplication should be proceeding at a rate of the order of 100 miles a year instead of the present rate of less than 20 miles a year. Roads being duplicated to-day will need additional lanes within eight years. New routes of by-pass road or " freeway " type must also be planned and commenced to relieve routes where traffic is already becoming intolerably congested. The next ten years is likely, in fact, to require a considerably greater effort than has been applied to the road network in the whole of the past forty-six years.

2. " TARGET " ROAD PROGRAMME.

The results of the survey undertaken during the previous year by the Board's Engineers in collaboration with Local Government Engineers throughout the State were made available in a brochure entitled " Ten Year Target Road Programme for Victoria 1958 ". The survey was carried out on a systematic detailed basis, estimates being prepared of the cost of the necessary works in each of ten successive years, mile by mile, covering the whole of the arterial and rural roads of the State. Allowance was made for expenditure in urban areas, in Government housing estates, State forests, &c., the total requirements for the ten-year period being £400,000,000 including some allowance for separate expenditure on metropolitan main roads.

The finance now in view available to the various responsible authorities still falls considerably short of this target, necessitating corresponding delay in its achievement. The community will thus be obliged to pay a considerably greater total cost than it would if improvements were carried out at a rate designed to keep pace with traffic requirements.

PRINCES HIGHWAY WEST.

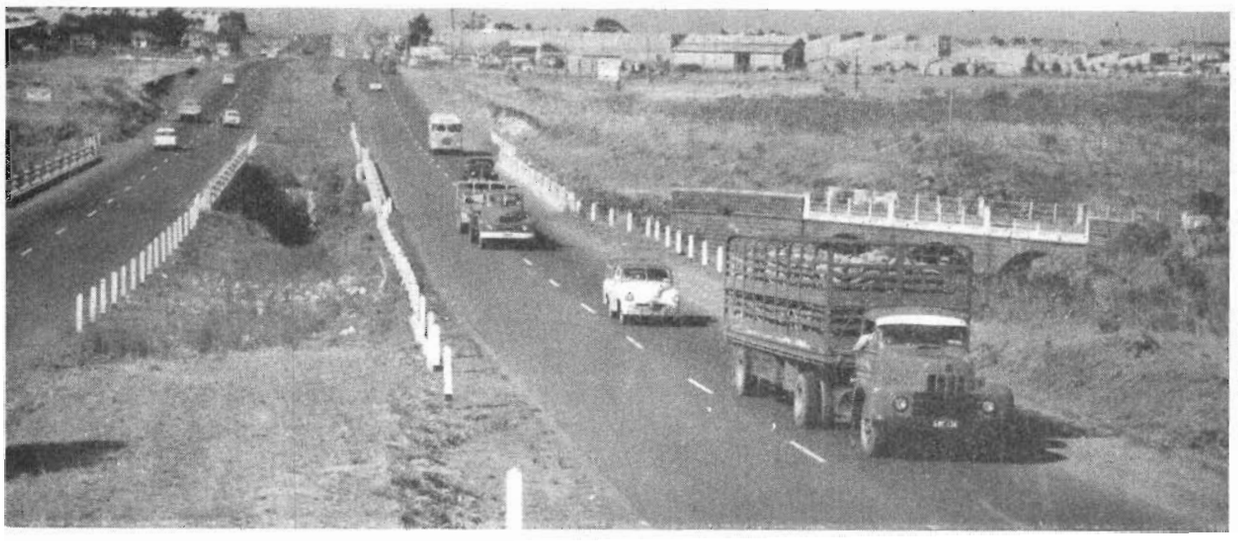

Plate 3.—Princes Highway West. Dual Bridges over Kororoit Creek. (Old Bridge at right).

Plate 4.—Princes Highway West. Duplication south of Kororoit Creek.

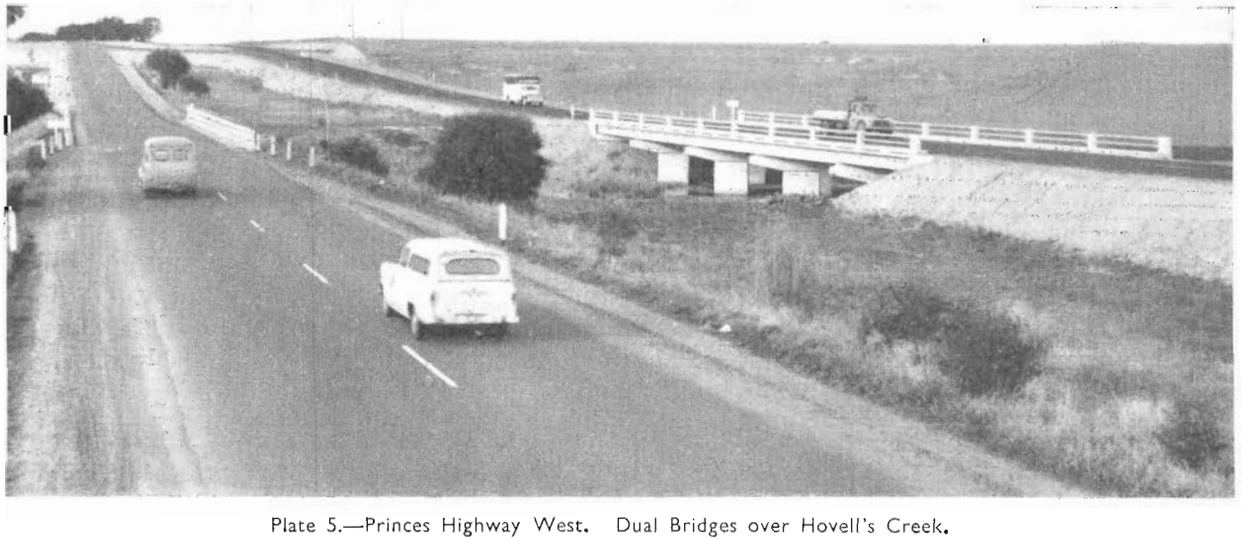

Plate 5.—Princes Highway West. Dual Bridges over Hovell's Creek.

MAIN HEIDELBERG ROAD.

Plate 6.—Main Heidelberg Road. Clifton Hill Railway Overpass showing turning lanes to connect with Hoddle Street.

OLD MELBOURNE–GEELONG ROAD.

Plate 7.—Melbourne–Geelong Road. As shown in 1st Annual Report (compare plate 3).

That cost will be hidden in numerous items of wastage relating to vehicle operation and upkeep and to loss of production in industry, avoidable damage to life and property and to patching the roads themselves. More than ever before the requirements of primary production, of industrial development, and of every type of inter-communication of goods and persons depend upon the adequacy of the road network and call for a progressively intensified programme of its modernization and systematic maintenance.

So far as the primary roads as declared by the Board are concerned the position may be shown as follows :—

—	1957–58.	1958–59.
	£'000.	£'000.
Actual expenditure	10,890	11,581
Expenditure required by ten-year plan	14,100	14,500
Value of necessary work not done owing to shortage of finance	3,210	2,919

Thus the effort being made to cope with requirements should be increased by at least 25 per cent. to achieve the target.

3. WORKS PROGRAMME 1958–59.

Planning of the programme of works to be undertaken during a financial year is commenced during the last quarter of the preceding year by which time the major part of the previous programme has been accomplished. Applications for works on the various categories of roads are prepared by the Board's engineers and by municipal councils according to whether the roads are under the Board's direct control or are under council supervision or jurisdiction. For the Board's declared roads items of maintenance naturally take priority. In most cases those responsible indicate any desired priorities for items of improvement. Construction works on unclassified roads are always set out by councils in order of priority.

Knowledge gained by the Board itself in travelling around the State on systematic inspections with councils and with its engineers is invaluable in securing appropriate priorities as between the many thousands of individual items of works of widely diversified type. The allocation of funds for the various parts of the programme is based on estimates of the income to be received during the ensuing year, and of actual commitments and and approvals held over from the previous year, together with a similar " carry over " into the next financial year. Many items such as bridge works commenced in a particular year extend into the next and sometimes into succeeding years, the rate of progress varying with local circumstances. In this way and by reason of the unavoidable necessity for uninterrupted maintenance, sufficient works are generally on hand at the 30th June each year to occupy construction, maintenance and contracting forces until the new programme is made available. The spread of work over several years and the presentation of lists of projects in order of priorities generally lead to applications considerably in excess of the amount which the Board can allocate in one year. Similarly expenditure within any year is generally somewhat less than the allocation. This is indicated in the following summary :

AMOUNTS IN £'000S. ALL WORKS.

—	1957–58.	1958–59.
Applications	32,878	39,204
Allocations	19,780	20,042
Expenditure	14,302	15,003

Plate 8.—Stawell–Warracknabeal Main Road Deviation by-passing Sheep Hills.

Plate 9.—Shire of Bairnsdale.—Bullamwaal Main Road approximately 7½ miles from Bairnsdale. Reconstruction in progress.

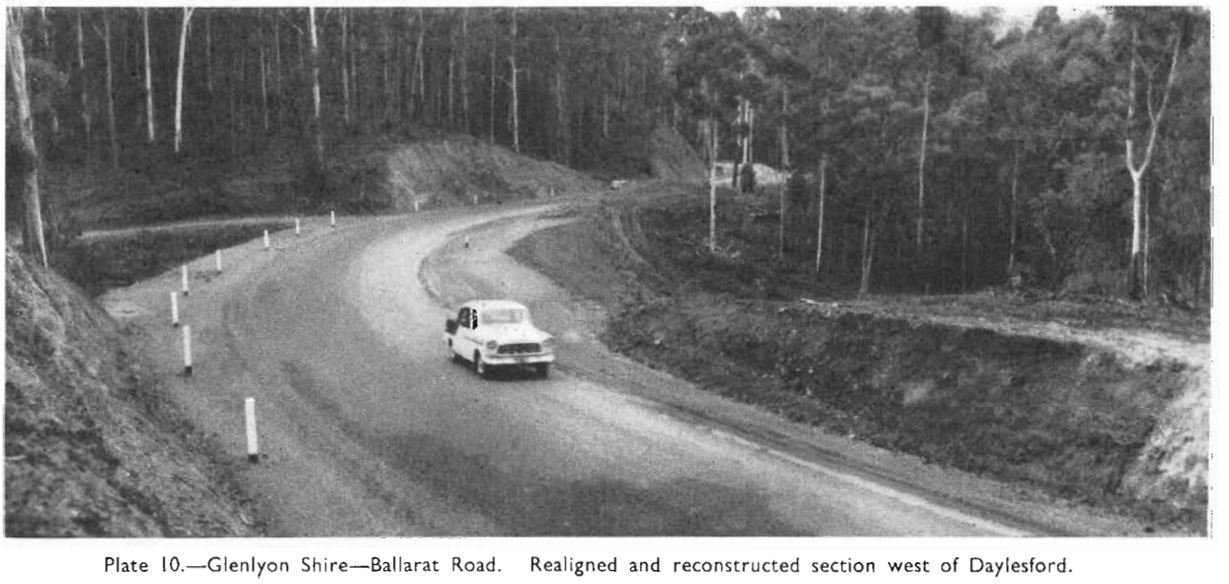

Plate 10.—Glenlyon Shire—Ballarat Road. Realigned and reconstructed section west of Daylesford.

The allocation of £20,042,757 was made up of £12,849,019 intended to be met from the Country Roads Board Fund, £7,118,675 provided from the Commonwealth Aid Roads revenues and £75,063 from Loan.

Main Roads.—For works of maintenance and improvement on 9,789 miles of "declared" main roads the total amount applied for by 195 municipal councils and in special cases by the Board's engineers, the total allocations made and the actual expenditure for the year are shown in the following summary. Particulars for the previous year are shown for comparison, together with relevant percentages indicative of the extent of "carry-over" inherent in planning and executing works:—

AMOUNTS IN £'000s. MAIN ROADS.

—	1957–58.	1958–59.
	£	£
A. Applications	12,111	14,207
B. Allocations	7,972	7,732
C. Expenditure	5,343	5,527
B as percentage of A	65·9%	54·4%
C as percentage of B	67·0%	75·4%

Plates 8 to 14 illustrate some of the types of work done on main roads.

State Highways and By-pass Roads.—Works on the 3,845 miles of State highways are dealt with in a later section of this report (see Page 21). These works except where purely local traffic is provided for are financed by the Board without cost to the municipalities, as is true also of by-pass roads and proclaimed tourists' roads and forest roads. Planning of a number of by-pass roads is in progress but construction work on by-pass roads is only just commencing, a contract having been let for the 0.75 mile of the Whitelaw By-pass Road and a start made with bridge works on the Werribee By-pass Road.

Tourists' Roads and Forest Roads.—Works on the 415 miles of proclaimed tourists' roads are generally carried out under the direct supervision of the Board, the sum of £606,430 being allocated for necessary maintenance and a limited programme of improvements. For works on the 378 miles of proclaimed forest roads the total allocation was £211,246.

Plates 15 to 18 illustrate some of the improvements undertaken.

Unclassified Roads.—There are throughout the State some 80,000 miles of unclassified roads and streets under municipal jurisdiction. The Board assists in works of construction and maintenance on these roads, the necessary finance being provided from the appropriate portions of Commonwealth Aid Funds depending on whether the works are in rural or urban areas. The allocations and expenditure shown in the following table relate to the financial assistance provided by the Board apart from the councils' contributions:—

AMOUNTS IN £'000s.

—	1957–58.	1958–59.
Construction—	£	£
Applications (totals)	9,102	11,221
Allocations (C.R.B. portion)	4,423	4,579
Expenditure (C.R.B. portion)	2,737	2,745
Maintenance—		
Applications (totals)	1,387	1,449
Allocations (C.R.B. portion)	602	613
Expenditure (C.R.B. portion)	561	593

Typical works undertaken are illustrated in plates 19 and 29.

Plate 11.—Omeo Shire.—Ramrod Flat Road. Recently sealed section. Connor's Hill deviation.

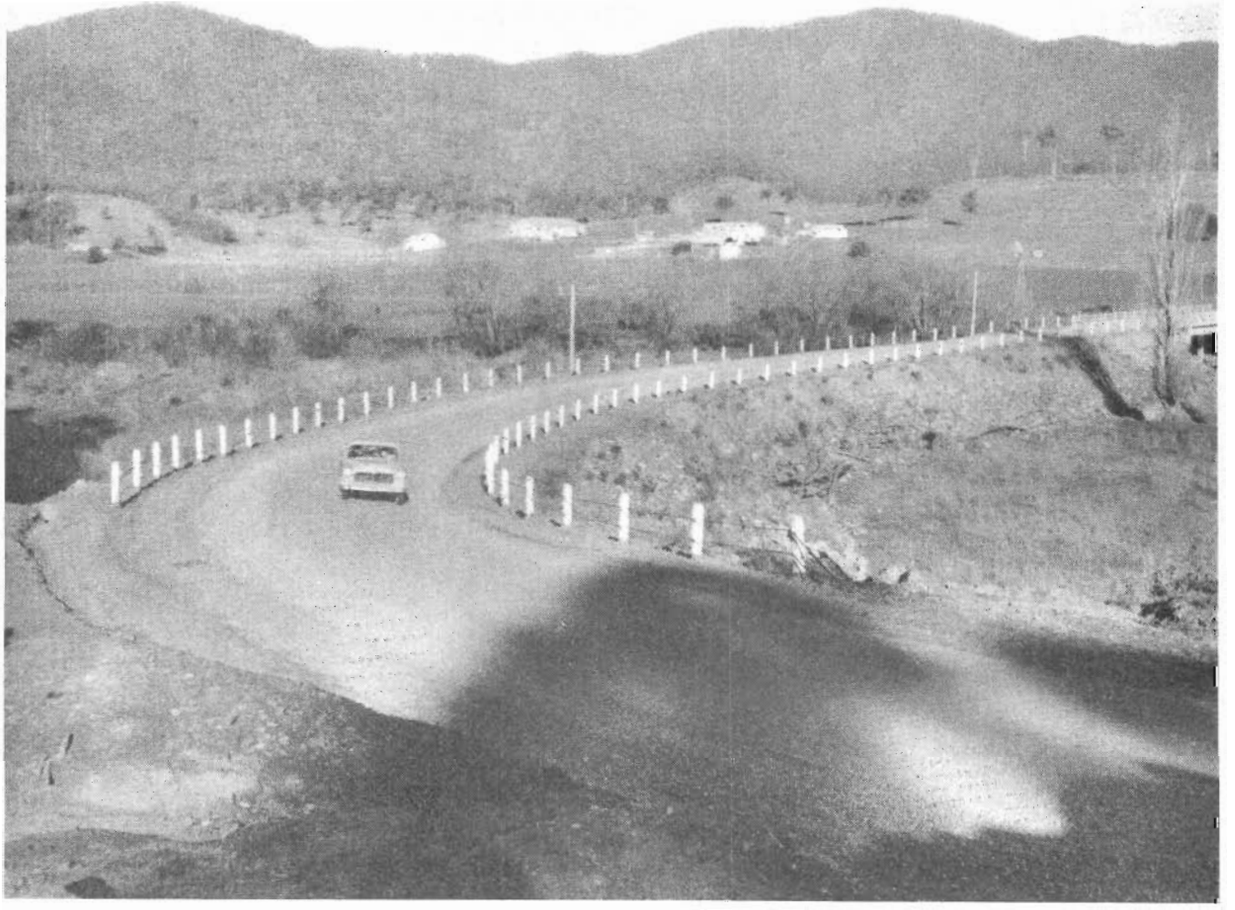

Plate 12.—Mansfield Shire.—Mansfield–Wood's Point Road. Reconstructed section at Howqua River.

FOREST ROADS.

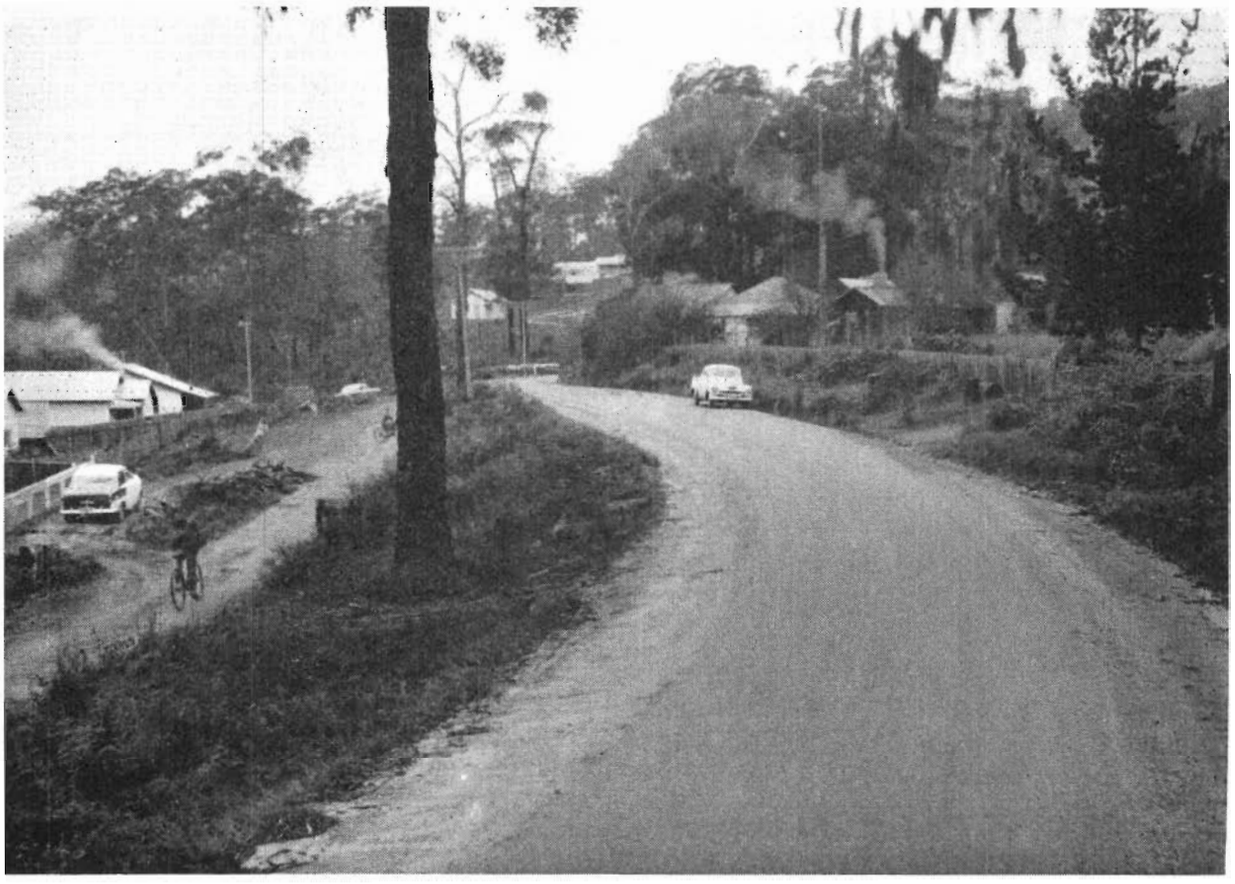

Plate 13.—Orbost Shire.—Combienbar Road. Bituminous sealed section in Club Terrace Township.

Plate 14.—Narracan Shire.—Walhalla Road. Deviation showing deep cutting 2 miles north of Moe.

TOURISTS' ROAD.

Plate 15.—Mt. Victory Road. Reconstruction in progress west of Wartook Road.

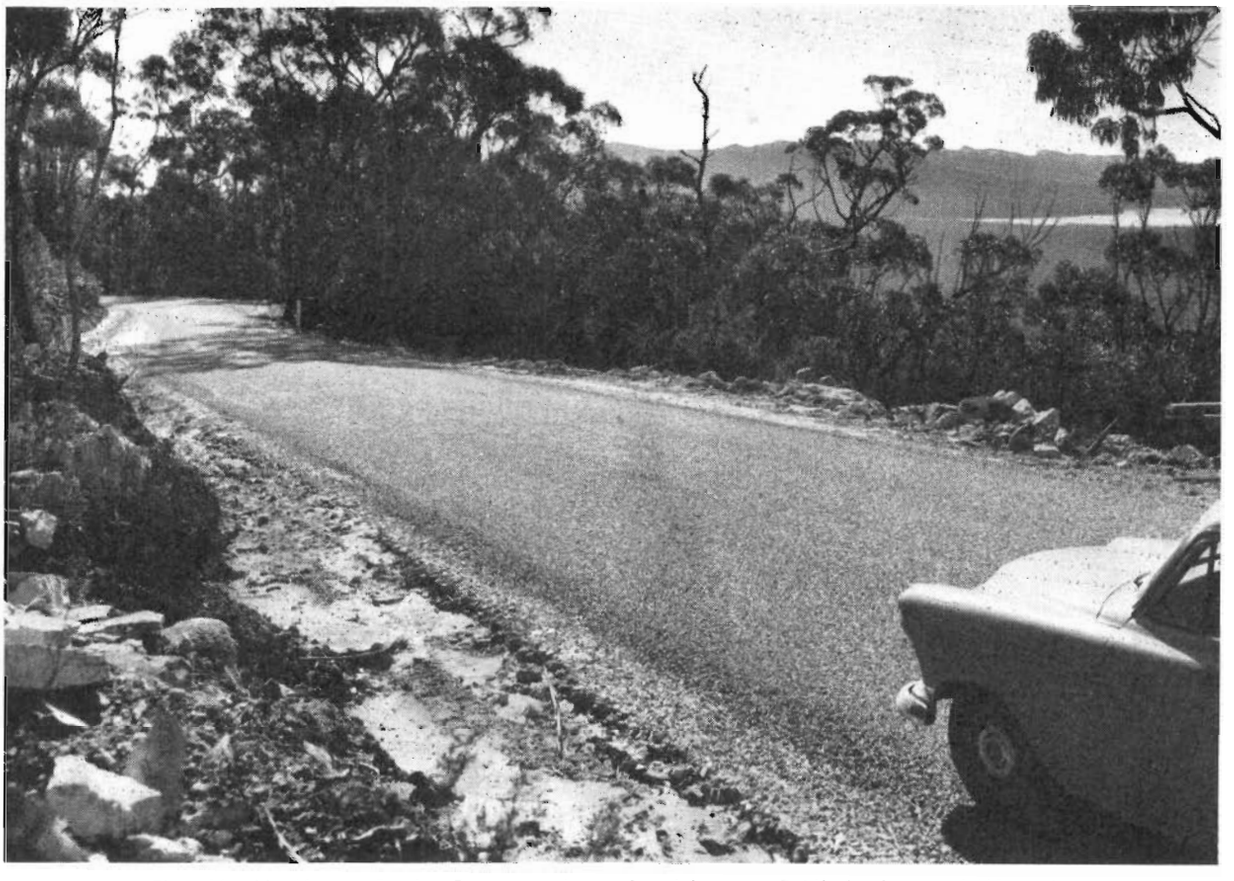

Plate 16.—Mt. Victory Road. Reconstruction and seal between Reid's Lookout and Wartook.

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4. SHARING OF BENEFITS AND COSTS.

Roads benefit those whose vehicles operate over them, the landowners whose properties they serve and the community as a whole. Road costs should therefore be shared in some manner between these three groups.

Road-users' and Ratepayers' Shares.—The replacement of horse-drawn transport by motor vehicles with greater operating range was one of the factors which led in 1913 to the establishment of the Country Roads Board in Victoria and of similar special road authorities in other States in subsequent years. The new medium of transportation and communications soon became the means of great development of rural lands, with corresponding enhancement of land values and gradual increase in rate revenues. Road transport is not however confined to the roads of any one municipal district, nor is the enhancement of land values confined to properties immediately adjoining a road. Land in market townships and indeed in the larger provincial centres and in the metropolitan area itself inevitably increases in value by reason of public expenditure on the development, improvement and maintenance of the roads as a whole.

The original terms of the Country Roads Act provided broadly for half the cost of maintenance of main roads to be borne by the councils affected and half by the Country Roads Board Fund derived from taxation of motor vehicle owners and drivers, i.e. from "road-users". What the appropriate proportions are in which road costs should be divided between ratepayers, road users, and the general taxpayer is a subject which has called forth many theoretical studies by road authorities, associations of road users, and other advisers of legislators in every country where motor transport has become a dominant factor in the progress and development of the community. However, no simple formula has been devised to cover every case, and it has been necessary to resort to somewhat approximate methods when legislators in Victoria, as elsewhere, or the administering authorities themselves, have been confronted with the problem of defining the principles to be followed in providing the means by which works on the roads as a whole, or on particular statutory groups of roads, are to be financed.

In 1924, Parliament deemed it expedient by an amending statute to reduce the maximum proportion of main road maintenance expenditure to be borne by municipal councils from one-half to one-third. Again in 1926, the Board was empowered to recommend the declaration of a new class of road known as "State highways", the maintenance of which was to be undertaken by the Board without municipal contribution. Whilst the earlier statutes provided for developmental roads to be maintained after construction entirely at the cost of the councils, the provision of special (Federal-aid) funds made it possible a little later for some contribution to be made by the Board to assist councils in this responsibility. This latter principle has subsequently been extended to apply to the general network of subsidiary roads whether originally constructed as developmental roads or otherwise. Relief has also been afforded to the councils concerned in respect of their proportion of the burden of interest and sinking fund charges on loan expenditure on both main roads and developmental roads. In addition, very substantial assistance from the special funds is provided year by year, for the construction and re-construction of many sections of unclassified roads.

The Country Roads Act also entrusts the Board with the responsibility of recommending which roads should be brought within the terms of the statute in various categories of main roads, State highways, by-pass roads, tourists' roads and forest roads. Inasmuch as declaration of any of the four latter classes of road involves remission of further contribution from the councils concerned, notwithstanding the local benefits which the improvement of these roads confers, it becomes a matter of judgment to determine what proportion each council shall bear of the cost of other road works in which such municipalities still participate in co-operation with the Board. On this account and also because the works which are necessary in a particular area vary with the character of local and regional developments, including (it may be for two or three years) large works of a non-repetitive nature, it is scarcely possible, nor would it be in the best interests of the State, to adopt an arbitrary or inflexible quota system. The preparation of the "Ten Year Target" Programme has, however, afforded one quite useful means of assessing the true requirements for further works in a particular district.

The statute contains other more detailed guiding principles to be observed by the Board in apportioning to municipalities their contribution towards main road maintenance expenditure. While the municipal contribution may not, in any case, exceed one-third

FOREST ROADS.

Plate 17.—Walhalla Road. Reconstructed, realigned and sealed section near Watson.

Plate 18.—Korong Shire.—Inglewood–Rheola Road. Reconstruction and sealing.

UNCLASSIFIED ROAD.

Plate 19.—Orbost Shire. Tamboon Road. Reconstruction and seal near Cann River Township.

it may be reduced below one-third where the cost of maintenance of a road is deemed to be excessive, and where such cost is due to motor traffic not of local origin, or to timber traffic. In dealing with the apportionment of the cost of works, the Board must take into account the revenue, valuation, and rating of the municipality concerned. From the application of this provision municipal contributions towards main road maintenance have in most cases been reduced below one-third. Furthermore, for larger items of works portions of the grants have been made from Commonwealth Aid Road moneys, free from additional contribution by the councils. The effects of these various reductions and of the complementary grants are indicated in the following summary of main roads expenditure :—

—	1956–57.	1957–58.
	£	£
Expenditure from the Country Roads Board Fund on main roads ..	2,684,694	3,985,049
Expenditure from Commonwealth Aid Road moneys on main roads ..	800,540	1,066,260
	3,485,234	5,051,309
Amount apportioned to councils (based on expenditure from Country Roads Board Fund only) to be repaid to Board in following year	542,651	663,738
	%	%
Percentage of amount apportioned to the total expenditure from the Country Roads Board Fund..	20·21	16·66
Percentage of apportionment to total expenditure (including Commonwealth Aid Roads grants)	15·57	13·14

If the whole of the expenditure for 1957–58 had been financed from the Country Roads Board Fund and apportioned strictly on a one-third basis, the councils would have contributed one-third of £5,051,309, that is £1,683,770 whereas the contributions actually required amount to £663,738 only, a reduction of £1,020,032. In applying these principles item by item on main roads, this very flexible method enables the Board to make financial adjustments appropriate to necessary variations in the volume of improvement works from place to place and from year to year and to make allowance for any special local circumstances.

It should be noted that main road expenditure in any financial year is charged in the first instance to the Country Roads Board Fund and the amount apportioned to the councils is not repaid by them to the Board until the following financial year. As there has been a marked trend for increase in expenditure year by year the percentage of municipal contributions to the expenditure in the year in which it is paid is usually less than the percentages indicated in the above summary. The amount apportioned to the councils in respect of expenditure in 1957–58 was, in fact, only 12·4 per cent. of the expenditure in the year 1958–59 when the repayment was actually made. When allowance is also made for the Board's expenditure in 1958–59 on State highways, by-pass, tourists' and forest roads on the one hand and for the councils' contributions to construction and maintenance works on unclassified roads on the other, the total contributions made by councils in the same year towards the road programme as a whole totalling £14,317,000 amount to only £1,639,000, i.e., less than 9 per cent.

General Community's Share.—Over the years the general revenue of the State has been used very sparingly and indeed only in emergencies to contribute to the cost of road works. It is quite a sound and logical policy to set aside taxes derived from road users who directly benefit as the chief source of finance for maintenance and even much of the reconstruction of the roads. An important feature of the early road programme undertaken by the Board soon after its inception was the application of loan moneys to pay for more permanent improvements on main roads and shortly afterwards on developmental roads; the total expenditure under these headings being £6,885,972 and £6,425,758 respectively. The loans were originally raised by the States generally on the basis of repayment over a period of 31½ years; but following the proclamation of the *Commonwealth and States Financial Agreement Act* 1927, the period of repayment was extended to 53 years.

At the outset the municipalities were required to accept liability for half the loan expenditure on main roads and portion of interest payments on developmental roads, but subsequently by amending statutes their remaining indebtedness was transferred to the Board, i.e., to be financed from "road-user" taxation. Loan expenditure has more recently been incurred for permanent works on State highways and in the metropolitan area in an endeavour to make up at least a little of the leeway in road improvement in these categories and to eke out revenues which had become increasingly inadequate in times of rapidly rising costs and with ever-increasing volume and weight of traffic.

From the inception of the Board to 30th June, 1959, interest and sinking fund charges paid by the Board have amounted to £14,907,839 including payment of £862,583 in 1958–59. There is no doubt that the works represented by the loan expenditures of £18,958,253 contributed very greatly to the productivity of the State as a whole. For water supply and railway developments which have made similar contributions a major portion of the interest and sinking fund charges has been transferred to consolidated revenue. The Board has previously suggested that similar action would be appropriate in respect of road works. Finance would thereby be released which could be applied by the Board in further road improvements actually to the benefit of the general economy of the State.

5. STATE HIGHWAYS.

The State highway system consisting of 3,845 miles has been developed to link important centres or regions of the State and to connect with similar systems of roads in the adjoining States. In order to function effectively, the system should be adequate and serviceable under all climatic conditions with safety to road user and pedestrian alike and with minimum congestion and attendant economic loss. The system should be constructed and developed to reduce maintenance charges to a minimum and enable a high proportion of available funds to be employed in the improvement of the existing mileage to cater for expanding or changing needs and ultimately to permit of some extension to include other important links.

The stage has now been reached when 3,344 miles of State highways have a bituminous or other dust free surface, leaving 501 miles, or approximately 13 per cent., still to be improved to that desirable state. Several sections of important interstate highways are still subject to serious flooding, while sections of other State highways having weak pavements are subject to load limitations. Many miles of existing bituminous pavements on most of the State highways are below the minimum width considered to be required for the traffic which is at present using them. On the more heavily trafficked sections of State highways radiating from Melbourne, and on short sections elsewhere, multi-lane facilities are required for the efficient handling of present and future traffic.

The programme of work carried out during the year was designed to provide in the first place for the effective maintenance of the State highway system, and secondly to carry out improvements and to advance towards the objectives set out above. In the routine road maintenance operations of the Board approximately 420 men operating from about 80 centres and equipped with motor trucks and necessary items of plant are continuously employed. Apart from the routine patrol maintenance carried out by this organization the principal maintenance operation consists of bituminous resealing of existing surfaces, a total length of 276 miles being thus treated in 1958–59. This work is carried out for the most part by C.R.B. teams with specialized plant as described in more detail elsewhere in this report.

Many sections of State highways were widened, strengthened and improved by realignment of horizontal curves and improvement of visibility in localities scattered throughout the State. Projects of this nature numbered about 150 and resulted in the improvement of 260 miles of the State highway system. While many of these projects were unspectacular as to size and scope their completion has resulted in a material improvement in travelling conditions. Duplication of densely trafficked sections between Melbourne and Dandenong and Melbourne and Geelong was mentioned earlier in this report. Typical items of other large works are briefly described below.

A 10-mile deviation was commenced on the Princes Highway East during the year between the McKenzie River and Cann River to replace the very tortuous and narrow section each side of Club Terrace and shorten the route length of this highway by 4·9 miles (Plate 20). On the same highway projects were commenced comprising bridges and embankments to raise the road above the floodwaters of the Thomson River and the Cann River.

HIGHWAY RECONSTRUCTION.

Plate 20.—Princes Highway East. Realignment and reconstruction. West of Club Terrace.

Plate 21.—Hume Highway. Provision of a Climbing lane on Pretty Sally Hill, north of Wallan

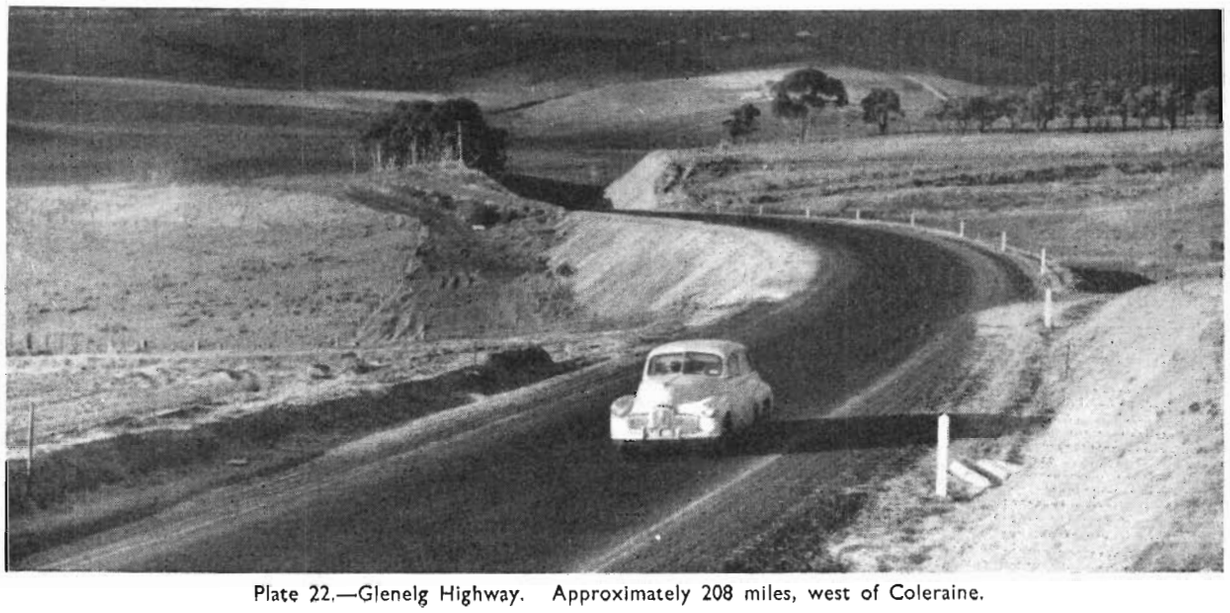


Plate 22.—Glenelg Highway. Approximately 208 miles, west of Coleraine.

On the Hume Highway another project for a high level roadway has been commenced at the crossing of the Ovens River at Wangaratta. Widening the Hume Highway pavement throughout to 24 feet was advanced considerably during the year, a total length of over 27 miles being widened or reconstructed and widened between Wallan and Springhurst. Included with this work was the provision of a climbing lane for slow moving, heavy traffic on the southern slope of " Pretty Sally's Hill " north of Wallan (Plate 21). The very heavily trafficked two-mile high level crossing of the River Murray flood plain between Wodonga and Albury was improved by the widening of two additional bridges, while a start was made to widen the pavement and formation to match up with the bridge widening work, which is scheduled for completion in 1959–60. Complete duplication of the bridges and embankments is becoming an urgent requirement as a second stage of improvements and plans for this are being developed. The large project of deviating sections of the Murray Valley Highway inundated by the enlargement of the Hume Reservoir was virtually completed during the year.

In addition to the major task of duplicating the Princes Highway West between Footscray West and Norlane referred to earlier in this report, a major improvement was effected on this highway through Belmont, a surburb of Geelong. A section extending from the Barwon River Bridge through the business area was completely reconstructed following dismantling of the electric tramway, the new facility replacing a former well-known " horror " section. The work included treatment of the intersection with the Barwon Heads and Barrabool Main Roads along modern lines.

In the Warrnambool Division a work of considerable magnitude was completed on the Glenelg Highway at Muntham Hill between Coleraine and Casterton (Plate 22). The former steep and badly aligned section has been replaced by a road of much higher standard. On this work and on other sections of the Glenelg Highway in this locality where the soil is very susceptible to water erosion the batters of cuttings and slopes of fillings have been treated by seeding and mulching with straw, this treatment having been applied with specialized " Finn " equipment in conjunction with the Soil Conservation Authority.

In the Bendigo Division considerable progress was made in extending bitumen sealing on the Henty Highway and Ouyen Highway, on the former a total length of almost 7 miles having been completed near Gama and Tempy (Plate 23), while on the Ouyen Highway the township of Murrayville is now connected by a bitumen surfaced road to Pinnaroo in South Australia, except for a short section to be completed in 1959–60 near the State border. A substantial improvement was effected to the Midland Highway from the northern outskirts of the City of Bendigo to Huntly and on the Bagshot Hills section. The total length improved in these localities was 6 miles. On the Bagshot Hills section a series of crests where visibility was seriously restricted has been replaced by a new road alongside built to a much higher standard (Plate 24).

A start was made to reconstruct and widen the Maroondah Highway from York Street to Elgar Road in the City of Box Hill and a divided section a half mile in length was constructed through Blackburn. A start was made on the construction of a divided highway on the west side of Ringwood in continuation of the project to provide a multi-lane facility on this heavily trafficked State highway between Box Hill and the Mt. Dandenong Road east of Ringwood.

In Horsham Division reconstruction and sealing of six miles of the North Western Highway between Donald and Birchip completed the sealing of all lengths of State highways in the division. Reconstruction of weak sections, including widening, was effected on sections totalling 43 miles out of the total of 380 miles. Tree planting on bare sections was continued, a further 7,000 trees being successfully established.

A work of technical interest completed was the reconstruction of $4\frac{1}{2}$ miles of the Borung Highway between Litchfield and Warracknabeal employing Portland cement to stabilize a failing pavement constructed some years ago with material obtained from a local source at low cost (Plate 25). This type of stabilization work with cement or hydrated lime or bituminous material enables the economical and satisfactory use of materials which in their natural state are unsatisfactory for pavements intended to be sealed. In some instances the process may show a substantial saving compared with the use of high class materials imported from a distance.

Maintenance and Construction Techniques.—In the Forty-fourth Annual Report mention was made of the creation of the position of Engineer for Construction and Maintenance in the Highways Division, the first appointee to this position being Mr. R. C. Handley, C.E., A.M.I.E. Aust. During the first full year all sections of State highways and

HIGHWAY RECONSTRUCTION.

Plate 23.—Henty Highway. Reconstructed and sealed section near Gama.

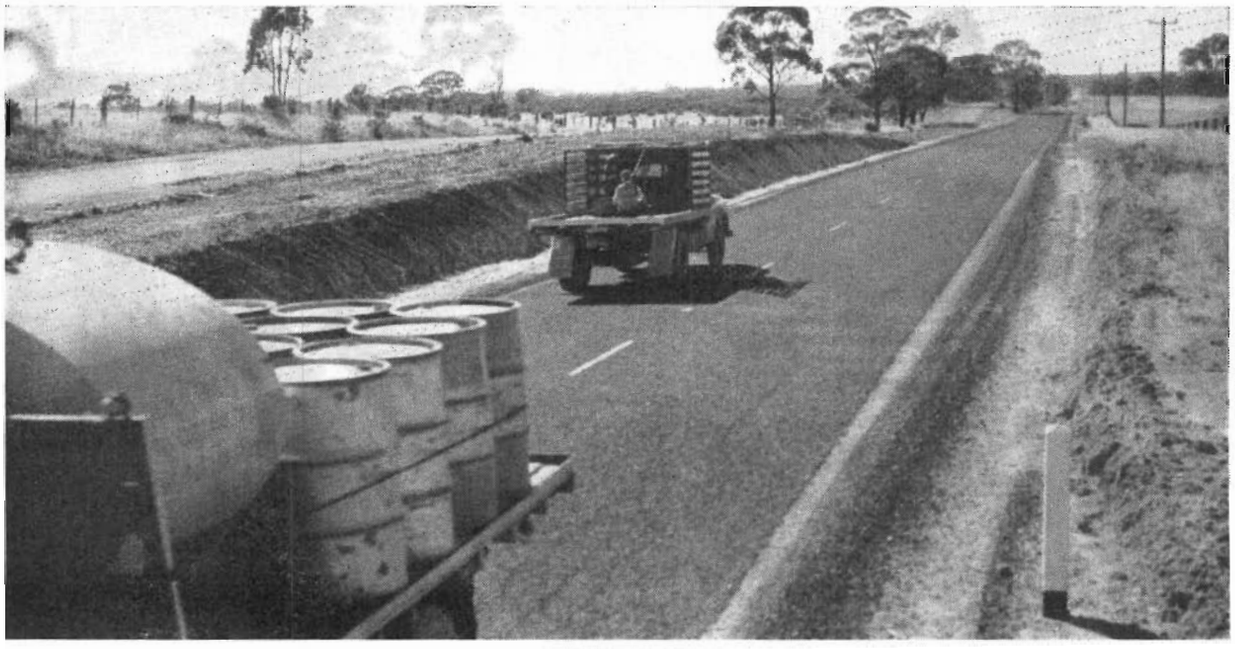


Plate 24.—Midland Highway. Reconstruction between Huntly and Bagshot alongside old worn-out "switch back" section

Plate 25.—Borung Highway. Cement stabilized section with Bitumen seal. West of Donald.

other roads under the direct control of the Board have been inspected to observe the standards of maintenance achieved and methods used, a high percentage of works in progress having been visited. Construction techniques, organization of work, employment of plant, performance of plant and other features affecting the quality and economy of construction of the jobs have been critically examined and discussed with the Divisional and Supervising Engineers concerned. The exchange of ideas resulting from the operations of the Engineer for Construction and Maintenance has already been of advantage to the Board's work, and greater benefits will accrue in future years. The Engineer for Construction and Maintenance has also, in conjunction with the Mechanical Engineer and the Plant and Equipment Officer, investigated the suitability of various items of plant for the Board's purposes and advised on the types and numbers of items of plant to be purchased for current and future works.

6. URBAN ROADS.

Although at its inception the Board's chief concern was with main roads (and later with developmental roads) serving rural areas, the Board was also charged with the responsibility of ascertaining what deviations, widening or new roads should be made so as to " facilitate communications and improve the conditions of traffic and of investigating the most effective methods of road construction in the whole or any part of Victoria." In more recent years the phenomenal development of road traffic has necessarily accentuated the need for application of the most up-to-date appropriate methods of design and construction in projects coming within the Board's consideration both in rural and urban areas.

In 1913 it was quite unnecessary to make provision for traffic volumes of say, 2,000 vehicles a day which are to-day quite usual on many short and some longer sections of both rural and urban roads. Reference has been made in the opening section of this report to some of the new types of road development which have become necessary. The very real requirements in urban areas have been impressed upon the Board in the post-war period by almost every municipal council throughout the State wherever there are townships laid out with an appreciable mileage of government roads now acting as thoroughfares of considerable importance. The number of applications for assistance in undertaking reconstruction both of declared and of unclassified roads in this category has steadily increased. Many such projects have become necessary throughout the State in order to cope with increased weight and volume of traffic and to relieve actual traffic congestion.

Urban work is costly owing to the need for fixing once and for all the levels at kerb lines and for constructing the road pavement in one stage to the necessary thickness. As a general rule the contribution required from councils towards this class of concentrated improvement has been somewhat larger than for works in rural areas where the local benefit is relatively smaller.

The effects of " ribbon development " along roads radiating from townships are quite evident throughout the State, rendering it necessary for the Board in conjunction with the councils to make provision wherever possible for segregation of through and local traffic by use of median and dividing strips. In the case of some narrow sections of main roads and State highways it has also been necessary to look ahead a few years and to provide at this stage for widening the road reserves in order that there will be sufficient space available to reconstruct the road pavement with provision for adequate traffic capacity and safety. Notwithstanding considerable increase in available finance during the last four or five years it has been possible to make provision to only a limited extent for many urgently needed projects of these various types.

The statutory categories into which the Board's programme is divided do not differentiate between urban and rural sections of its declared roads. There is one statutory restriction requiring differential treatment on these lines contained in the Commonwealth Statute stipulating that 40 per cent. of Federal Aid Funds be spent on subsidiary roads in rural areas and not on main roads or State highways. As an example of an urban area the Metropolitan Planning Area of 716 square miles includes portions only of several municipal districts and the boundaries intersect the Board's roads in random fashion. It thus requires a complicated dissection of data to analyse with accuracy the Board's records of allocation or expenditure on various classes of roads in the area into " urban " and " rural ".

Within the area there are 185 miles of main roads and 84 miles of State highways. In addition assistance is given by the Board in the improvement of other important roads in the area, some urban and some rural. An approximate analysis indicates that for 1958–59 the Board's expenditure on roads in the metropolitan area as a whole is estimated

at £1,065,000, being approximately 7·1 per cent. of the amounts spent by the Board on actual roadworks throughout the State. A further £357,000 approximately was spent in cities, towns and boroughs throughout the State outside the metropolitan area.

7. RECENT CAPITAL WORKS.

Since 1949 the Board has utilized loan moneys—

(*a*) to carry out capital works on main roads in the metropolitan area being financed on a loan basis in conjunction with councils in terms prescribed in the Country Roads Act;

(*b*) to assist in accelerating major reconstruction works throughout the State on State highways under the Board's direct control.

Expenditure under these headings is shown in the following statement:—

Year.	State Highways.	Main Roads.	Total.
	£	£	£
1948–49	324,540	37,769	362,309
1949–50	290,704	41,876	332,571
1950–51	756,000	34,956	790,956
1951–52	949,539	100,461	1,050,000
1952–53	567,383	197,617	765,000
1953–54	951,812	315,188	1,267,000
1954–55	690,588	265,412	956,000
1955–56	762,093	272,907	1,035,000
1956–57	80,821	289,179	370,000
1957–58	216,666	183,334	400,000
1958–59	Nil	75,000	75,000
	5,590,146	1,813,690	7,403,836

For 1958–59 application was made for loan moneys totalling £2,002,000 towards the Board's programme of urgent road and bridge construction and reconstruction on State highways and metropolitan sections of main roads, but only £75,000 was made available. In the circumstances no loan expenditure could be permitted on State highways and delay of some main road works already in hand was necessary, only a small programme being possible in this category.

Major works on main roads in the metropolitan area generally require large annual expenditures even when undertaken progressively in more than one year. Loan finance is, therefore, appropriate for such works. Metropolitan councils concerned are bearing half the cost on the basis of paying 5 per cent. per annum of such half share over a period of 35 years. If it is necessary, however, owing to lack of loan money, to meet the cost of these projects chiefly, from the revenues of the Country Roads Board Fund, an apportionment to councils is required by the Country Roads Act up to a maximum of one-third of the year's expenditure on each project.

Thus for construction of road or bridge works costing in one year approximately £100,000 and financed from loan the council concerned would make an annual repayment of only £2,500, but if the project were financed from revenue, the council might be required to contribute up to one-third of the construction expenditure for a year, say, of the order of £30,000. The immediate burden on councils may thus be considerably greater if only revenue finance is available for major works. It is important also that loan moneys should be availed of to augment revenues so that urgently needed capital works can be undertaken more rapidly than is possible using limited revenues alone which must be shared throughout the State.

8. BRIDGES.

Since the commencement of its work in 1913 throughout the State 5,179 bridges have been built or are in course of construction with funds provided by the Board. 235 new bridges were started in 1958–59. Their total estimated value is £1,460,000. Of these new bridges, 191 costing £880,000 are being constructed under municipal supervision and 44 costing £580,000 (excluding King Street and Napier Street Bridges) under the supervision of the Board.

BRIDGES.

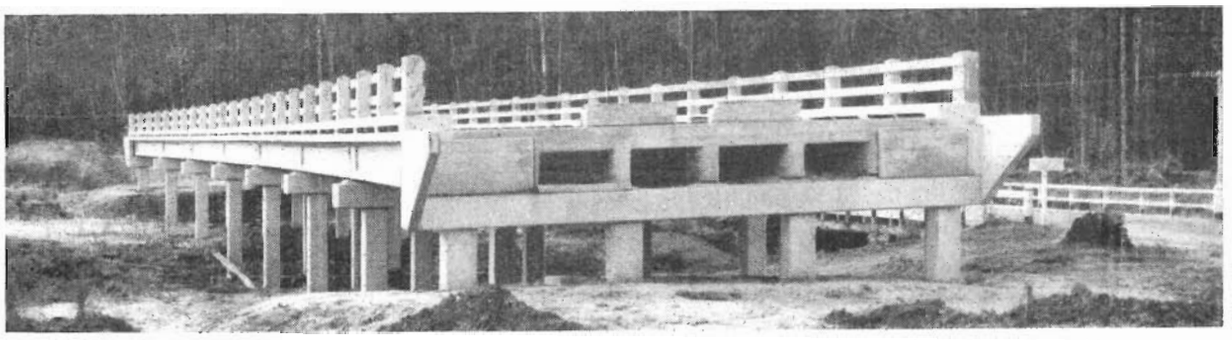


Plate 26.—Princes Highway East. New bridge over Blue Nose Creek. West of Cann River Township.

Plate 27.—Princes Highway East. Bridge over Mitchell River at Bairnsdale. Available to general traffic after official opening on 13th August, 1958.

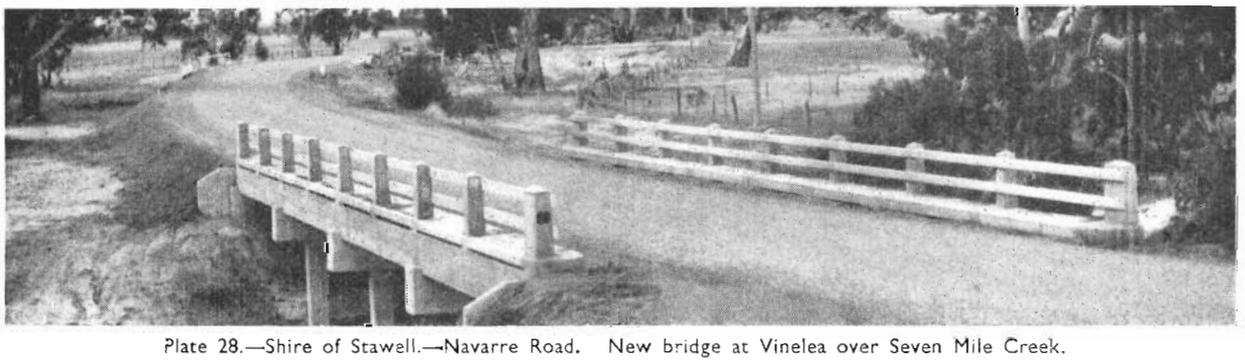


Plate 28.—Shire of Stawell.—Navarre Road. New bridge at Vinelea over Seven Mile Creek.

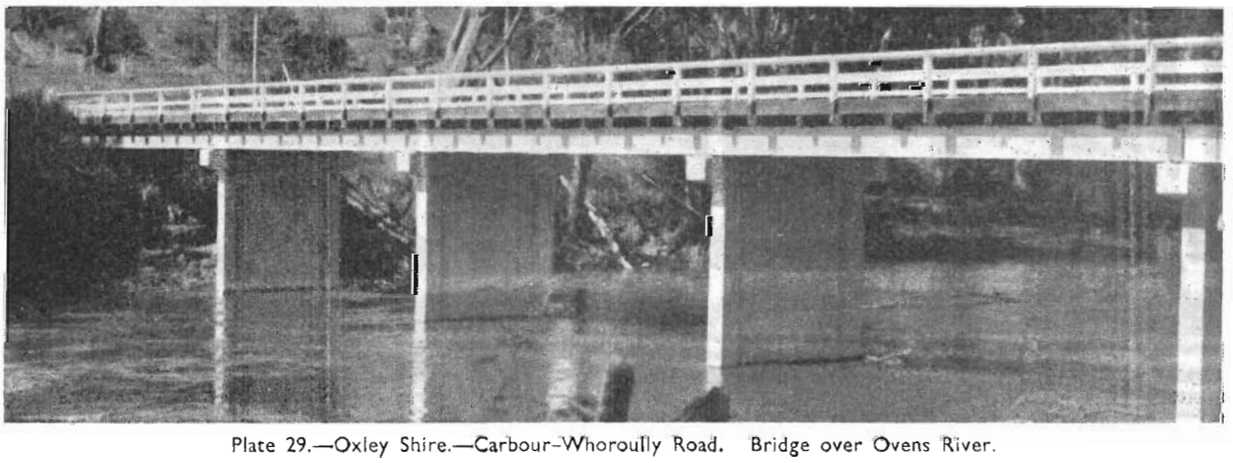


Plate 29.—Oxley Shire.—Carbour-Whoroully Road. Bridge over Ovens River.

Contracts were let for the supply of prestressed concrete deck slabs and beams costing £106,000 and for welded mild steel plate girders costing £20,000. In addition £177,000 was spent in purchasing precast reinforced concrete pipes and box culverts and £15,000 for corrugated galvanised steel pipes. In addition to bridge works structural contracts to the value of £195,000 were let for building the Board's Syndal Depot.

Country Bridges.—Work was completed on the driving of piles and the supply of 40 ft. prestressed concrete beams, and a contract let in June, 1959, for the construction of a bridge 482 ft. x 22 ft. over the Glenelg River at Harrow, on the Coleraine–Harrow–Apsley Road.

To eliminate interruptions to traffic due to flooding of the Princes Highway East at Sale and Cann River, contracts were let and considerable progress made in the construction of three bridges at Sale, and work is almost complete on the construction of the Blue Nose Creek and Cann River Bridges (Plate 26).

Following completion of the piers and abutments a contract was let in May, 1959, for the construction of the superstructure of a bridge 321 ft. x 24 ft. between kerbs plus a 6-ft. footway over the Wannon River at Cavendish on the Henty Highway.

Work on the bridge over the Mitchell River at Bairnsdale on the Princes Highway East referred to in previous reports was completed and the new structure was opened to traffic on 13th August, 1958, the ceremonial ribbon being cut by Lady Lind the wife of the Hon. Sir Albert Lind, M.L.A. (Plate 27). Work was commenced on the construction of another bridge over the same river approaching Bairnsdale on the Bullumwaal Road at Wy Yung. The new bridge will be 240 feet long with a roadway 24 feet wide between kerbs and a 6-ft. footway.

Bridges constructed by Stawell Shire during the year, included a 4-span reinforced concrete bridge 82 feet long by 24 feet between kerbs over Seven Mile Creek at Vinelea on the Navarre Road (Plate 28). Several bridges were completed in Oxley Shire including Newth's Bridge of 4 spans totalling 241 ft. x 18 ft., between kerbs over the Ovens River on the Carbour–Whorouly Road (Plate 29). The bridge consists of reinforced concrete piers and abutments with a timber and rolled steel joist superstructure. Composite rolled steel joist and reinforced concrete bridges completed in Woorayl Shire included Benn's Bridge of 3 spans totalling 77 ft. 6 in. x 22 ft. between kerbs on Farmer's Road and a single span bridge 46 ft. x 20 ft. between kerbs on the Mardan-Dumbalk Road.

A recent welcome innovation has been the setting up of new reinforced concrete pipe works in various country centres. During the year the Avoca Shire Council produced pipes and box culverts valued at £25,000 and other reinforced concrete precast units valued at £10,000.

King Street Bridge.—The foundations for the river bridge and the viaduct approach consist of 123 5-ft. diameter steel cylinders filled with concrete. During this year all 123 were sunk by the "Benoto" method. At the peak of the work two of these machines, which the contractors had imported direct from France together with their operators, were in action. When the foundation bed was inadequate to take the load on a diameter of 5 feet and adjacent bores indicated that there was no better bed at an economical depth the foundation was "belled" out to provide a greater bearing area. The lower portions of the cylinders were concreted under water by means of a tremie to make an adequate plug, the cylinder then being pumped out and the remainder cast in the dry. Construction of the main piers and abutments and of columns for viaduct piers was commenced following completion of cylinders (Plate 30).

The substructure for the first stage of the Flinders Street overpass has almost been completed and 30 precast prestressed concrete beams had been placed in position by 30th June. The contractor originally proposed to use precast driven piles but as this would have caused interference with the main Melbourne and Metropolitan Board of Works sewer in Flinders Street and also batter piles would have been likely to "wander" on encountering basaltic boulders, 4 ft. 6 in. square shafts were sunk by ordinary sinking methods and founded on basalt, except for a length of 100 feet at the extreme eastern end of the overpass where cellular construction was used. In six shafts west of King Street, the bases of the shafts were enlarged to reduce the bearing pressure to $2\frac{1}{2}$ tons per square foot as the boulders were small and the clay seams thick.

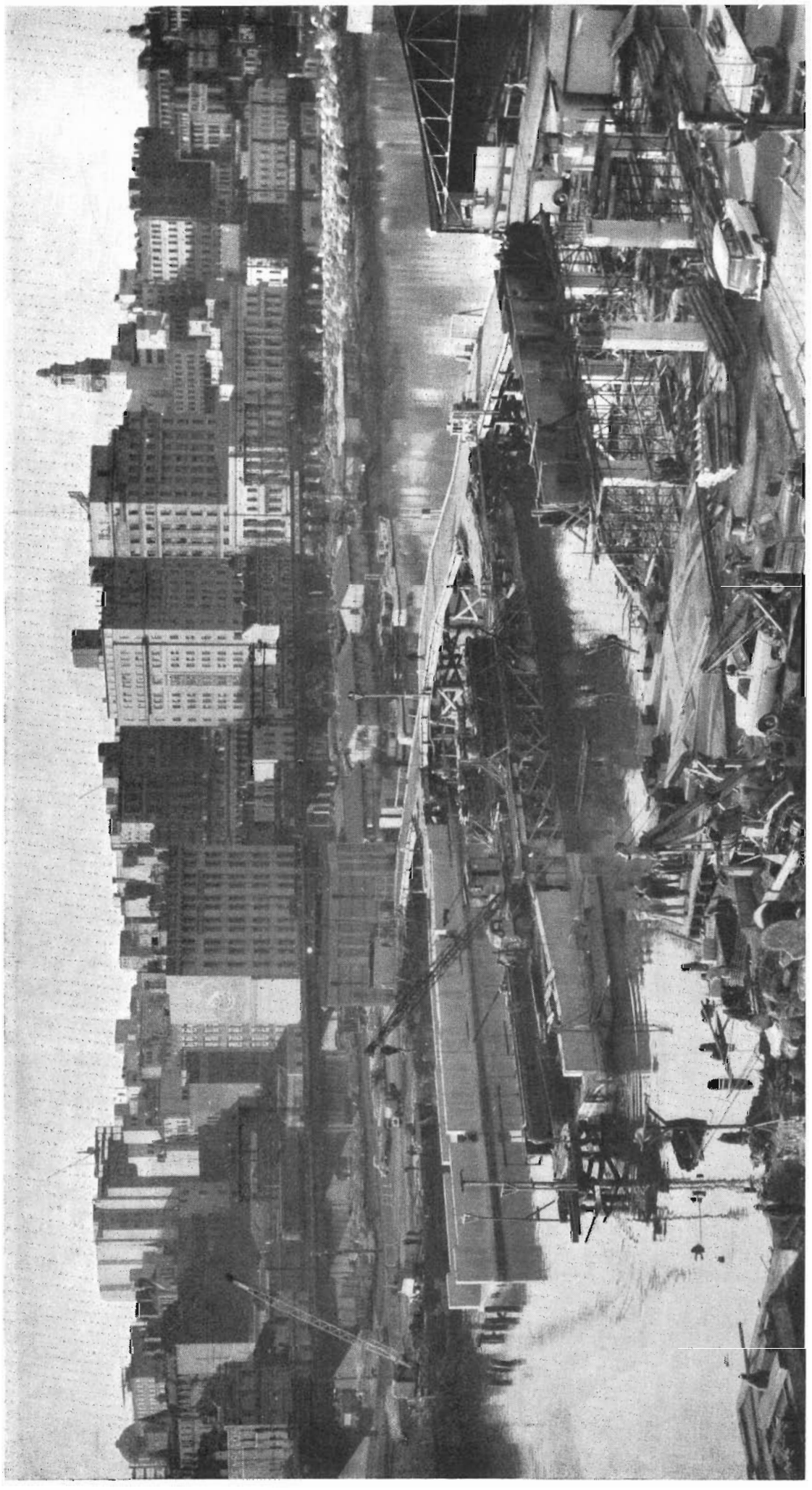


Plate 30.—Construction of King Street Bridge over Yarra River, July, 1952.

Napier Street Bridge.—This new bridge over the Maribyrnong River at Footscray, as shown in the photograph as a frontispiece to this report, was constructed by the Board which was appointed as the constructing authority in accordance with the Napier Street Bridge Act, No. 5822, of 7th December, 1954. The cost of £460,000 was shared by the Treasurer of Victoria 65 per cent., Victorian Railways Commissioners 5 per cent., City of Melbourne 20 per cent., City of Footscray 5 per cent. and the Melbourne Harbor Trust Commissioners 5 per cent.

The new bridge was constructed on the site of an old two-lane steel swing bridge. Corrosion of the steel in the old bridge had reached such a stage that traffic was restricted to a single lane, and a temporary timber bridge was built upstream and opened for traffic early in 1953. The swing bridge was finally closed to traffic in February, 1957, when a commencement was made on the substructure for the new bridge.

The elevated roadway of the new bridge, acting as an overpass, replaces an existing level crossing of the railway serving the adjoining wharf, and also allows roads on each side of the river to pass underneath the new structure.

Plate 31 illustrates the first stage of traffic diversion in April, 1959, on to the southern half of the new structure, traffic proceeding towards Moreland Street (Footscray South) only being so diverted whilst the temporary bridge still carried other traffic in both directions. Early in May, 1959, all west bound traffic was able to use the new structure and by the end of the month traffic in both directions had been diverted to the new bridge, enabling demolition of the temporary bridge.

The new bridge structure consists of thirteen spans, including three plate girder spans of lengths 70 ft.–88 ft.–70 ft., over the river, six precast reinforced concrete beam approach spans of total length 193 feet, two rigid frame spans of 35 ft. 6 in. and 30 ft. 6 in. over Sims Street and Maribyrnong Street respectively, and two rigid frame spans each of 15 feet over the railway. The total length of the structure is 519 feet, the roadway width being 52 feet with an 8-ft. footway on each side. The foundations were constructed by the Board by direct labour and the superstructure and road approaches by contract.

9. FLOOD DAMAGE.

In the Board's Forty-fifth Annual Report further reference was made to the Commonwealth–State Flood Relief Agreement under which an amount of £274,000 was initially made available for flood protection and other allied works as distinct from road and bridge restoration. All claims having been met in respect of emergency flood protection, the sum of £40,000 which still remained was made available towards the cost of restoration of roads and bridges in the Wimmera area where very severe damage had been sustained. Restoration of the damage in these parts is proceeding and early completion is expected.

10. ELIMINATION OF RAILWAY LEVEL CROSSINGS.

An access road was constructed following on completion of the deviation of the Hume Highway at Glenrowan so that a level crossing on the old route of the Hume Highway might be closed. The overpass replacing the Corio level crossing on the Princes Highway was almost completed.

Two level crossings were eliminated by the construction of the Carina deviation between Murrayville and the South Australian border on the Ouyen Highway. Four rail crossings of the original fourteen have now been eliminated on this State highway, and it is proposed to remove a further six in the section to be constructed between Underbool and Murrayville.

During the year, in conjunction with the Victorian Railways Department, considerable work has been done in the elimination of level crossings in the metropolitan area. Work was continued on the Nepean Highway and South Road at Moorabbin and although not completed, it has been possible to " grade-separate " rail and road traffic. A start has been made by the Victorian Railways at Glenhuntly Road, Elsternwick, while the work started some time ago at Napier Street, Footscray reached a stage where the road traffic was able to use the underpass. The whole job is nearing completion.

METROPOLITAN BRIDGE.

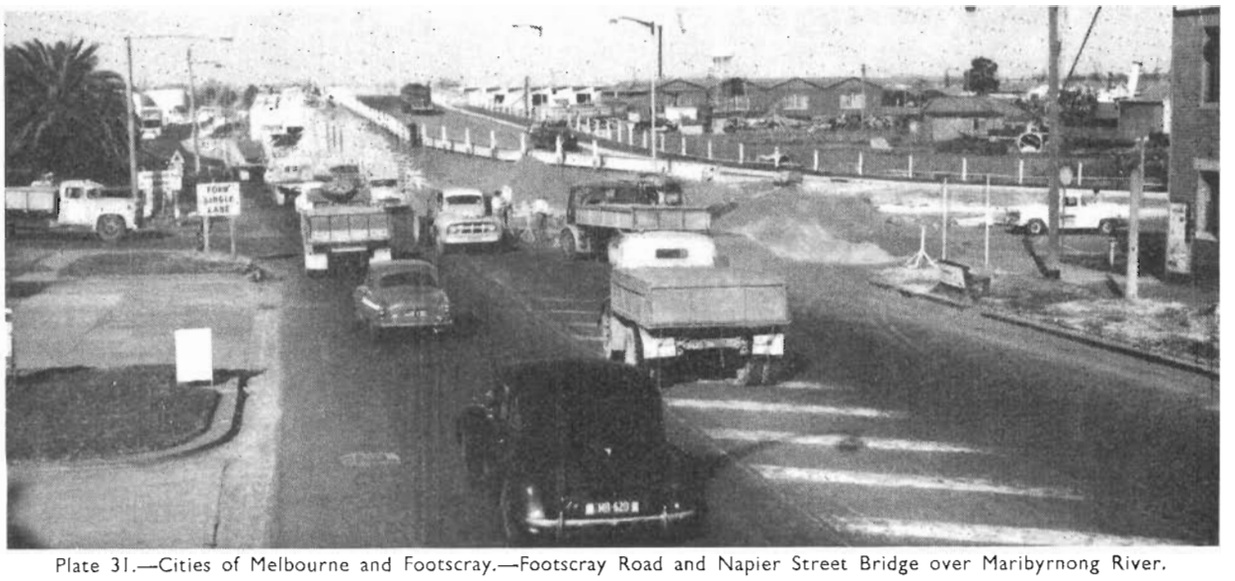


Plate 31.—Cities of Melbourne and Footscray.—Footscray Road and Napier Street Bridge over Maribyrnong River. South bound traffic diverted in April, 1959, over southern half of new bridge (at right).

WORK FOR OTHER AUTHORITIES.

Plate 32.—Otway Shire. Heytesbury Settlement Area. New road under construction.

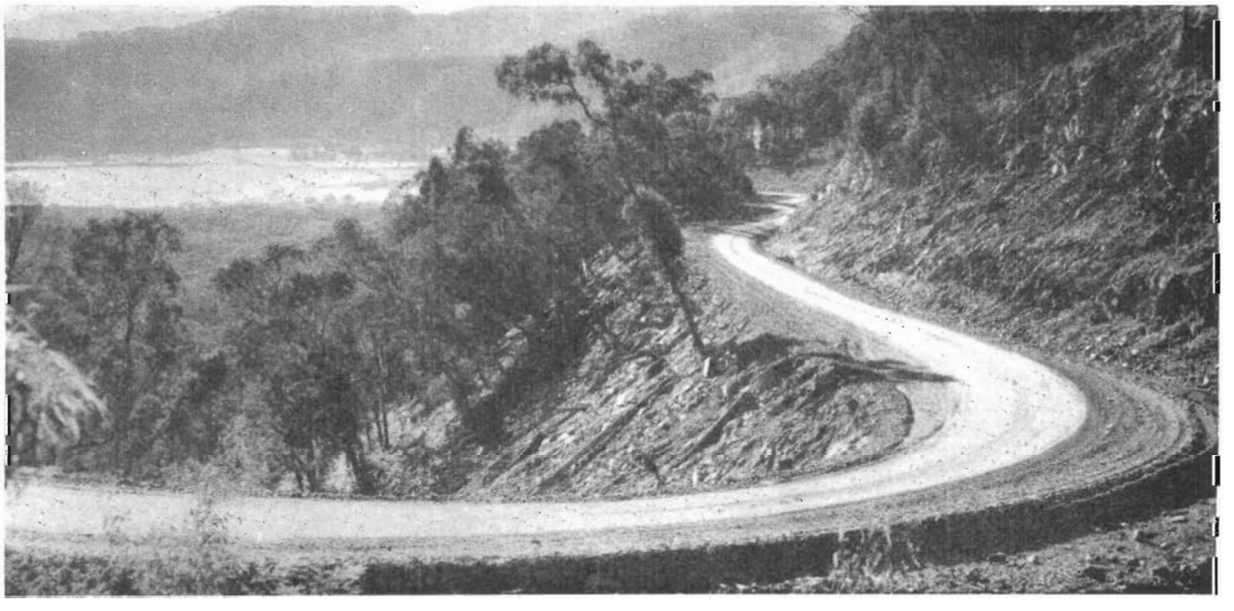


Plate 33.—Eildon–Jamieson Road. Deviation around Eildon Reservoir, approximately 4 miles from Jamieson.

Proposals are now being examined for the necessary work at Warrigal Road, Oakleigh, at Melbourne Road, Newport and at various level crossings on the main Melbourne to Wodonga railway.

The cost of works of this category, undertaken in accordance with the Country Roads Acts and agreements between the Board and the Railways Commissioners to share further in such projects, has been divided as follows: –

	£	%
Level Crossings Fund	1,107,695	54·9
Country Roads Board	487,904	24·2
Railways Department	421,863	20·9
Total	2,017,462	

11. SOLDIER SETTLEMENT ESTATE ROADS.

In conjunction with the Soldier Settlement Commission and municipal councils further works were put in hand to provide subdivisional roads in estates purchased by the Commission or allotted from Crown lands.

Plate 32 illustrates work in the Heytesbury Settlement Area.

The total expenditure during the year 1958–59 on road and bridge works to serve Soldier Settlement Estates was £184,197 of which £77,228 was paid by the Commission, £88,013 by the Board and £18,956 by the Councils. The total expenditure on all roads and bridge works associated with Soldier Settlement Estates since the inception of the scheme is £1,579,033, of which £901,535 was contributed by the Commission, £490,235 by the Board, and £187,263 by the Councils.

12. WORKS FOR OTHER AUTHORITIES.

The following summary shows works undertaken during the year at the cost of other authorities.

	Description of Works.	Expenditure.		
		£ s. d.	£ s. d.	
Victorian Departments.				
Department of Public Works	Roadworks and Bridgeworks—Chandler Highway, Dookie and Longerenong Colleges	20,165 5 7		
Forests Commission ..	Roadworks—Maffra Shire, Licola Road	4 5 2		
Housing Commission ..	Roadworks and Bridgeworks—Morwell and Norlane Housing Estates, Barry's Road Overpass, Broadmeadows	43,300 14 7		
Lands and Survey Department	Roadworks—Glenelg, Heytesbury and Kaniva Shires ..	3,908 1 7		
Latrobe Valley Development Advisory Committee ..	Roadworks—Narracan Shire	867 2 4 *Cr.*		
Melbourne and Metropolitan Board of Works	Roadworks—Healesville Shire	577 1 10		
Premier's Department ..	Roadworks—Rosedale Shire, Limestone pit Road ..	124 16 8 *Cr.*		
Soldier Settlement Commission	Roadworks—Estates throughout Victoria	77,228 3 10		
State Electricity Commission	Roadworks—Morwell Shire	8,459 15 5		
State Rivers and Water Supply Commission	Roadworks and Bridgeworks—Eildon and Hume Weir Projects, Bairnsdale Shire—Erosion Prevention—Skull Creek	201,056 19 0		
Victorian Railways ..	Roadworks—Clunes Borough, Traralgon Shire	425 15 1		
Victoria Police	Skid Pan and Roadworks—Police Driving School, Broadmeadows	15,655 8 2		
			369,789 11 3	
Commonwealth Departments.				
Department of Works ..	Construction, Maintenance and Sealing Works ..	35,086 4 5		
			35,086 4 5	
Special Projects.				
King Street Bridge ..	Construction of bridge over the Yarra River with southern viaduct approach and overpass in Flinders Street, including land acquisition—Cities of Melbourne and South Melbourne	1,148,263 4 2		
Napier Street Bridge ..	Construction of bridge over the Maribyrnong River and rail overpass—Cities of Melbourne and Footscray	181,629 9 9		
Railway Level Crossings ..	Elimination of various railway level crossings	66,970 7 2		
Municipalities Forest Road Improvements	Improvement of various roads adjacent to State forests to facilitate the extraction of forest produce	5,252 9 0		
			1,402,115 10 1	
	Total	.. ..	1,806,991 5 9	

Apart from King Street and Napier Street bridge projects the largest items in progress were road deviations around Eildon and Hume Reservoirs, the main work still under construction being the Eildon–Jamieson Road (Plate 33).

13. MUNICIPALITIES FOREST ROADS IMPROVEMENT FUND.

This fund was established in 1955 by the Government with a contribution of £50,000 to be used for the improvement and protection of roads under control of municipalities adjacent to State forest areas in order to facilitate the extraction of forest produce.

The whole of this amount having been fully allocated, additional applications from councils amounting to more than £100,000 remain for consideration apart from a large volume of similar work known to be desirable. The Government has contributed a further £15,000 to the fund following representations by the Forests Commission and the Board. The Board has submitted recommendations for utilizing the amount of £15.000 to the Forests Commission for joint review.

The expenditure out of the initial contribution to the end of 1958–59 was £49,398.

14. BITUMINOUS SURFACING.

During the full spraying season another 1069 miles of new bituminous surfacing was undertaken on all classes of roads chiefly by the Board's mobile spraying gangs. Their operations also included extensive resealing and the restoration of sealing on reconstructed sections. The programme of extension varied considerably from district to district, maximum progress being achieved in Kowree Shire where 44 miles of new sealing were completed. In Mildura Shire 28 miles were added to the length of sealed roads and in Rosedale Shire 25 miles.

The total length of sealing, resealing and restoration was 2,298 miles. This was less than the length of work done in the year 1957–58, by 55 miles, or 2·39 per cent. The length of sealed surfacing in the declared system of 14,430 miles was increased by 42 miles on State highways, 455 miles on main roads and 32 miles on tourists' and forest roads. bringing the total length sealed to 9,843 miles, or 68·2 per cent. of the declared system. On unclassified roads 540 miles of new seal, an increase of 25 per cent. on similar work in 1957–58, and 129 miles of other sealing works was completed. Retreatment and restoration of the seal coat on reconstructed sections of previously sealed pavement on the declared system amounted to 903 miles or 9·7 per cent. of the treated system. this including the retreatment by sealing of 7·1 per cent. of the sealed system.

Again, in accordance with its practice, the Board made available its mobile spraying units to undertake sealing work for municipalities who may not otherwise be able to have the work done, and for other State and Commonwealth Departments. A total length of 93 miles of work has been carried out this year for other authorities. Full details of the length of various types of treatments carried out on the various road categories are set out in Tables 1, 2, 3 and 4 in the Chief Engineer's section of this Report.

Bituminous Plant.—To carry out the work this year 24 mobile spraying units were used, each with its complement of sprayers, mechanical brooms, aggregate loaders, aggregate spreaders, rollers and auxiliary equipment, together with mobile heaters, bitumen storages and road tankers, required for the handling of bitumen, and, to a growing extent, tars and other priming materials in bulk. On the average a sealing unit is manned by about 28 men, so that a total of approximately 670 men were engaged on the work continuously over a period of approximately seven months of the year.

Reference was made in the Forty-fifth Annual Report to steps which were being taken to acquire additional plant for bituminous surfacing, and to replace worn out units. Some of this plant was available during the season and good use was made of it by augmenting, in certain areas, the plant being used by the sealing units, thus increasing the ability of the units to carry out more work with very little increase in the labour requirement.

Bitumen Supplies.—Bitumen was again obtained from two oil refineries in Victoria, a quantity of 23,586 tons being used in the work. A serious situation arose towards the end of March, 1959, at the very peak of the bituminous surfacing season, when both oil refineries broke down simultaneously, and supplies of bitumen were drastically curtailed. Both suppliers had limited reserve stocks of bulk bitumen, and exercised their right to ration material to all users, not only in Victoria, but in other States, and the Board experienced difficulty in continuing the sealing work.

Fortunately it was possible to obtain from one supplier a quantity of nearly 1000 tons of drummed bitumen which was available as the result of a cancelled export order, and the use of this material, together with much re-arrangement of programmes in the field, helped to keep the work going. Some loss of time and additional expenditure in the handling of bitumen in drums instead of in bulk were incurred. Generally, approximately 1 per cent. only of the bitumen used in the Board's work is handled in drums, but this year, because of the trouble at the refineries, the quantity used in drums rose to approximately 5 per cent. Both refineries are now taking steps to increase their capacity to hold reserves of supply, in order to meet situations of this nature in the future.

Aggregate.—During the year a quantity of 243,363 cubic yards of covering aggregate was used by the Board's sealing units in the sprayed work programme, which is 6·43 per cent. less than the quantity handled in 1957–58. The Board's own crushing plants continued to contribute materially to the requirements by building up reserves of supply so necessary for planning and carrying out the work economically. While the position regarding supply throughout the State is generally better than it has been hitherto, there is still room for improvement amongst the suppliers of aggregate, to ensure ample supplies. Table 5 in the Chief Engineer's section of this Report, sets out details of the costs of material over the past five years. Other matters of technical interest in relation to bituminous surfacing are included in the Chief Engineer's section of this Report.

15. ROADMAKING MATERIALS AND RESEARCH.

The Board's crushing and screening plant at Bald Hills, seven miles north of Ballarat, operated throughout the year in providing quartz aggregate for bituminous surface treatment work.

In the Benalla Division, because of deterioration in the quality of gravels available for pavement construction in the Shire of Shepparton, it has become necessary to mix a fine non-plastic sand with plastic gravel to produce a pavement material suitable for sealing.

In the Bendigo Division two separate contracts were let for (*a*) the supply of 30,000 cubic yards of aggregate for sealing purposes in the Charlton area, and for (*b*) 18,000 cubic yards of aggregate at Lake Boga for sealing purposes in the Swan Hill area. These contracts overcame some of the supply difficulties which have hindered work in past years. 36,000 cubic yards of mine tailings were crushed in the Bendigo area, using the Board's "Goodwin Barsby" primary and secondary crusher, producing pavement materials for use on the Midland Highway. In addition, a small quantity of aggregate was produced from this material.

Towards the end of 1956 the Board installed a new crushing plant in its quarry at Stawell, where the stone is a very hard feldspar porphyrite. Crushing commenced in January, 1957, the plant finally closing down in December, 1958, after having crushed 105,000 cubic yards of roadmaking materials, screenings, crushed rock, &c. Sufficient quantities of material are now stockpiled on the roadside to cater for the Board's B.S.T. work in the area till June, 1961.

Country Roads Board Fellowship.—In 1955, the Board extablished a Research Fellowship in Highway Engineering at the University of Melbourne, tenable in the first place for a period of three years and under the direction of a Research Committee consisting of two representatives of the Engineering Faculty of the University and two representatives of the Board. The Research Fellow was appointed in April, 1956, and commenced duties in May of that year. The immediate problem to be investigated was the strength of multi-layered systems representing flexible pavement construction. This problem is a primary element in the larger question of the determination of the appropriate thicknesses of road pavements for various wheel loads, traffic densities and soil and climatic conditions, a subject of great importance in highway economics.

The investigation falls into three broad stages—

(1) A thorough appraisal of published work.

(2) Laboratory scale model experiments to determine the mode of distribution of wheel loads through a pavement to the prepared base.

(3) The relation of the theoretical and laboratory work to the modifying effects of full scale construction and the particular requirements of local conditions.

The work done so far includes a careful survey of the literature and the development and adaptation of equipment. Certain difficulties were encountered in constructing the equipment which delayed the performance of the second stage of the experiment.

The work done so far has made a contribution to basic knowledge of the behaviour of the small pressure cells to be used to measure internal stresses in pavements. This may ultimately lead to the development of a satisfactory cell or at least to a knowledge of the limiting conditions under which possible designs of cells may be used.

16. TRAFFIC LINE MARKING.

During 1958–59, 2,992 miles of the Board's declared roads and 130 miles of roads for Sundry Debtors were maintained in a striped condition. Approximately 700 miles are striped twice a year on State highways and 300 miles on main roads. The standard white striped line consists of 10-ft. dashes 3 inches wide and 30-ft. gaps.

The total expenditure on this type of work during the financial year was £33,229 representing an average of £6 4s. 6d. per mile of standard stripe. An average of 16·4 miles of line was striped per day, that is, 5,410 square feet of painted area. The total quantity of lacquer used was 17,960 gallons with an average rate of application per mile of stripe of 3·37 gallons per mile.

17. AERIAL SPRAYING OF ROADSIDE EUCALYPTS FOR PEST CONTROL.

Large areas of eucalypts in Eastern Gippsland have progressively deteriorated over the past seven years due to severe infestation by insects. The Board was particularly concerned with infested trees along a 25-mile section of the Princes Highway East between Stratford and Bairnsdale.

A number of insects were causing the damage, the main ones being :—

(*a*) Leaf eating beetles of the Paropsis species (*Chrysomelidae*). These appear in different colours and sizes. The larvae of these beetles were also damaging the trees.

(*b*) Larvae of the seedling gum moth (*Nola Metallopa*). These are very hairy in appearance, green in colour, with a double row of yellow spots down the back.

(*c*) Saw fly larvae of the Perga Species.

These three insects damage foliage in different ways :—

(i) The Paropsis beetles chew the outside edge of the leaves leaving a jagged appearance.

(ii) The larvae of the seedling gum moth tend to chew the leaves on both surfaces leaving a skeleton effect.

(iii) The saw fly larvae chew holes in the leaves causing them to break up and wither.

All eucalypts in the area are attacked particularly the following varieties :—

Red gum	(*euc. camaldulensis*)
Red box	(*euc. polyanthemos*)
Brown stringybark	(*euc. capitellata*)

Of these the red gum trees appeared to be most severely attacked and a number were already dead. It was felt that if no attempts were made to control the pests all trees along this section of highway would eventually be killed. It was noted also that trees on side roads and in stock shelter belts were affected to some degree by the insects and that many had been killed.

Following discussions with representatives of the Forests Commission and the Biological Division of Imperial Chemical Industries of Australia and New Zealand, the Board in conjunction with I.C.I. decided to carry out aerial spraying tests in order to check the effectiveness of this method of eradication of the insects.

PRESERVATION OF HIGHWAY TREES.

Plate 34.—Tiger Moth Aircraft spraying Eucalypt trees affected by insects. Princes Highway near Bairnsdale.

Mr. N. McInnes of " Fairmair " Tinamba also co-operated in these trials. The aircraft used was a Tiger Moth of 60 gallons carrying capacity with a 30-ft. boom mounted beneath the lower wing to dispense the spray through 24 nozzles. Flying speed was 75 miles per hour at 10 to 15 feet above the tree tops, the effective spray being 1 chain wide and the application $2\frac{1}{4}$ gallons per acre. Tests were carried out in the early hours of the morning as perfectly calm conditions are necessary. (Plate 34).

To test the effectiveness of the aerial spray application for dispersion and insect control, brown paper (12-ft x 8-ft.) was spread at two points in each 1 mile test section. At each site an ordinary piece of glass (14 in. x 10 in.) was placed on the paper. Altogether, eight test flights over 1 mile control sections were carried out on two mornings using varying applications and sprays. On the second morning commencing at 5.30 a.m. under perfect conditions, excellent application was obtained on all four runs with even and heavy distribution of droplets over the glass test sheets.

Without listing details of all the sprays used it was found that the mixtures using lower rates of D.D.T. were not so effective. From the observations made it is considered that 1 lb. of D.D.T. per acre in miscible oil applied from the air is adequate to control the infestation of eucalypts found on the roadside trees in this area. Following these preliminary tests the remaining 20 miles of highway reserve on which the infected trees were located were sprayed in November, 1958, with this spray and the insects were almost completely eradicated.

By Christmas the trees were showing signs of recovery but were then attacked by a plague of Christmas beetles. This attack was of short duration but all the new growth was removed. However a recent inspection revealed that the trees were recovering and that there is now little sign of any infestation. In the past heavy infestation has started in the early Spring and the effectiveness of the control will not be known until another spring and summer cycle has passed.

The cost of spraying was £20 per mile for each one chain wide strip or approximately £2 10s. per acre. In dealing with large areas the cost could be considerably reduced.

The spray is non-poisonous but can cause eye irritation. Aircraft flying low over the highway will distract drivers' attention. It is therefore desirable to barricade each section of highway for the short duration of each flight. In the early hours of the morning there is very little interruption to traffic movement. Indications are that aerial spraying can be developed as a cheap and effective method of controlling infestation of roadside eucalpyts.

18. CONTROL OF HEAVY TRAFFIC.

Fines and costs imposed during the year under the Motor Car Act amounted to £108,007 1s., an increase of £32,913 0s. 8d. or 43 per cent. over the figure for 1957–58; these penalties resulted from 7,863 offence reports, an increase of 1,047, or 15 per cent., over 1957–58.

The percentage increase in fines is greater than the percentage increase in the number of offences, mainly because the average fine imposed per prosecution during 1958–59 was 17 per cent. greater than the average fine imposed during 1957–58. A year has now elapsed in which Courts were bound by the provision of mandatory minimum penalties for overloading offences, and the pattern of offences has altered, overloading offences increasing by 42 per cent. and speeding offences by 46 per cent., other categories showing a compensating reduction.

It is of interest to note that cases of refusing to unload an overloaded vehicle show a decrease from 41 to 4, following the legislative provision for the impounding of vehicles when drivers refuse to unload. Sixty trucks were impounded during the year. Whilst the number of commercial vehicles using the roads has increased, the amount of road usage by these vehicles cannot be accurately determined; it is thought that the increase in vehicle miles travelled may be of the order of 10 per cent. to 15 per cent., thus approximating the increase of offences detected. The average overload on axles is 14 cwt. per offence, compared with 16 cwt. last year and 28 cwt. in 1956–57. The number of traffic officers operating was the same as in 1957–58.

Four thousand eight hundred and twenty-two cattle were found unattended on State highway reserves compared with 6,653 in 1957–58. Four hundred and seventy-one were impounded, being 30 less than last year.

At 30th June, 1959, the following mileages of roads were limited to five tons gross axle load :—

State highways	142 miles
Main roads	237 miles
Tourists. and forest roads	224 miles
Total	603 miles

Eight hundred and forty-seven miles were limited as at 30th June, 1958, and the present mileage limited is a reduction of 244 miles or 38 per cent. for the twelve months.

The number of actual permit forms issued during the year was 7,011, an increase of 755, or 12 per cent., of which 1,597 were issued in regional divisional offices.

Difficulties are still being experienced in the collection of fines. An additional police officer has been seconded to the Board to assist. Many offenders have no fixed place of abode, many others seldom visit their home addresses, and the system of collection of fines is generally unsatisfactory. 1,607 warrants were executed during 1958–59, resulting in the collection of £21,080 7s. 10d. Twenty-nine drivers were arrested on warrant for non-payment of fines.

Of all fines imposed in 1957–58 (£75,230) £14,361 (19·1 per cent.), remains unpaid twelve months later. Of £63,344 imposed in 1956–57, £6,533 (10·3 per cent.) remains unpaid two years later. Statistics are not yet available for 1958–59, but it is estimated that in excess of 30 per cent. is unpaid. Comparative figures for the years 1947 to 1956 show a maximum of 6·4 per cent. unpaid in any one year with an average of 5·3 per cent. for the period. To remedy the situation the Board may be compelled to recommend strong action in dealing with offenders who are still escaping penalties.

The co-operation of the Chief Commissioner of Police and the keenness and efficiency of the members of the Mobile Traffic Section of the Victoria Police who have been seconded for duty with the Board are greatly appreciated.

19. DECENTRALIZATION.

The Board's new two-storey brick divisional office at Bairnsdale was completed and officially opened by the Hon. M. V. Porter, M.L.A., Minister for Local Government, on 6th November, 1958. (Plate 35).

A brick veneer residence was constructed in Warrnambool for occupation by one of the Board's engineers. Land was purchased at Dartmoor for the establishment of a patrol depot and patrolman's residence. The Board purchased a property known as " Greystones ", 57 Queen Street, Bendigo, for conversion into divisional offices.

20. WORK STUDY.

Following the survey of the Secretary's and Accountant's Branches by W. D. Scott and Co. Pty. Ltd., an Office Methods Section has been established within the Board's organization.

To initiate the Works Simplification Programme W. D. Scott and Co. Pty. Ltd., conducted at the University of Melbourne a two weeks' training conference during February, 1959, for 21 of the Board's senior engineering and administrative officers, including the Officer-in-Charge, Office Methods Section. Certain specified lectures which were of general application were attended by other supervisory personnel of the Board's staff.

A panel of six commercial and engineering consultants from the staff of W. D. Scott and Co. Pty. Ltd., lectured and guided the conferees. The techniques of observation and analysis taught were applied in practical exercises to various sections and operations within the Board's organization. The course was very successful and all personnel who attended were convinced of the benefits of Work Simplification.

The Office Methods Section has now successfully completed several surveys of different aspects of the Board's Office activities under the guidance of W. D. Scott and Co. Pty. Ltd., whose services are being retained for a limited number of investigations. Besides these direct benefits to the Board, techniques learnt by all the conferees have been, in many instances, applied independently of the Office Methods Section with resultant benefits.

21. CONFERENCE OF STATE ROAD AUTHORITIES OF AUSTRALIA.

The Twenty-first Confernce was held at the office of the Main Roads Department, Perth, Western Australia, from the 13th to the 17th October, 1958. Representatives of each State Road Authority throughout the Commonwealth and the Director-General of the Commonwealth Department of Works attended whilst officers of the Commonwealth Department of Shipping and Transport and the Commonwealth Scientific and Industrial Research Organization were present when items of special interest to those authorities were being discussed.

Fifty-eight items on the agenda were discussed, including the principles and practice of bituminous surface treatment, standard specifications for various classes of roadmaking materials, the application of methods engineering to workshop practices, and national route numbering. The Conference closely examined the question of establishing an Australian Road Research Organization on the general lines of the United States of America Highway Research Board and agreed that action be taken to set up an organization to be known as the " Australian Road Research Board ", the Conference of State Road Authorities being the controlling authority. The new organization will co-ordinate road research and arrange periodical road research congresses thus providing a national clearing house and correlation service for research activities and information on road technology. In arriving at its decision the Conference received great assistance from the senior executive officer of the C.S.I.R.O.

Arrangements were made for the next Conference of State Road Authorities of Australia to be held in Sydney in September, 1959, and for the various sub-committees to meet during the year, i.e., Principal Technical Committee, Materials Research Committee, Bridge Design Committee, Traffic Engineering Committee, Plant and Equipment Committee and Secretarial and Accounts Committee. The Conference also decided to establish the Advance Planning Committee to co-ordinate the work involved in the " road needs survey " which the Conference of State Road Authorities has in progress, and arranged for the first meeting of this Committee to be held in March, 1959. Approval was also given for issue of a revised edition of " Roads in Australia ", a pamphlet prepared by the Conference giving a summary of the work of the constituent road authorities and of the Conference and statistics relating to the Australian road network.

22. MUNICIPAL ASSOCIATION CONFERENCES.

This year conferences were held as follows : -

Municipal Association of Victoria . .	At Melbourne on 8th and 9th October, 1958—attended by the Chairman and Members of the Board.
Northern District	At Cohuna on 23rd April, 1959—attended by Mr. C. G. Roberts, Deputy Chairman.
North-Eastern	At Euroa on 22nd May, 1959—attended by Mr. C. G. Roberts, Deputy Chairman.
North-Western	At Dimboola on 27th May, 1959—attended by Mr. D. V. Darwin, Chairman.
Western	At Hamilton on 28th May, 1959—attended by Mr. W. H. Neville, Member.
Gippsland	At Maffra on 12th March, 1959—attended by Mr. W. H. Neville, Member.

The Board appreciates the opportunity to attend these conferences because of the close co-operation which exists between it and Local Government.

23. CONFERENCE OF MUNICIPAL ENGINEERS.

The Fifteenth Conference of Municipal Engineers, convened by the Board, was held in the Royale Ballroom, Exhibition Building, Melbourne, on 13th and 14th May, 1959. Engineers from most of the 206 municipalities throught the State attended, together with senior engineers of the Board and representatives of various Commonwealth and State Government Departments which were interested in certain items on the agenda. Approximately 240 were present.

The Hon. Sir Thomas Maltby, E.D., M.L.A., Minister of Public Works, welcomed the delegates and officially opened the Conference. Items on the agenda included the discussion of a paper prepared by the Engineer, Shire of Rosedale, on experience with a small tar priming spraying outfit and of other papers on explosives and their detonation, the economic comparison of various types of grading equipment, and the use of preservative treated timbers by the vacuum pressure method for bridgework. The more important papers have been duplicated and distributed to the engineers attending the Conference.

24. BOARD'S INSPECTIONS.

On completion of the allocation of funds in July, members of the Board accompanied by the Divisional Engineer concerned resumed the inspection of roads and bridges in various parts of the State. During the year 38 municipalities were visited, as follows: Shires of Mornington, Walpeup, Mount Rouse, Leigh, Kilmore, Colac, Winchelsea, Mansfield, Alberton, Birchip, Donald, Glenlyon, Upper Yarra, Healesville, Seymour, Goulburn, Newstead, Metcalfe, Warracknabeal, Cohuna, East Loddon, Gisborne, Phillip Island, Lillydale, Pyalong, Lexton, Grenville, Morwell, Ballan, Mulgrave, South Barwon, Barrabool, and Benalla, Towns of Colac and Castlemaine, Boroughs of Daylesford, Ringwood, and Benalla. The mileage travelled on these inspections totalled 11,280.

The Board extends its thanks to the municipalities visited for their co-operation in making detailed arrangements. These inspections are of inestimable value both to the Board and the Councils as they enable information to be exchanged and problems of mutual interest to be discussed. The Board is also able to refresh and increase its knowledge of the municipalities and to examine their potential development and future road requirements.

25. LEGISLATION AFFECTING THE BOARD.

The Board is very appreciative of the work performed by the Director of Statutory Consolidation and staff in consolidating over 40 separate Country Roads Acts into one consolidated Act. The various Country Roads Acts passed from 1912 to 1957 are now consolidated in the *Country Roads Act* 1958 (No. 6229).

The main legislation enacted during the financial year which affected the Board was the *Country Roads (Amendment) Act* 1959 (No. 6500). This Act provides for the following amendments :—

(*a*) *Interference with Main Roads.*

The Crown Solicitor had indicated that the Board's existing powers over the digging up of main roads might not extend to the section of road between the edge of the pavement and the road reserve boundary. The amendment places the Board's powers beyond doubt without affecting the existing rights, powers and authorities of government departments and statutory bodies.

(*b*) *Owner Driver and Person in Charge of Vehicle Guilty of Offence.*

This amendment concerns carrying a weight in excess of that fixed by the Board over any bridge or culvert. It increases the penalty from £20 to £50 and makes the owner of the vehicle liable in addition to the driver.

(*c*) *Destruction, Etc., of Roadside Fixtures.*

This amendment imposes a penalty of not more than £50 for damages to or destruction of guide posts, bridge handrails, signs or other roadside fixtures.

(*d*) *Impounding of Cattle.*

This amendment concerns the release of cattle which have been impounded by an officer of the Board. It requires a person claiming cattle which have been impounded or are being taken to a pound to give his full name and address and the full name and address of the owner of the cattle to the Board's officer or the pound-keeper before the cattle are released.

(*e*) *Developmental Roads—Payments to Municipalities or Contractors.*

This amendment makes the procedure to be observed in making partial payments on account to municipal councils and contractors for works performed by them on developmental roads consistent with that provided for in the Act in respect of other roads. The Act previously provided that the total cost of making permanent works and maintenance on developmental roads should in the first instance be paid by the Treasurer upon warrant by the Board. For some time past, by arrangement with the Treasurer, payments to municipal councils and contractors for works performed by them on roads have been made direct by the Board, the amount involved being subsequently reimbursed by the Treasurer.

(*f*) *Power to Erect Structures for the Protection of Passenger or Regulation of Traffic.*

This amendment gives the Board power to erect structures for the protection of pedestrians or regulating the traffic similar to that contained in the Local Government Act.

(*g*) *Maps sealed by the Board to be* Prima Facie *Evidence.*

This amendment provides that any maps sealed by the Board shall within twelve months of sealing be *prima facie* evidence that any road shown thereon as a main road, State highway, developmental road, tourists' road, forest road or by-pass road is such a road. All Courts of Justice and persons acting judicially are required to take judicial notice of the Board's seal on the map.

(*h*) *Increase of Penalties.*

This amendment increases penalties under the Country Roads Act to a uniform amount of £50.

(*i*) *Miscellaneous.*

Other enactments which concerned the Board were the *Hawthorn and Kew Railway (Dismantling) Act* 1958 (No. 6465) the *Motor Car (Amendment) Act* 1958 (No. 6532), and the *Commonwealth Aid Roads Act* 1959. The *Hawthorn and Kew Railway (Dismantling) Act* 1958 gave the Victorian Railways Commissioners authority to dismantle the Hawthorn and Kew railway. The Board has since obtained a lease of the old Kew railway station site for the erection of a new office building. Section 3 of the *Motor Car (Amendment) Act* 1959 provides that no registration fee shall be payable in respect of the registration of motor vehicles used or intended to be used in Victoria solely for interstate trade, commerce or intercourse.

Federal Aid for Roads.—On 22nd May, 1959, the *Commonwealth Aid Roads Act* 1959 received Royal Assent. This Act provides that as from 1st July, 1959, payments to the States for roads and works connected with transport will be based on fixed grants for the next five years. For more than 30 years, Commonwealth assistance for roads has been proportioned to the increasing consumption of petrol and diesel fuel used in road vehicles. This direct association of Federal aid for roads with a form of road user taxation has thus been terminated.

Victoria's share will increase from 17·573 per cent. under the area–population formula of the old Act to 19·936 per cent. under the new area–population–motor vehicle formula.

The Act provides for basic grants of £40,000,000 to the States in the first year, rising by £2,000,000 each year to £48,000,000 in the fifth year. In addition, provision is made for a matching grant of £2,000,000 to the States in the first year, rising to £10,000,000 in the fifth year, on the condition that the States must contribute additional funds for roads equal to the amount of the Commonwealth matching grant. So far as Victoria is concerned the annual increment in Federal aid will thus be approximately £800,000 provided the State can also increase its own road funds by £400,000 per annum.

26. SUBDIVISIONS.

Rapid land development in recent years, particularly in urban areas, has resulted in large-scale subdivision into residential, commercial and rural lots. These, in turn, generate increased local traffic and the Board is therefore concerned to ensure that subdivisional roads are planned so that the safe and smooth flow of traffic along declared roads abutting the subdivision is not impaired.

DECENTRALIZATION.

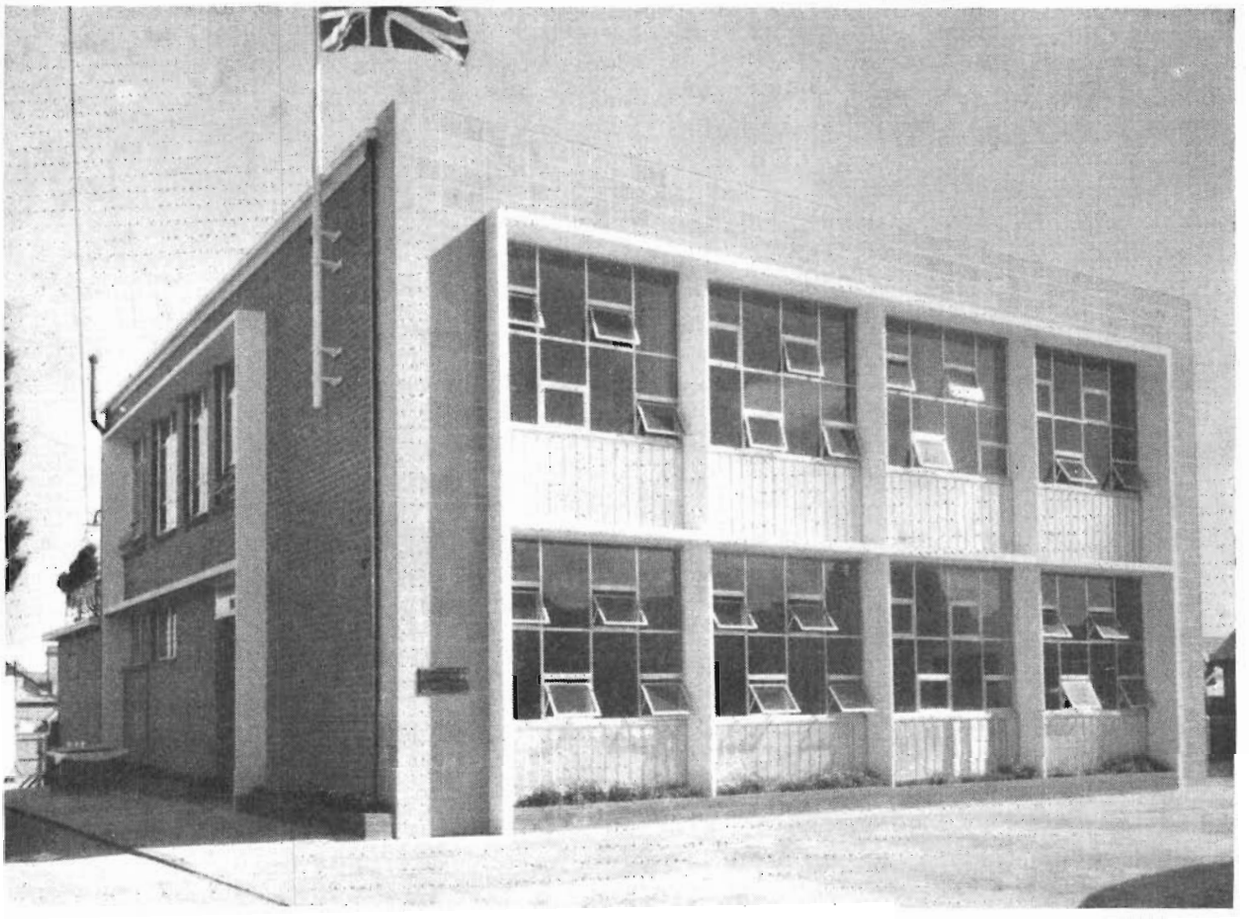


Plate 35.—New Country Roads Board Divisional Offices at Bairnsdale.

DISPLAY.

Plate 36.—Country Roads Board display at Royal Melbourne Show, 1958.

The Board appreciates the co-operation received from survey consultants in preparation of subdivisional plans to acceptable standards and from municipal councils and their officers in arranging for the inclusion of subdivisional roads or the setting back of new buildings to meet the Board's requirements.

27. PHOTOGRAPHY.

The Board's mobile projection unit serviced 37 camps in locations remote from townships during the year and gave 117 screenings to a total of 2,850 people. Films hired from commercial distributors and those made by the Board's staff were used in the programmes. Board's films were projected at schools, clubs and other organizations on twenty occasions, to audiences totalling 2,260 people. Board's films were also lent to 24 organizations and were viewed by 2,930 persons.

On three occasions film supplied by a television station has been exposed by the Board's photographers and the processed film has been transmitted in televised news sessions. Favourable comments have been made concerning the work of the Board's photographers in exposing these films. On two other occasions television stations have photographed projects undertaken by the Board for inclusion in news sessions. The co-operation of television stations in placing aspects of the Board's activities before the general public is greatly appreciated.

For record purposes many still photographs were taken throughout the year of Board's and Councils' activities on road and bridge works. Some colour transparencies in 5 in. x 4 in. and 120 film size were produced and a number of 35mm. transparencies were prepared for lecture purposes. The Board's photographers also produced for the Tourist Development Authority, black and white and colour photographs of holiday scenes, and photographed, edited and scripted a film of three short subjects in black and white for television release.

28. DISPLAYS AND EXHIBITIONS.

At the 1958 Show of the Royal Agricultural Society of Victoria the Board's exhibit of photographs emphasized the theme that roads connect primary producers to markets. Coloured transparencies were used to indicate how roads serve the community and films of works in progress by the Board were exhibited (Plate 36).

At a convention arranged by the Traffic Control Equipment Manufacturers Section of the Victorian Chamber of Manufacturers, the Board exhibited in the Exhibition Buildings various traffic counters, speed meters and signs used by the Board. A model of the King Street Bridge project which is being constructed under contract and supervised by the Board together with large photographs of divided highways and a display of traffic counters formed the Board's exhibit at the 1959 Motor Show. At all these displays, Board's officers answered many inquiries regarding details of the exhibits.

During the year a model of the King Street Project was shown for some months in the Museum of Applied Science.

29. STAFF AND EMPLOYMENT.

Staff.—Thirty-three male officers and 26 female officers resigned during the year and new appointments totalling 104, comprising 76 males and 28 females were made. There is still a need for additional qualified engineers, draftsmen and engineering surveyors to cope with the increased works programme for the current year.

The following officers retired during the year 1958–59 :—

Mr. C. G. Griffiths, Accountant on the 2nd April, 1959, after 34 years service with the Board.

Mr. L. Popplewell, Divisional Accounts Clerk, Benalla, on the 10th June, 1959, after 12 years service with the Board.

It is greatly regretted that two highly valued officers passed away during the year. The names of these officers whose loss is greatly felt by the Board and staff, are as follows :—

Mr. E. S. Cox.

Mr. E. Hansen.

Staff Charities Fund.—This fund again received substantial support from a number of members of Board's staff mainly by contributions deducted from each fortnightly pay. The total sum contributed during the year including special donations was £363 8s. 1d., a slight increase over the contributions for the previous year.

A total amount of £355 was contributed to 23 charities throughout the State, including various metropolitan and country hospitals, the Junior Legacy Group, the Institute for the Blind, and various appeals by or on behalf of the Returned Sailors, Soldiers, and Airmen's Imperial League of Australia. Donations on a " bulk " basis were also made to several special button day appeals by purchasing buttons or badges for each contributor to the fund. The balance of £143 2s. 9d. on hand at the 30th June, 1959, will be used to meet commitments which will arise later in the calendar year.

Cadetships and Scholarships.—Mr. R. T. Underwood, B.C.E., D.T.R.P., C.E., M.A.P.I., resumed with the Board at the end of the 1958 academic year, having qualified as a Bachelor of Civil Engineering with honours at the University of Melbourne. He received the Civil Engineering Prize for 1958, awarded by the Institution of Engineers, Australia. In March, 1959, Mr. Underwood was awarded the Sidney Myer Highway Traffic Scholarship tenable at Yale University, U.S.A., commencing in August, 1959.

Mr. E. T. Oppy, B.C.E., C.E., A.M.I.E. Aust., an Assistant Engineer, Benalla Division, was nominated by the Board for the course in Highway Engineering at the University of New South Wales.

The Board decided in 1955, to establish cadetships for the degree courses in Civil Engineering and Surveying and, in 1958, added Commerce to the cadetships available.

The following table shows the number of Board's cadets at the University in the current academic year :—

Year.	Course.	Number of Cadets.
First Year	Surveying	1
First Year	Civil Engineering	4
Second Year	Civil Engineering	4
Third Year	Civil Engineering	2
Fourth Year	Civil Engineering	1

Three probationary cadets commenced with the Board in January, 1959, and on the successful completion of their probationary period will commence at the University in March, 1960.

Pupil Surveyors.—Four pupil surveyors were articled to Board's Licensed Surveyors during the year 1958–59.

Employment.—The number of employees for the year averaged 2,760. The peak of employment for the year was reached in November, 1958, when 2,995 were working for the Board and the lowest number was 2,435 in June, 1959.

The total number employed in works being carried out for other authorities reached its peak during August, 1958, when 144 men were working for :—

State Rivers and Water Supply Commission	68	employees
Housing Commission	43	,,
Public Works Department	9	,,
Victoria Police	24	,,

During the year 1958–59 no difficulty has been experienced in recruiting employees.

ACKNOWLEDGMENTS.

The sincere thanks of the Board are tendered to the Minister of Public Works, the Hon. Sir Thomas Maltby, E.D., M.L.A., for his help and interest in its work.

The Board also desires to place on record its thanks and appreciation for the co-operation and assistance of officers of Government Departments, other State instrumentalities and municipal councils, as well as the road authorities in other States.

We have the honour to be,

Sir,

Your obedient servants,

D. V. DARWIN, M.M., M.C.E., M.I.C.E., M.I.E. (Aust.), C.E., F.A.P.I.. Chairman.

C. G. ROBERTS, M.C., B.Sc. (Eng.), A.M.I.C.E., M.I.E. (Aust.), C.E., F.A.P.I., Deputy Chairman.

W. H. NEVILLE, J.P., A.A.S.A., Member.

R. E. V. DONALDSON,
J.P., A.A.S.A., A.C.A.A.,
Secretary.

COUNTRY ROADS BOARD.

Statement of Receipts and Payments for Year ended 30th June, 1959.

(Adjusted to nearest pound.)

—		Country Roads Board Fund.		Commonwealth Aid Roads.			Loan Funds.		Commonwealth/ State Flood Restoration.	Total.
		Act 6229.	Act 6222 Road Maintenance Account.	Act 1954–56.		Act 1957.	Permanent Works.	Restoration of Flood and Bush Fire Damage.		
				Sec. 9 (2).	Sec. 9 (3).	Special Assistance.				
Receipts.	£		£	£	£	£	£	£	£	£
Balances at 1st July, 1958		219,787	35	..	..	..	..	..	..	219,822
Motor Car Registration Fees	8,191,521		..	..	..	..	..	..	..	..
Additional Registration Fees	537,645		..	..	..	..	..	..	..	..
Drivers Licence Fees	284,994		..	..	..	..	..	..	..	..
Fines	185,231		..	..	..	..	..	..	..	..
	9,199,391									
Less Cost of Collection	574,318									
		8,625,073	..	..	..	..	..	..	..	8,625,073
Municipalities Repayments—										
Permanent Works—Main Roads	22,036		..	..	..	..	..	..	..	..
Maintenance—Main Roads	663,737		..	..	..	..	..	..	..	685,773
		685,773								
Money provided by Commonwealth Aid Roads Acts		..	..	3,570,243	2,600,732	700,000	..	..	..	6,870,975
Proceeds from Commercial Goods Vehicles Act 6222		..	1,873,424	..	..	..	..	..	..	1,873,424
Receipts from State Loan Funds—										
Act 6229		..	..	..	..	..	75,000	..	..	75,000
Act 6066—Flood and Bush Fire Damage		..	..	..	..	..	..	834	..	834
Moneys provided under Commonwealth/State Agreement for Flood Restoration		..	..	..	..	..	..	..	53,171	53,171
Fees and Fines under Country Roads Act		1,453	..	..	..	..	..	..	..	1,453
General Receipts		28,810	..	..	..	..	..	..	..	28,810
		9,560,896	1,873,459	3,570,243	2,600,732	700,000	75,000	834	53,171	18,434,335

Payments.										
Main Roads—										
Construction and Reconstruction	3,030,398	..	1,241,870	..	..	75,000	..	9,854	4,357,122
Maintenance	1,140,269	..	39,040	..	..	..	..	..	1,179,309
State Highways—									
Construction and Reconstruction	1,572,950	..	1,202,006	..	700,000	..	..	9,317	3,484,273
Maintenance	..	1,873,459	..	..	..	..	..	..	1,873,459
By-pass Roads—Construction and Reconstruction	28,579	..	..	..	..	..	..	..	28,579
Tourists' Roads—									
Construction and Reconstruction	302,366	..	..	..	..	..	..	..	302,366
Maintenance	151,511	..	..	..	..	..	..	..	151,511
Forest Roads—									
Construction and Reconstruction	115,805	..	..	..	..	..	..	..	115,805
Maintenance	74,847	..	..	..	..	..	..	..	74,847
Unclassified Roads—									
Construction and Reconstruction	..	..	882,016	1,861,779	..	..	834	34,000	2,778,629
Maintenance	..	..	..	592,804	..	..	..	..	592,804
Murray River Bridges and Punts	82,899	..	..	..	..	..	..	..	82,899
Traffic Line Marking	33,150	..	..	..	..	..	..	..	33,150
Plant Purchases	712,974	..	..	..	..	..	..	..	712,974
Traffic Lights	1,700	..	..	..	..	..	..	..	1,700
Interest and Sinking Fund Payments	862,583	..	..	..	..	..	..	..	862,583
Payment to Tourist Fund	144,770	..	..	..	..	..	..	..	144,770
General and Administrative Expenditure	969,692	..	..	..	..	..	..	..	969,692
	9,224,493	1,873,459	3,364,932	2,454,583	700,000	75,000	834	53,171	17,746,472
Balances at 30th June, 1959	336,403	..	205,311*	146,149*	..	..	..	..	687,863

NOTE.—Relief to Municipalities granted under Act 6229, Section 32, amounted in 1958–59 to £94,223.

* Contributions received on the 26th June, 1959.

AUDITOR GENERAL'S CERTIFICATE.

The accounts of the Country Roads Board for the year ended 30th June, 1959, have been audited. In my opinion the above statement of Receipts and Payments fairly presents in summary form the transactions during that period.

R. W. GILLARD,
Auditor-General.
23rd December, 1959.

R. G. COOPER,
Accountant.
13th November, 1959.

COUNTRY ROADS BOARD.

Loan Liability as at 30th June, 1959.

—	£ s. d.	Main Roads, &c. £ s. d.	Developmental Roads. £ s. d.	Total. £ s. d.
Permanent Works—				
Main Roads	6,885,971 15 11			
State Highways	5,590,147 1 9			
Tourists' Roads	55,292 10 3			
Forest Roads	1,083 18 11			
		12,532,495 6 10	..	12,532,495 6 10
Developmental Roads		..	6,425,757 10 11	6,425,757 10 11
Discounts and Expenses		251,240 13 10	264,064 15 8	515,305 9 6
Total Amount Borrowed		12,783,736 0 8	6,689,822 6 7	19,473,558 7 3
Less Redemption of Loans—				
Redemption Funds		85,219 1 1	646,386 7 4	731,605 8 5
Main Roads Sinking Fund		285,688 7 7	..	285,688 7 7
Developmental Roads Sinking Fund		..	55,083 0 2	55,083 0 2
State Loans Repayment Fund		1,105,348 9 5	..	1,105,348 9 5
National Debt Sinking Fund		1,329,331 7 0	1,708,832 2 8	3,038,163 9 8
		2,805,587 5 1	2,410,301 10 2	5,215,888 15 3
Loan Liability at 30th June, 1959		9,978,148 15 7	4,279,520 16 5	14,257,669 12 0

CHIEF ENGINEER'S REPORT

Country Roads Board,
Melbourne.
23rd November, 1959.

THE CHAIRMAN,

SIR,

I have the honour to submit a report on matters of technical interest carried out during the year 1958–59.

MECHANICAL DIVISION.

With the continued increase in the Board's plant there has been a concomitant increase in the amount of routine maintenance required, but no commensurate increase in staff. The staff is still inadequate for the performance of the necessary functions of the division, and it will be necessary to engage additional engineering and clerical personnel. In spite of this difficulty a considerable amount of experimental and developmental work has been carried out, an outline of which follows :—

(i) *Mobile Cookhouse.*—Two newly designed and completed mobile cookhouses are about to undergo field tests. The cookhouses are lighter, cheaper, and have a better stability than the present models used. Propane gas is used for heating, refrigerating, and lighting, and this should provide easier maintenance and cleaning of all implements. The cookhouse is mounted on a four-wheel central bogie-type suspension in accordance with accepted present-day caravan standards. (Plate 1.)

(ii) *Aggregate Loader.*—Encouraged by the success in the field of the first prototype of a new aggregate loader the first four production loaders are in the course of manufacture. The new loaders are expected to go into the field late in 1959.

(iii) *Concrete Roller.*—A single axle, dual-tyred, two-wheel roller using a concrete trough as a ballast box is in the course of manufacture. The roller, which is entirely of the Board's design, will have a tare weight of 7½ tons and a ballasted weight of 19 tons with a tyre inflation pressure of 105 lb. per square inch. The tyres are of a steel wire core type and are fitted to 24-in. rim wheels.

(iv) *Road Broom.*—A new rotating road broom was designed and tried successfully for use in bituminous surfacing work. The broom is hydraulically raised and lowered, and will, at a substantial saving in construction and maintenance costs compared with the present types used, form the basis of the Board's future brooms. (Plate 2.)

(v) *Water Sprayer.*—The design of a new 1,000-gallon capacity truck chassis mounted water sprayer has been completed. It is expected that six of these new sprayers will be manufactured shortly.

(vi) *Spark Arresters.*—It is proposed to carry out jointly with the University of Melbourne further spark arrester tests. The purpose of these tests is to establish the suitability of commercial spark arresters for a range of engines of known characteristics, with complete safety from causing fire, without the lengthy and costly tests now required. The results should prove a saving both to the Board and to the Board's suppliers of internal combustion engine powered plant.

Plate 1.—Mobile Cookhouse.

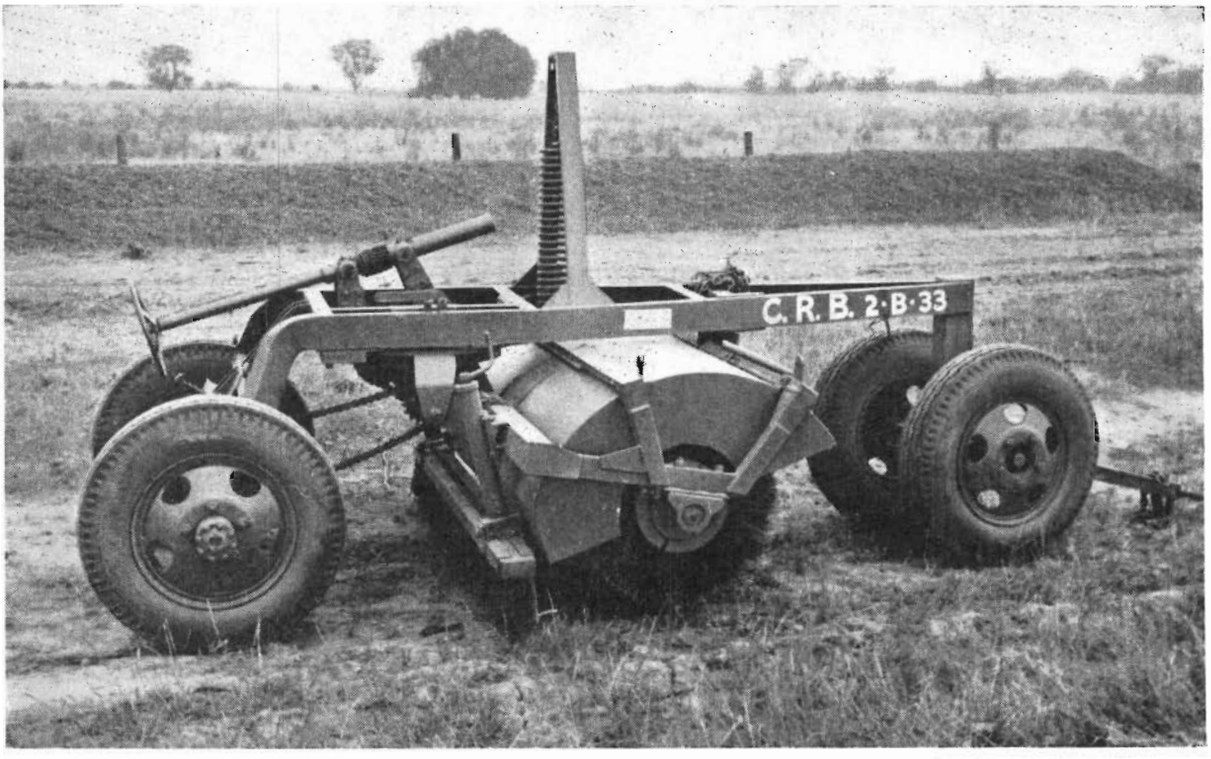


Plate 2.—Road Broom.

Plate 3.—Seaman-Gunnison Duo-pactor.

(vii) *Duo-pactor.*—During the year the Board obtained and started to use a Seaman-Gunnison "Duo-pactor". The "Duo-pactor" is a self-propelled roller which combines a pneumatic-tyred roller with a steel wheeled roller. (Plate 3.) The machine is hydraulically steered, is most mobile, and can be used ballasted or unballasted. The "Duo-pactor" can, depending on the ballasting, produce the equivalent of the compacting figures of any of the Board's

TABLE 1.—PLANT EFFICIENCY.

	Overall Efficiency.		Overall Mechanical Efficiency.		Mechanical Efficiency of Units in the Field.	
	1954–55.	1958–59.	1954–55.	1958–59.	1954–55.	1958–59.
	%	%	%	%	%	%
Crawler Tractors—						
Class I.	34	40	40	40	85	81
II.	40	54	51	63	81	91
IV.	33	48	42	62	79	81
Power Graders—						
Heavy tandem diesel	63	74	69	80	93	95
Patrol power graders	53	64	62	70	89	94
Front End Loaders—						
Pneumatic tyres	45	45	57	56	88	90
Crawler	28	56	36	66	76	92

pneumatic-tyred multi-wheel rollers or of its steel tyred road rollers. Its main specifications are as follows :—

Shipping weight .. 5 tons 7 cwt. 1 qr.
Length .. .. 22 ft. 6 in.
Width .. .. 7 ft. 2 in.
Height .. .. 6 feet
Front tyres (2 sets dual) 11 x 28 x 4-ply
Rear tyres (8) .. 7·50 x 15 x 6-ply
Steel roll width .. 72 inches
Steel roll diameter .. 31 inches
4 cylinders, 46 h.p., International.

Rolling speeds—

High range from 2·6 m.p.h. to 16·7 m.p.h.; 3·2 m.p.h. reverse.

Low range from 1·8 m.p.h. to 11·3 m.p.h.; 2·2 m.p.h. reverse.

Road speed 18 m.p.h.

Weights with sand ballast—

	T.	C.	Q.		T.	C.	Q.
Front axle	5	18	2	Front axle	3	9	2
Rubber ..	10	11	1	Steel roll	13	0	1
	16	9	3		16	9	3

= 405 lb./in. on roll.

(viii) *Snow Plough.*—A caterpillar D.7 tractor was fitted with a snow plough blade designed and made in the Board's South Melbourne workshop. The angling and indexing of the plough blade is performed by hyraulic rams while a cable from a power control winch accomplishes its lifting and lowering. The plough has now commenced working in the field at Mount Buffalo, in the Benalla division.

(ix) *Rippers.*—Some experiments were carried out to establish ripper tine and tine shoe angles for best operation and minimum tractor horsepower demand. Some results are already available but further tests will have to be carried out before definite conclusions and a report can be submitted.

(x) *New Workshop.*—Considerable progress has been made toward the completion of the new Central workshop and depot at Syndal. The main part of the workshop building is already in limited use. It is expected that the office and amenities buildings will be completed towards the end of 1959, at which time it is proposed to transfer the entire mechanical division to the new location.

(xi) *Plant Purchased.*—Other new units used were—

(*a*) L.W. 16 Tournadozer

(*b*) Model D Tournapull

(*c*) Michigan front end loaders

(*d*) Domor trench widener

(*e*) Blade rooters

(*f*) Root rakes.

(xii) *Efficiency.*—A steady improvement is being maintained in the operating and mechanical efficiency of the Board's plant, as shown in Table 1, there being percentage increases of from 6 per cent. to 28 per cent. in overall efficiency over the figures shown in 1954–55, with the exception of pneumatic-tyred front end loaders whose overall efficiency has remained the same.

BITUMINOUS SURFACING.

1. *Extent of Work.*—Table 2 sets out the mileages of work carried out on declared roads, unclassified roads, and for other authorities, during the past two years, the total length for 1958–59 amounting to 2,298 miles or 55 miles less than the length carried out in 1957–58.

TABLE 2.—LENGTH OF WORK CARRIED OUT IN 1957–58 AND 1958–59.

Type of Road and Plant Used.	Miles.			
	1957–58.		1958–59.	
(*a*) Work on C.R.B. declared roads—				
(i) Board's plant ..	1,654		1,460	
(ii) Municipal plant ..	55		60	
(iii) Contractor's plant ..	24		16	
		1,733		1,536
(*b*) Work on undeclared roads to which the Board contributes—				
(i) Board's plant ..	458		596	
(ii) Municipal plant ..	54		73	
(iii) Contractor's plant ..	22		..	
		534		669
(*c*) Work for other Authorities done by Board's plant—				
(i) Municipalities ..	73		84	
(ii) State instrumentalities ..	5		9	
(iii) Commonwealth of Australia	5		..	
		83		93
(*d*) Work done for municipalities by C.R.B. contractor's plant ..		3		..
		2,353		2,298

TABLE 3.—MILEAGE OF EACH TYPE OF WORK CARRIED OUT ON DECLARED ROADS DURING 1958–59.

Type of Road and Control of Work.		Length in Miles.																			
		Nature of the Work.																		Summary of Work.	
		Initial Treatments.										Retreatments.									
												Reseals.									
												Nominal Size of the Aggregate.					Two Application Reseal.	P.M.S.	Pen. Mac.	State Highways.	Other Declared Roads.
Road.	Control.	Duplication and Widening.		One Application Seal Only.		Two Application Seal Only.		I.T. Prime and Two Application Seal.		I.T. Prime and Seal.											
		Widen.	Duplication.	E.	R.	E.	R.	E.	R.	E.	R.	¾-in.	⅝-in.	½-in.	⅜-in.	¼-in.					
State Highways	Direct	33·46	20·58	20·81	27·19	..	1·45	..	..	20·77	104·95	13·88	28·68	28·53	47·57	117·94	..	22·59	..	488·4	..
	Municipal	..	..	..	..	..	..	..	..	..	4·40	..	..	16·00	..	..	..	0·98	..	21·38	..
Main, Tourist's, and Forest Roads	Direct	19·84	..	8·93	2·10	..	..	..	..	29·68	8·84	0·38	0·75	5·58	6·69	7·46	0·75	..	..	..	91·00
	Municipal	30·21	..	185·56	39·07	2·06	..	2·00	..	259·30	55·65	10·33	48·78	108·94	81·13	105·08	..	6·57	0·94	..	935·62
	Totals ..	83·51	20·58	215·30	68·36	2·06	1·45	2·00	..	309·75	173·84	24·59	78·21	159·05	135·39	230·48	0·75	30·14	0·94	509·78	1,026·62
		104·09		283·66		3·51		2·00		483·59		628·47						31·08			
		876·85										659·55								1,536·40	
		1,536·40																			

Abbreviations.—E, Extension to the bituminous surfaced system. R, Initial treatment on reconstructed length of previously sealed pavement. P.M.S., Treatment with plant mix.
R.M.S., Treatment with roadmix. Pen. Mac., Penetration Macadam.

NOTE.—The Table does not include 669 miles of work done on Undeclared roads to which the Board contributes funds.

Table 3 (page 52) shows the lengths of different types of treatment carried out on the declared system while Table 4, sets out similar information in respect of unclassified roads. The work carried out was predominantly spraying, the tables indicating that of the total of 2,298 miles of work done, only 30 miles consisted of either bituminous macadam or bituminous concrete which provided some correction of any irregularities of the surface.

TABLE 4.—MILEAGE OF WORK CARRIED OUT ON UNDECLARED ROADS DURING SEASON 1958–59.

Work.	Miles.	
Initial Treatments—		
Extensions	539·99	
Reconstructed lengths of previously sealed pavements	21·42	
Widening	5·05	
		566·46
Penetration		3·67
Retreatments		98·56
Total		668·69

Table 5 sets out in a summarized form the lengths of work carried out on roads to which the Board contributes funds.

TABLE 5.—MILEAGE OF DIFFERENT CATEGORIES OF WORK CARRIED OUT ON ROADS TO WHICH THE BOARD CONTRIBUTED FUNDS DURING THE YEAR 1958–59.

Work.	Miles.	
Initial Treatments—		
Extensions to the length of sealed roads	1,069·1	
Reconstructed lengths of previously sealed pavements	269·7	
Widening of existing sealed pavements	88·6	
Duplication—initial treatment of additional traffic lanes	20·6	
		1,448·0
Retreatments—		
Reseals or plant mixed work		757·1
Total		2,205·1

To carry out the work 243,363 cubic yards of aggregate was required, and Table 6 sets out the average prices per cubic yard of the different types used during the past five years. The comparison indicates that the average price of aggregate used was slightly lower this year than in the previous two years.

TABLE 6.—AVERAGE PRICE OF AGGREGATE FOR BITUMINOUS SURFACING AT PER CUBIC YARD IN STACKS BY THE ROADSIDE FOR THE YEARS 1954–55, 1955–56, 1956–57, 1957–58, 1958–59.

Material.	Price per Cubic Yard.				
	1954–55.	1955–56.	1956–57.	1957–58.	1958–59.
	s. d.	s. d.	s. d.	s. d.	s. d.
Screenings	44 5	44 10	51 5	49 4	47 9
Gravel	40 4	44 1	39 11	46 1	46 1
Sand	23 4	20 6	29 3	26 3	32 6
Scoria	12 1	18 4	26 2	18 9	8 6
Average price all aggregates	42 4	43 8	48 8	47 11	47 0

Table 7 (page 54) sets out the average costs of sprayed work of various types carried out this year, subdivided into the four major categories—materials, labour, plant hire, and stores. A broad analysis of the costs of the work indicates that, generally, the overall average costs in 1958–59 were slightly less than those in 1957–58.

2. *Bituminous Plant and Materials.*—A new type of aggregate loader, referred to on page 49 and in the Chief Engineer's report of 1957–58, was given extensive trials. Generally, it has proved to be successful. Although providing no better output than the standard type of loader, it shows promise of being more manoeuverable, and more easily maintained, than its predecessor. Additional loaders of the new type are being built, incorporating modifications which seemed necessary after experience gained during the use of the prototype.

Limited trials were undertaken with a rotary road broom of a semi-trailer type, embodying improvements to the broom drive and hydraulically operated control gear.

The 23,586 tons of bitumen used during the year were distributed throughout the State from local refineries by road and rail tankers in the proportion of 31 per cent. by road and 69 per cent. by rail. The quality of the material which was supplied to the specification for 80/100 penetration bitumen recommended by the National Association of Australian State Road Authorities, for Commonwealth-wide use, was kept under close control by tests carried out by an officer of the Materials Research division, who was in constant attendance at the refinery during the season. Some inconsistent ductilities after thin film baking were observed upon the resumption of manufacture of bitumen after the breakdown of the refineries, referred to in an earlier section of the Board's report, but generally, material throughout the year has complied satisfactorily with the quality specification.

Tar and benzol available at the Gas and Fuel Corporation's works at Morwell have been used for priming, 170,000 gallons of the mixture being used in the Traralgon division during the year. Better control of the quality and temperature of the material in the Corporation's storage tanks at Morwell is required, as the mixture is extremely critical and susceptible to temperature variations and conditions of the pavement to be treated. Only with care and a full knowledge of the characteristics of the mixture can satisfactory and economical use be made of this priming material.

3. *Rubber Incorporated in Binder.*—Past experience appears to have proved that the addition of rubber to bitumen in sprayed seal coats is an advantage when the surface to be treated is badly cracked, the increased "elasticity" of the bitumen apparently providing more tolerance to movement in the pavement, and following this, 5 miles of cement stabilized sand pavement on the Hume Highway near Creighton's Creek, south of Euroa, have been sealed with bitumen in which was incorporated 2 per cent. of "Rodarub" rubber powder.

(*a*) *Pavement Condition.*—The pavement consists of a 6-in. depth of cement stabilized sand which was laid in January, 1957, and sealed with 5/8-in. one size basalt aggregate. Stripping of the seal coat was obvious during 1958, and it was considered that this was basically due to extensive shrinkage cracking of the cement stabilized sand, permitting entry of water, and weakening the interface between the seal coat and the pavement. It was decided to try a $\frac{1}{4}$-in. one size reseal incorporating 2 per cent. rubber in the binder to improve the tolerance of the seal to cracking and help bridge the existing cracks.

TABLE 7.—AVERAGE COST OF B.S.T. WORK CARRIED OUT BY C.R.B. PLANT ON ROADS TO WHICH THE BOARD CONTRIBUTED FUNDS DURING 1958–59.
(Cost in pence per Square Yard.)

Item.	Nature of Work.																			
	Initial Treatments.								Retreatments.											
									Reseals.											
	I.T. Seal Only.		I.T. Two Application Seal Only.		I.T. Prime and Two Application Seal.		I.T. Prime and Seal.		Nominal Size or Gauge of Aggregate Used.										Two Application Reseal.	
									¾-in. "E".		⅝-in. "F".		½-in. "G".		⅜-in. "H".		¼-in. "I" and Sand.			
Square yards costed ..	4,133,077		101,413		32,807		6,729,473		268,355		910,010		165,373,4		144,877,3		242,106,4		18,500	
	d.	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%
Material	16·7	67·6	22·6	71·1	33·1	70·3	22·6	60·0	22·3	68·0	17·8	65·5	13·5	64·6	12·1	68·4	10·0	73·0	20·7	76·1
Labour	4·1	16·6	4·4	13·8	7·1	15·1	7·7	20·4	5·3	16·2	4·9	18·0	3·8	18·2	3·0	16·9	1·8	13·1	3·1	11·4
Stores	0·7	2·8	1·0	3·1	1·0	2·1	1·3	3·4	0·8	2·4	0·8	2·9	0·5	2·4	0·4	2·3	0·4	2·9	1·2	4·4
Plant Hire	3·2	13·0	3·8	12·0	5·9	12·5	6·1	16·2	4·4	13·4	3·7	13·6	3·1	14·8	2·2	12·4	1·5	11·0	2·2	8·1
Totals ..	24·7	100	31·8	100	47·1	100	37·7	100	32·8	100	27·2	100	20·9	100	17·7	100	13·7	100	27·2	100

(*b*) *Work Details and Method.*—The rubber was in powder form supplied in 70-lb. bags under the trade name of "Rodarub". The bitumen was R.90 supplied in bulk and the covering aggregate was ¼-in. one size partly-crushed river gravel.

The bitumen in the heaters was brought to a temperature of about 380° F. before the powdered rubber was added. The rubber, 20 lb. per 100 gallons, was then spread evenly over the surface of the bitumen and stirred in, until completely dissolved. This required three men stirring continuously for twenty minutes. The temperature of the bitumen was maintained during this period and the mixture was then taken into the sprayer and fluxed ready for spraying.

The fluxing adopted was 100 bitumen : 5 asphaltic oil : 17½ power kerosene. The quantity of power kerosene used was greater than normal in order to counteract the increase in viscosity of the binder caused by the addition of the rubber powder. The binder spraying temperature was 315° F. and the average rate of application was 0·134 gallon per square yard. The ¼-in. one size aggregate was pre-coated with asphaltic oil at 1 gallon per cubic yard and spread on the road at 1 cubic yard to 106 square yards of pavement surface.

(*c*) *Observations.*—It was particularly noticeable that the binder was more "sticky" than usual, and its adhesion to the stones was much better than on the control section which had no rubber in the binder. After six months the surface appeared water-tight and in a satisfactory condition. It is considered, however, that more time is required before any definite data can be obtained from this experiment.

As the result of this experience, cement stabilized sand pavements constructed during April and June, 1959, totalling approximately 5 miles, have been sealed with bitumen in which was incorporared 2 per cent. of "Rodarub" rubber powder.

4. *Use of "Paccal" Tars.*—Experimental work was also carried out in the Benalla division, using "Paccal" petroleum tars as priming materials and as adhesion agents to aid binder aggregate adhesion. The following types were used :—

"Paccal tar 3002," pre-coating tar ;

"Paccal tar 3004," light priming tar ;

"Paccal tar 3020," heavy priming tar.

(*a*) "*Paccal* 3002," *Pre-coating Tar.*—This material was used for pre-coating aggregate in order to deal with dust or moist conditions, i.e., those conditions under which the aggregate would usually be treated with 50/50 A.O. and P.K. plus an adhesion agent or, alternatively, an adhesion agent would be incorporated in the binder. An experimental reseal was carried out under these conditions on a section of the Rutherglen-road in the township of Springhurst. A length of 0·25 mile was resealed with 5/8-in. one size partly-crushed river gravel. The aggregate was dusty when dry and damp when used. "Paccal tar 3002" was sprayed on to the aggregate at the rate of 1¼ gallon per cubic yard during loading. For comparison, adjoining sections of road were treated as follows :—

(i) Without treatment of the aggregate, but with ½ per cent. by weight of Stearine Amine incorporated in the binder.

(ii) Aggregate treated with a 50/50 asphaltic oil and power kerosene mixture with "Nostrip" additive at 1¾ gallon per cubic yard.

It was observed that the "Paccal" tar was more difficult to spray than the A.O./P.K. mixture due to its higher viscosity, and would probably require heating during cold weather.

The initial adhesion of aggregate pre-coated with "Paccal" tar was slightly better than that of the other two processes, although after three weeks no difference in adhesion between the three sections was noticeable. The use of "Paccal" tar caused discoloration of the aggregate and this is still noticeable after a period of three months.

(*b*) "*Paccal* 3004," *Light Priming Tar.*—This tar is of approximately the same viscosity as Vertical Retort tar and is said to be suitable for deep penetration of average light pavement materials where rapid drying is desirable, and to be capable of carrying traffic. An experimental section on the Yarrawonga-road near Wangaratta was primed with "Paccal tar 3004" applied at the rate of 0·20 gallon per square yard at a spraying temperature of 120° F. The pavement was tightly bonded granitic sand which was slightly damp. The work was carried out in warm weather. An adjoining section was primed with Vertical Retort tar applied at the rate of 0·20 gallon per square yard.

The "Paccal" tar penetration was good but did not appear to be much better than the Vertical Retort tar. Both primed sections were sealed fourteen days after priming, and during this period both primers withstood medium traffic satisfactorily. The "Paccal" tar primer appeared to be in slightly better condition than the Vertical Retort tar primer.

(*c*) "*Paccal* 3020," *Heavy Priming Tar.*—This tar is of approximately the same viscosity as Horizontal Retort tar and it was suggested that this type be used on an absorbent gravel pavement where a heavy primer would usually be used. Because only a small quantity of "Paccal tar 3020" was available, only about 200 feet on the Ovens Highway at Bowman's Gap could be treated. The pavement was of fine crushed rock (river gravel) which was dry and tightly bonded. "Paccal 3020" was sprayed by hand from a patrol heater at the rate of 0·20 gallon per square yard at a spraying temperature of approximately 155° F. An adjoining section was primed with Horizontal Retort tar, applied at the rate of 0·20 gallons per square yard. Wet weather developed before the primers had set up sufficiently and, consequently, both sections were lightly covered with sand. The general characteristics of the "Paccal 3020" tar primer appeared little different from the Horizontal Retort tar primer. Sealing was carried out nine days after priming, and both primers withstood the traffic satisfactorily.

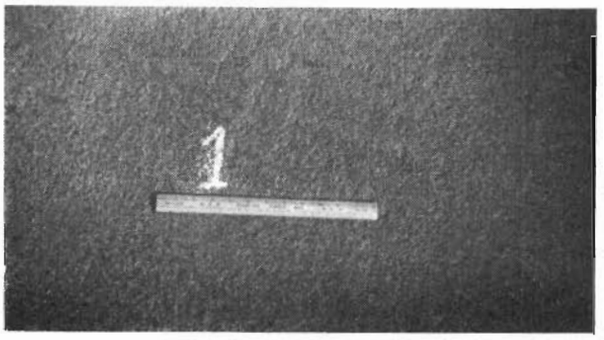
(*d*) *Cost Comparison.*—In general, comparison of the price of "Paccal" tar and Retort tars is as follows :—

	s.	*d.*	
"Paccal" tar, f.o.r. Albury (drums)	2	6½	per gallon
,, ,, ,, ,, (bulk) ..	2	5*	,, ,,
H.R. tar, *ex* Wagga Gas at Albury	2	2	,, ,,
H.R. tar, *ex* Albury Gas at Albury	2	0½	,, ,,
V.R. tar at Albury	2	3	,, ,,
50/50 A.O./P.K. + Nostrip mixture	2	9¼	,, ,,

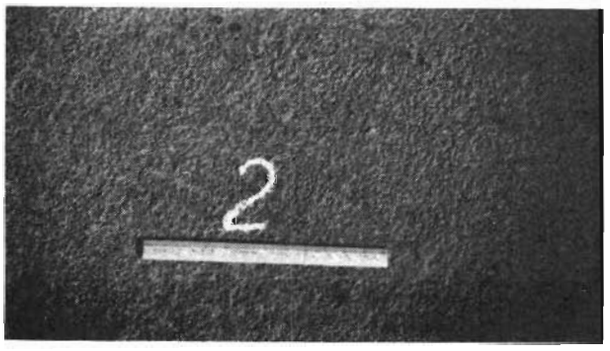
* Plus demurrage.

(*e*) *Conclusion.*—In general, the characteristics of the "Paccal" priming tars are little different from the corresponding Retort tar primers, but the cost is higher.

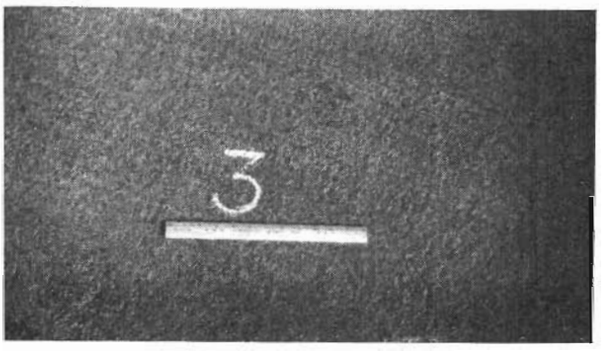
1. Pavement before application of seal.



2. After application of Mix 1



3. After application of Mix 2.



4. After application of Mix 3.

Plate 4.—Slurry Seal.

5. *Slurry Sealing.*—Slurry sealing, a process originating in Los Angeles, is a method of rejuvenating old, dried, oxidized bituminous pavements which may be cracked or ravelling. The slurry is composed of fine aggregate of 3/16-in. maximum size, having not more than 15 per cent. passing a 200-mesh sieve, 18 per cent. to 20 per cent. by weight of slow setting bituminous emulsion, and 10 per cent. to 12 per cent. by weight of added water mixed to the consistency of thick cream, the objective being to produce a mixture which will flow without segregation while being spread. A layer between $\frac{1}{8}$-in. and $\frac{1}{4}$-in. thickness is applied to the pavement. An experimental length of about 1 mile of the Murray Valley Highway near Cohuna, where the pavement was very badly cracked, was treated by this method in February, 1959. The gradings of aggregate and the mixtures used were as follows :—

GRADINGS.

Material.	Percentage Passing B.S. Sieves.							
	Sieve Sizes.							
	3/16 in.	No. 7.	No. 14.	No. 25.	No. 36.	No. 52.	No. 100.	No. 200.
Granite quarry dust ..	100	99	74	46	35	25	12	4
Fine sand ..	..	..	100	85	65	44	17	2

MIXTURES.

Mix No.	Quarry Dust.	Sand.	Emulsion.	Water.
1	200 lb.	Nil	4 gals.	2 gals.
2	200 lb.	Nil	3 gals.	1 gal.
3	134 lb.	66 lb.	3 gals.	1¼ gal.

The slurry was mixed in a half-bag concrete mixer mounted on a 5-ton truck, discharged by a chute into a spreader box towed behind the truck, and forced into the pavement by a rubber squeegee mounted across the width of the spreader. Thorough cleaning and dampening of the existing surface was necessary to facilitate the spreading and coverage of the slurry.

The best mixture appeared to be that containing quarry dust and fine sand, but all sections now present a reasonably uniform surface appearance and texture (Plate 4), although some of the worst cracks had reappeared by the time it was inspected on 27th May, these being due to the excessive movement of the old pavement.

It has been stated that under average weather conditions it is possible to allow traffic onto the slurry seal within two or three hours, but owing to the deformed pavement conditions the slurry seal was up to ½ inch in thickness in some places, and it was found necessary to exclude traffic for between 24 and 30 hours. Considering the experimental nature of the work and the improvised mixing equipment, the cost of 1s. 7d. per square yard was reasonable and the general result satisfactory.

ANALYSIS OF CONSTRUCTION COSTS.

Table 8 gives a summary of the cost analyses of 57 construction jobs completed during the financial year covering a total expenditure of £1,016,433, the cost of individual projects ranging from £2,225 to £90,365.

The total value of road construction works completed during the financial year, for which costing records were maintained, was £2,249,626. Table 9 gives a comparison of the "break-up" between plant, labour, materials, and stores for the previous five years, and indicates that there is little change from year to year.

TABLE 8.—DISTRIBUTION OF EXPENDITURE ON 57 CONSTRUCTION JOBS.

Item.	Cost.	Percentage.
	£	%
Plant	366,753	36·08
Labour	327,267	32·20
Materials	237,294	23·35
Stores	85,119	8·37
Total	1,016,433	100·00

TABLE 9.—COMPARISON OF THE BREAK-UP BETWEEN PLANT, LABOUR, MATERIAL, AND STORES IN THE PREVIOUS FIVE YEARS.

Financial Year.	Plant.		Labour.		Materials.		Stores.	
	Cost.	%	Cost.	%	Cost.	%	Cost.	%
	£		£		£		£	
1954–55	320,966	39·9	273,420	34·0	164,647	20·4	45,857	5·7
1955–56	324,247	35·2	307,126	33·3	209,715	22·8	79,773	8·7
1956–57	211,578	32·6	207,110	31·9	173,346	26·6	57,748	8·9
1957–58	395,415	32·3	377,896	30·9	327,696	26·7	123,367	10·1
1958–59	366,753	36·1	327,267	32·2	237,294	23·3	85,119	8·4

MATERIALS RESEARCH DIVISION.

1. *Analysis of Adhesion Agents.*—A pH electrometer with separate electrodes and magnetic stirrer has been obtained for use in the analysis of adhesion agents by potentiometric titration. This apparatus can also be used for the determination of the acidic constituents of bitumen and for studies of the corrosion of metals immersed in various natural waters.

2. *Lime Stabilization.*—The process of soil stabilization by the use of hydrated lime has been used extensively in some States of the U.S.A. Extensive use of the process in this country would require large quantities of lime, and although the lime need not be of the best quality, adequate supplies may not be available.

There are cases where this form of stabilization could be used economically, particularly as it permits more latitude in construction procedures than does cement stabilization. For instance, it can be done more easily with simple equipment such as rotary hoes and other farm machinery, and there is not the same limited working period before the material sets. In dry areas the lime can be mixed with water and sprayed as a slurry, and in this form it is a much less objectionable material to handle. The process is applicable to the improvement of subgrade soils, so that a lesser pavement thickness may be used, and also to the improvement of gravels which show excessive plasticity. Tests have been done on a number of samples which were compacted to 100 per cent. B.S. compaction, cured moist for seven days and then soaked for seven days before testing. The results are given in Table 10.

In all cases the addition of lime increases the C.B.R. and reduces the plasticity index, but the amount of improvement produced varies.

3. *Concrete Test Cylinder Results.*—During the last two years there have been several jobs from which a series of concrete test cylinders of the same nominal mix have been taken. These results have been statistically analysed mainly by analysis of variance, and in all cases the job mean and variance have been calculated. Where pairs of results are available, the testing variance was also determined.

The results fit into three groups: first, concrete used in the construction at Syndal depot; secondly, concrete from certain prestressed jobs; and thirdly, one particular mix from a "ready-mixed concrete" company.

Results: except where mentioned, all results are at 28 days' old and given in lb./sq. inch.

(*a*) *Syndal Depot.*

(i) Late 1957—Concrete supplied by a ready-mixed concrete firm to a strength specification.

Mean of 75 groups = 4,520.

Batch standard deviation (S.D.) = 690.

Coefficient of variation (C.V.) = 15 per cent.

Testing S.D. = 150, C.V. = 3½ per cent.

(ii) Early 1958—Concrete supplied by the same firm to the same specification.

Mean of 121 groups = 4,080.

Batch S.D. = 800, C.V. = 20 per cent.

Testing S.D. = 130, C.V. = 3½ per cent.

(iii) Early 1959—Concrete mixed on job by C.R.B. gang—6-bag mix.

Mean of 13 = 5,780.

Batch S.D. = 565, C.V. = 9½ per cent.

(iv) Middle 1959—Concrete mixed on job by C.R.B. gang. Same mix as above except for different cement.

Mean of 20 = 3,740.

Batch S.D. = 580, C.V. = 15½ per cent.

(*b*) *Prestressed Work.*

(i) Early 1958—Prestressed beams. Contractor "One".

Mean of 63 tests = 7,250.

Overall batch S.D. = 500, C.V. = 7 per cent.

TABLE 10.—LIME STABILIZATION TEST RESULTS.

Test Material.	Mechanical Analysis. Percentage Passing.			Plasticity Index. Percentage Limil.			C.B.R. Percentage Limil.		
	No.7.	No. 36.	No. 200.	0.	2.	4.	0.	2.	4.
Scoria—Mt. Frazer ..	49	29	13	38	6	6	25	70	160
Clay—Cohuna	100	99	97	31	23	19	7	40	60
Clay—Hamilton	100	86	80	36	30	26	9	15	20
Gravel—Mangalore ..	65	41	30	31	22	18	9	30	45

This variation was further split into two parts; variation between batches on a single day, S.D. = 340, C.V. = 4¾ per cent., and variation between days, S.D. = 370, C.V. = 5 per cent.

Tests at early ages from this job showed S.D. in the range 400 to 600, C.V. being 8 per cent. to 12 per cent.

(ii) Middle 1958—Prestressed deck slabs. Contractor "Two".

Mean of 76 groups = 8,330.

Batch S.D. = 620, C.V. = 7½ per cent.

Testing S.D. = 250, C.V. = 3 per cent.

Tests at early ages from this job showed S.D. in the range 700 to 1,000, C.V. being 15 per cent. to 20 per cent. The testing variation on these groups was actually lower in absolute value but stayed steady around 3 per cent. C.V. for each group.

(iii) Early 1958—Prestressed formwork slabs. Contractor "Three".

Mean of 22 groups = 7,210.

Batch S.D. = 1,060, C.V. = 14½ per cent.

Two extremely wide group results (not single cylinders) on the last two groups put these figures for variation well up. Without these, the results would be—

Mean of 20 groups = 7,240.

Batch S.D. = 690, C.V. = 9½ per cent.

On this job the testing variation was S.D. = 120, C.V. = 1½ per cent.

At early ages, the batch variation was 700 to 900, C.V. = 18 per cent. to 23 per cent., whilst the testing S.D. was similar to above.

(*c*) *Ready-mixed Concrete.*

Over about fifteen months, a ready-mixed concrete firm had supplied to several jobs a mix of the same nominal proportions. The cement content was about 6¼ bags/yard.

(i) At 7 days—

Mean of 32 = 3,790.

Batch S.D. = 740, C.V. = 19½ per cent.

(ii) At 28 days—

Mean of 32 = 5,530.

Batch S.D. = 730, C.V. = 13 per cent.

In both these groups, the figures for variation were very markedly influenced by one very high result and one very low result. Test of significance showed that the possibility of their occurrence by random chance was 1 in 300,000. Since this suggests that clear cut errors were involved, the above results were recalculated omitting these. They then became—

(iii) At 7 days—

Mean of 30 = 3,780.

Batch S.D. = 510, C.V. = 13½ per cent.

(iv) At 28 days—

Mean of 30 = 5,520.

Batch S.D. = 470, C.V. = 8½ per cent.

Conclusions.

(i) *Ready-mixed Concrete.*—It is not appropriate to base industry-wide generalizations on results of particular firms, but here the one supplier was concerned with results (*a*) (i), (*a*) (ii), and all of (*c*). For this firm, when supplying to a strength specification their concrete is likely to be significantly different at various times (compare (*a*) (i) with (*a*) (ii)). The variations (S.D. and C.V.) were higher than the firm claimed. In (*a*) (i), only one batch failed whilst in (*a*) (ii) the worsening of the quality was reflected by five failures.

When, however, supplying to a specified mix (results (*c*)), their concrete is likely to be much less variable and here the observed results were in the "good or better" class. There is apparently some possibility of a complete error, e.g., wrong mix being supplied.

(ii) *Prestressed Work.*—From results (*b*) (i), (ii), and (iii) it is apparent that the calibre of the work (as reflected in the S.D. and C.V.) varies from contractor to contractor. It is generally agreed that for the same degree of control the coefficient of variation lowers somewhat as the mean strength increases. Allowing for this, it appears that the control at these plants were "good to better". Contractor "One" was rather better than either of the others, particularly when it is noted that his batch S.D. was calculated on a different series of tests from the other contractors.

(iii) *Syndal Depot.*—Results (*a*) (iii) and (iv) show that the control of concrete job-mixed by C.R.B. gangs is good and is not inferior to that from ready-mixed firms.

The big drop in mean strength due to the change of brand of cement used is very significant. Conditions being otherwise similar, it can only be caused by the influence of the cement.

(iv) *Testing Variation.*—The most important conclusion is that the testing variation of cylinders made by C.R.B. operators is very small. The testing variation is the measure of the possible variations between cylinders made in the field at the one time from one quantity of concrete by one operator and cured, capped, and tested in standard fashion at Head Office laboratory. In no case was the cylinder maker either an expert or laboratory trained. Apart from a certain amount of practice due to the numbers involved, the procedure was similar to that on any Country Roads Board job.

A low value for testing variance has been observed before on all C.R.B. jobs. The effect of this is that the chance of a very low result due only to testing causes is negligible, particularly since any manifestly faulty cylinder must be rejected anyway.

4. *Asphalt Control.*—During the year, officers of the division have been stationed at contractors' asphalt plants to measure temperatures, take samples, and to guard against easily recognizable bad practice. This supervision has been valuable, but the full benefit is difficult to obtain because of a lack of experienced men, and the actual testing of materials at the plant has usually been confined to simple gradings on aggregate fractions and bulk density tests on fillers. As well as current plant control, samples of all materials used, and of the final mix are tested at the laboratory for compliance with Board specifications. A summary is presented of results of asphalt extractions found during a well-controlled job at one of Melbourne's most modern plants. (Table 11.)

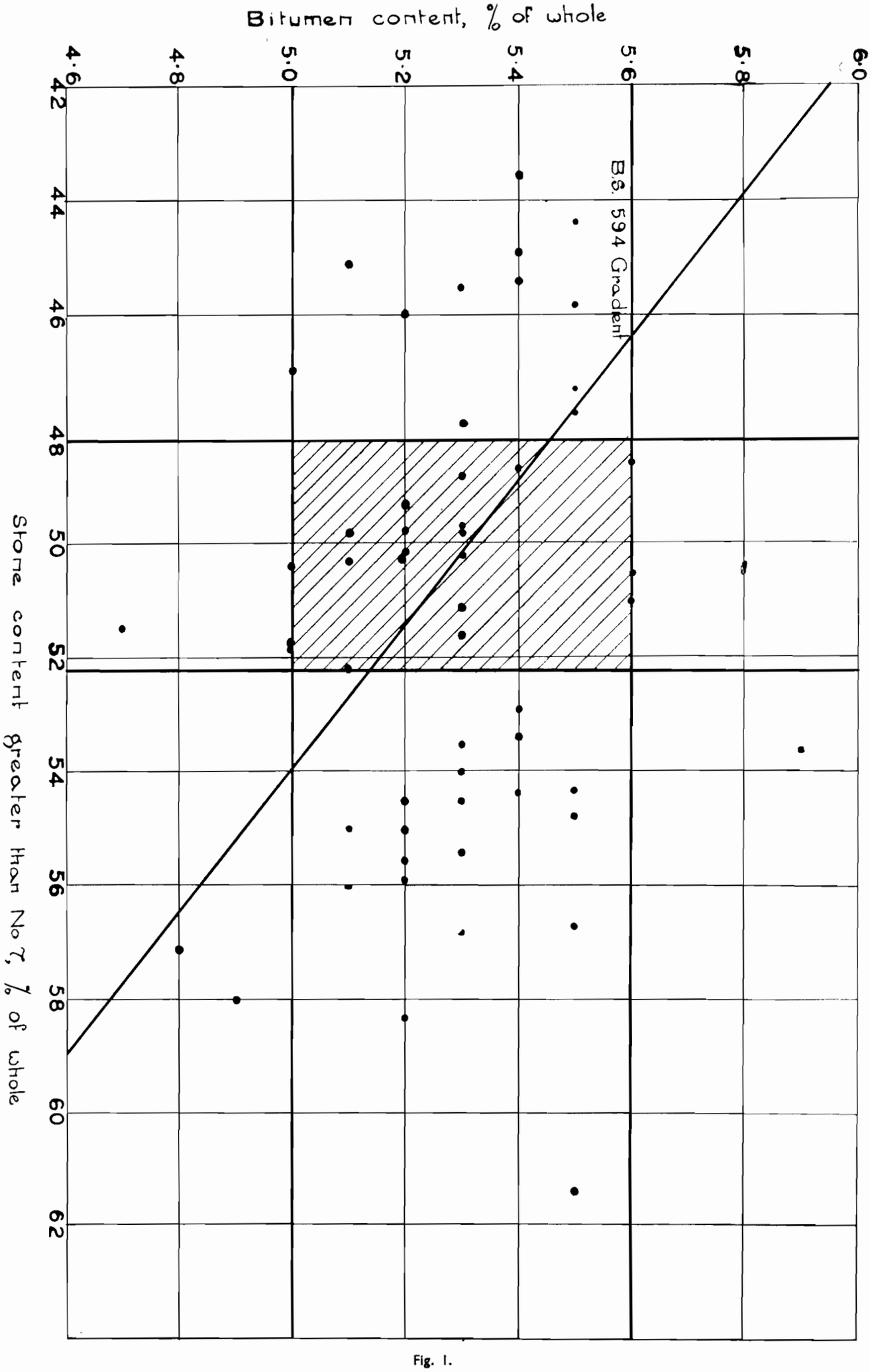

Bitumen content, % of whole
4·6
4·8
5·0
5·2
5·4
5·6
5·8
6·0
42
44
46
48
50
52
54
56
58
60
62
B.S. 594 Gradient
Stone content greater than No 7, % of whole

Fig. 1.

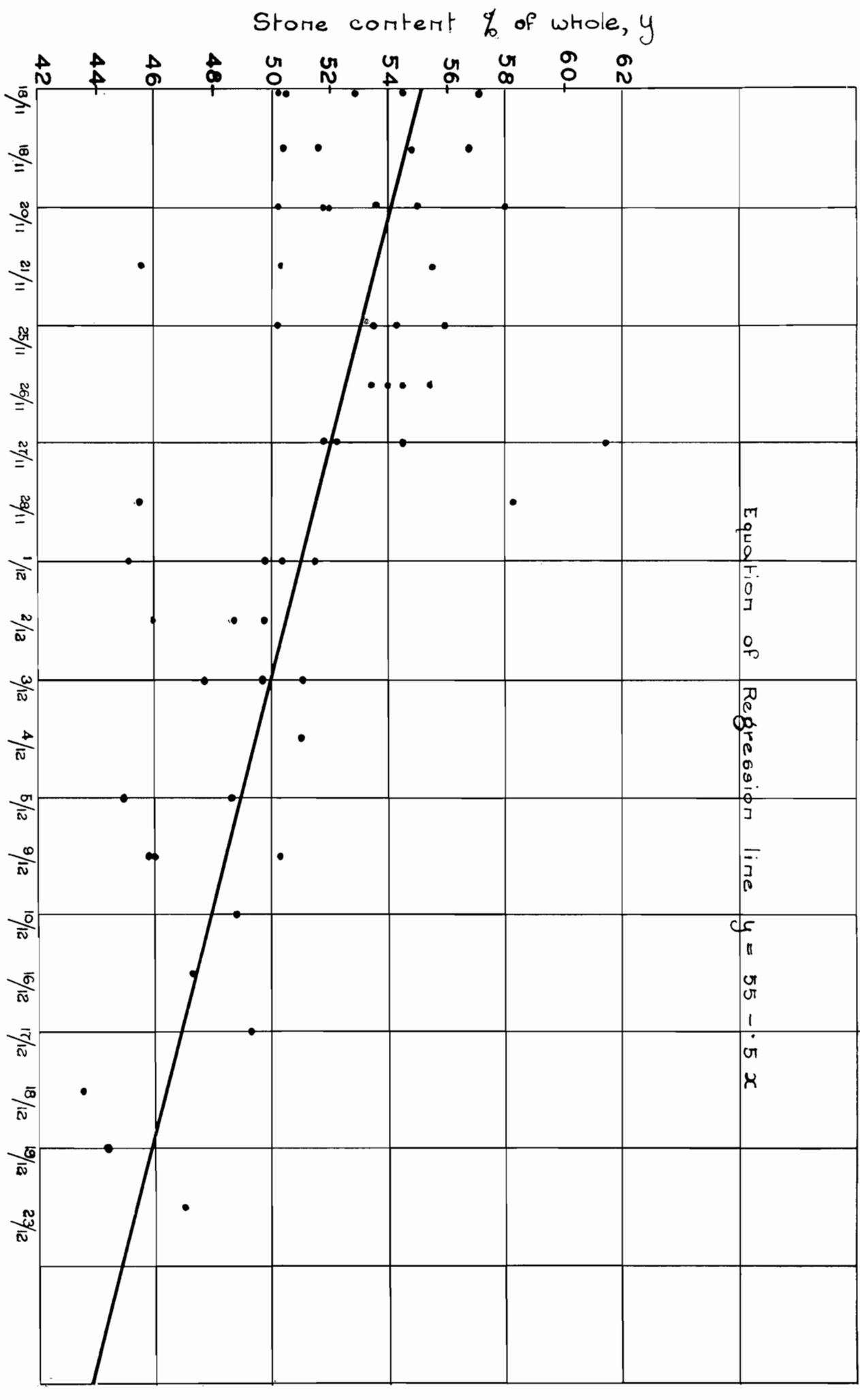

Stone content % of whole, y
42
44
46
48
50
52
54
56
58
60
62
Days of production, x
18/11
19/11
20/11
21/11
25/11
26/11
27/11
28/11
1/12
2/12
3/12
4/12
5/12
9/12
10/12
16/12
17/12
18/12
19/12
23/12
Equation of Regression line y = 55 - .5 x

Fig. 2.

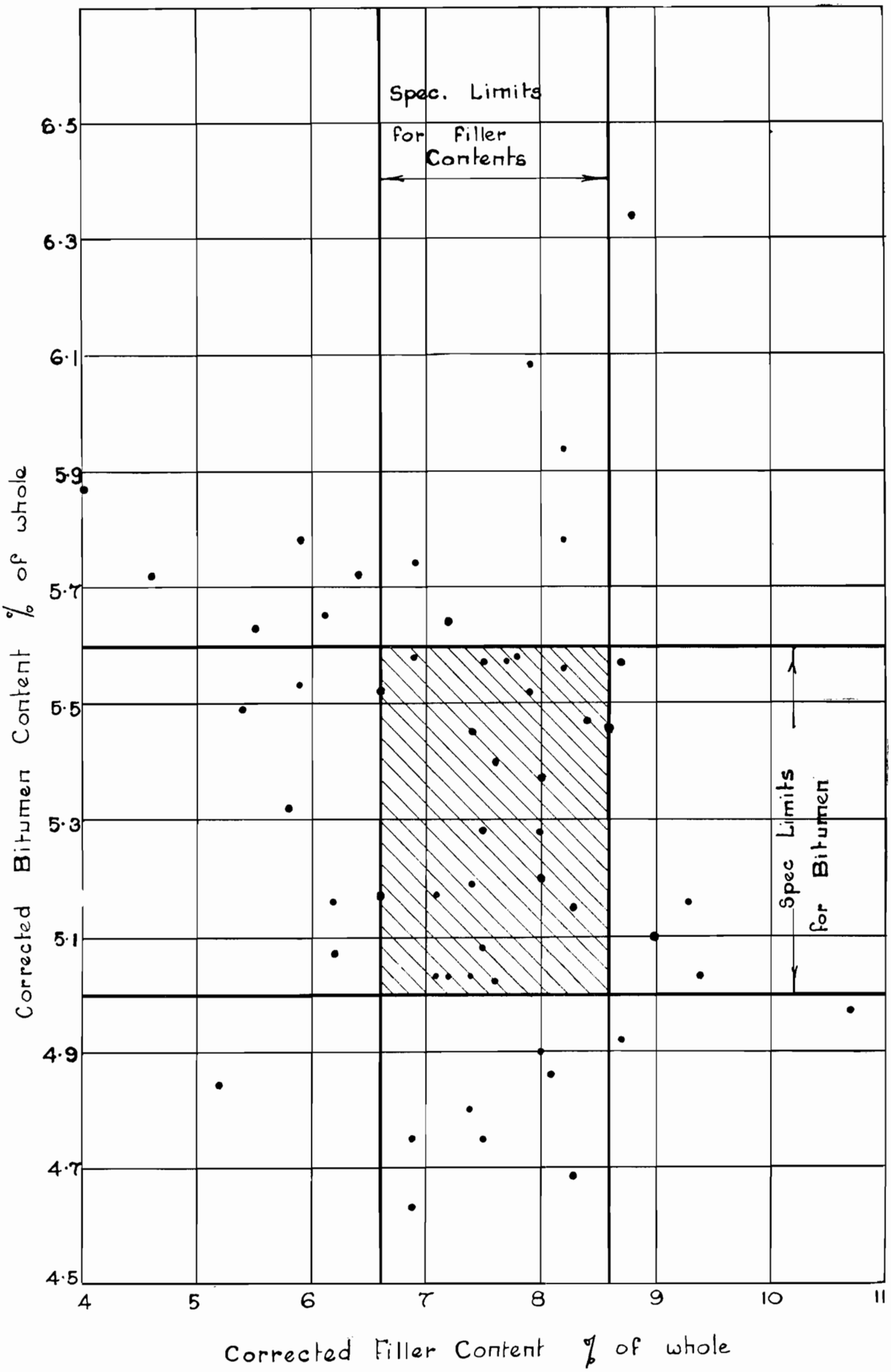

Spec. Limits
for Filler
Contents
Spec Limits
for Bitumen
6·5
6·3
6·1
5·9
5·7
5·5
5·3
5·1
4·9
4·7
4·5
4
5
6
7
8
9
10
11
Corrected Bitumen Content % of whole
Corrected Filler Content % of whole

Fig. 3.

TABLE 11.—SUMMARY OF ASPHALT EXTRACTIONS.

—		Bitumen Content Percentage of Whole.	Stone Content Percentage of Whole No. 7.	Filler Content Percentage of Whole No. 200.
Number of Tests ..		59	57	57
Average ..	%	5·30	51·40	7·13
Range of results	%	4·7 to 5·9	43·6 to 61·4	3·2 to 10·9
Standard deviation	%	·268	4·011	1·605
Coefficient of variation $= \frac{\text{S.D.}}{\text{Mean}} \times 100$	%	5·06	7·80	22·5
Job mix range	%	5·3 ± ·3 5·0 to 5·6	50·2 ± 2 48·2 to 52·2	7·6 ± 1 6·6 to 8·6
$\frac{\text{Spec. range}}{\text{Spec. mean}} \times 100$	%	11·3	8·0	26·3

Statistical analysis of the results shows that the probability—

(*a*) that specification limits for bitumen will be exceeded, is 1 in 4;

(*b*) that specification limits for stone content will be exceeded, is ·53 or approximately 1 in 2;

(*c*) that specification limits for filler content will be exceeded, is ·55 or approximately 1 in 2.

These statements indicate the inability on several counts of the plant to produce asphalt complying with the present specification. This failure is confirmed by Fig. 1 which is a plot of measured bitumen content against measured stone content. The cross hatched area includes those results complying with the specification. Another fault can be seen in Fig. 2, in which 57 observed stone contents are plotted against days of production. There is a definite trend relating time and stone contents, i.e., the plant did not keep to a constant stone content either inside or outside the specification.

The Road Research Laboratory of Great Britain has described a method to correct observed bitumen and filler contents proportionately to the difference between the observed stone content and the overall mean stone content. This procedure tends to reduce the observed variation. The amount of the reduction is that part of the variation due to sampling. What fluctuation remains in the corrected results is due to real plant variation plus testing variation. The testing variation is about ± 3 per cent. of the observed result for bitumen and about ± 7 per cent. for filler. These ranges are small compared with the ranges quoted in Table 11.

Such corrections have been made, Fig. 3 being the result. This figure shows that the performance of the plant as assessed on the corrected results was not improved. This leads to the conclusion that a considerable degree of real plant variation has occurred.

Instead of basing the corrections on the overall mean stone content new corrections based on the daily average stone content were calculated. Since the daily average stone content varies with time (see Fig. 2) this might be expected to improve the uniformity of the results. Such is not the case and this can be taken as evidence that there has been a real plant variation in bitumen content in any one day as well as a real plant variation in stone content from one day to the next.

DIVISION OF ROAD DESIGN.

This division, as reconstituted in 1958, includes traffic engineering and location, surveying (both title and engineering), and the preparation of plans and specifications for road works.

1. *Scope.*—Its scope is increasing rapidly because of the general pattern of development in this State, as evidenced by—

(*a*) the spectacular growth of traffic volumes, particularly on roads in the inner areas;

(*b*) the intensive and extensive development of land use for industry, housing, and other purposes;

(*c*) the urgent necessity, because of factors (*a*) and (*b*), of both short range and long range planning and provision for these developments.

While most of the land use development for industrial purposes is realistic and genuine, and development usually follows reasonably closely on land purchase, a good deal of subdivision for other purposes is largely speculative, and from the point of view of essential services and public transport, quite unrealistic and much in advance of requirements. There is also abundant evidence that many private subdivisions for housing, &c., are prepared with a prime view of maximum yield for the subdivider, without consideration of modern planning or the provision of amenities for future residents. However, the legislative controls now available over subdivisions in respect of access to the major road system have proved helpful in building some degree of safety and good appearance into the roads affected.

The need to ensure especially that the spate of subdivisions does not prejudice the future of the arterial road system means that staff must often be diverted for considerable periods from other essential work. The grave shortage of staff makes this diversion unfortunate. The Director of Highways for the State of Utah, writing on The National Highway Programme in "Traffic Quarterly" for July, 1959, states, "Because of their dimensions and complexity, interstate projects usually require at least several years for planning decisions, locations, survey, design, and acquisition of right-of-way, before actual construction can begin." The same considerations apply, no less, to the development of any arterial system, especially in the vicinity of urban and metropolitan areas along the routes.

2. *Contract and Direct Labour.*—The increased volume as well as the increased percentage of work now being done by contract rather than direct labour has thrown heavy demands on the Plans and Survey section of this division. Plans, specifications, and estimates for contract work are required in considerably more detailed form than for direct labour, and the very limited staff available for this work has responded well to the demands made on them.

3. *Traffic Counts.*—The Board's annual census of traffic on the State highway system was carried out on Wednesday, 11th March, 1959. Each year about 600 stations on State highways and 400 stations on main roads at junctions with State highways, are counted. In the recent census about 50 stations on the more heavily trafficked main roads were also included.

The spectacular growth of traffic on the Princes Highway East has continued, volumes being as high as 21,000 vehicles in twelve hours, just beyond Oakleigh, and over 12,000 beyond Dandenong. In Fig. 4, traffic volumes counted at each annual census since 1946 are shown for the Princes Highway, west of Springvale-road, and the Hume Highway, south of Camp-road. Volumes at each of these stations were approximately 1,500 vehicles per day in 1946, but on the Princes Highway it has now increased to over 16,000, while that on the Hume Highway has increased to a little under 7,000 vehicles per day.

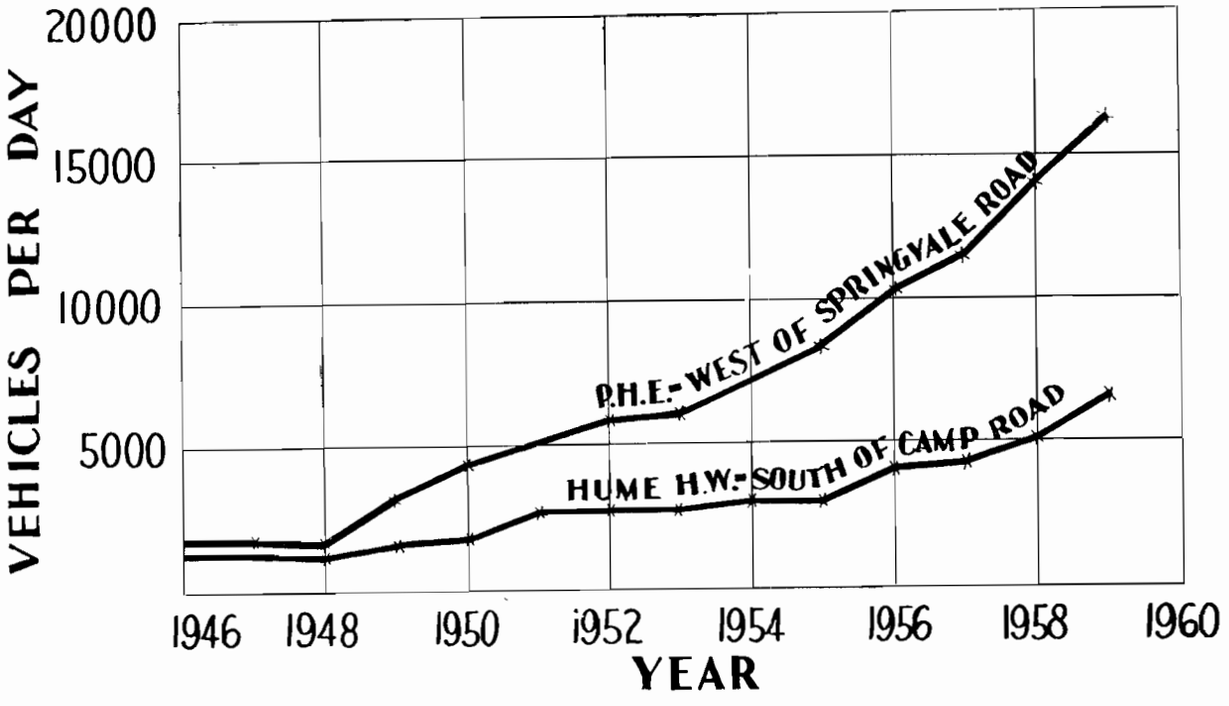

20000
15000
10000
5000
VEHICLES PER DAY
P.H.E.- WEST OF SPRINGVALE ROAD
HUME H.W.- SOUTH OF CAMP ROAD
1946
1948
1950
1952
1954
1956
1958
1960
YEAR

Fig. 4.

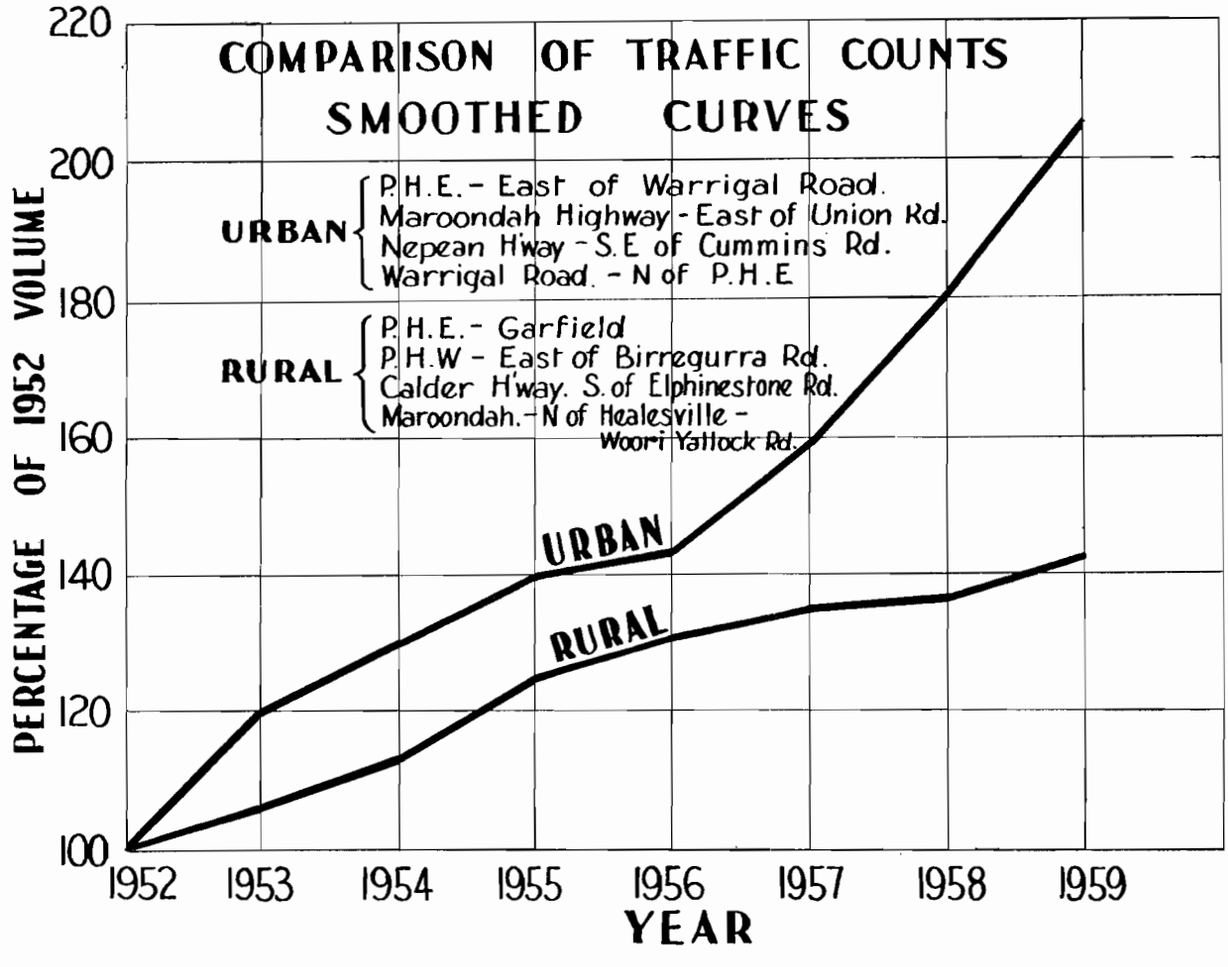

COMPARISON OF TRAFFIC COUNTS
SMOOTHED CURVES
URBAN
P.H.E.- East of Warrigal Road.
Maroondah Highway - East of Union Rd.
Nepean H'way - S.E of Cummins Rd.
Warrigal Road. - N of P.H.E
RURAL
P.H.E.- Garfield
P.H.W - East of Birregurra Rd.
Calder H'way. S. of Elphinestone Rd.
Maroondah.- N of Healesville - Woori Yallock Rd.
URBAN
RURAL
PERCENTAGE OF 1952 VOLUME
220
200
180
160
140
120
100
1952
1953
1954
1955
1956
1957
1958
1959
YEAR

Fig. 5.

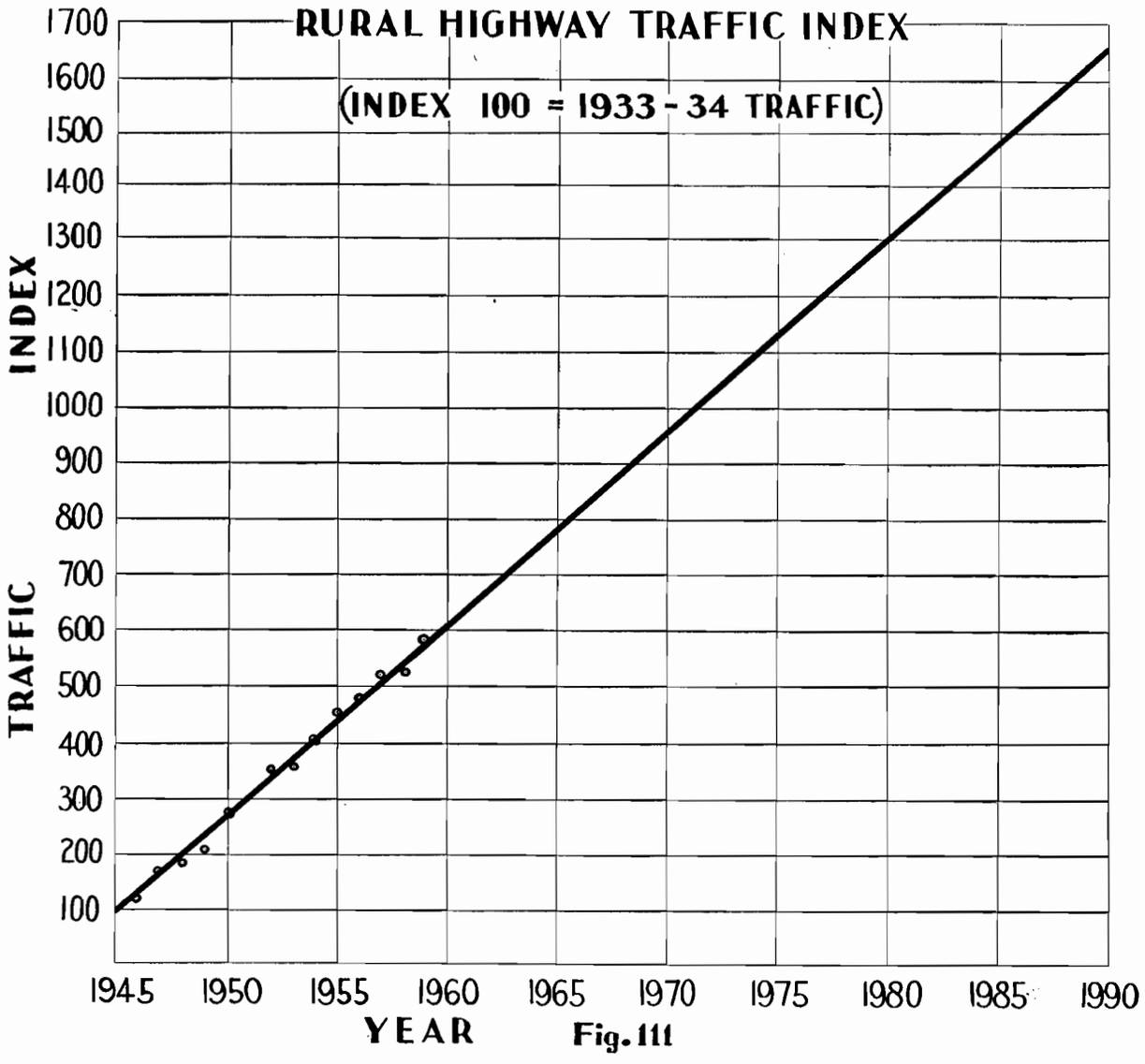


Fig. 6.

Some of the main roads, on which counts have not been taken since 1955, show much higher volumes than four years ago. An example of this is Burwood-road, east of Toorak-road, which in 1955 had a daily volume of 5,000 vehicles, and in 1959 a daily volume of 11,000 vehicles.

As an illustration of the rapidly increasing traffic in the outer metropolitan area, as compared with rural areas, Fig. 5 compares traffic counts at four stations in the outer urban area, with four which are greater than 50 miles from Melbourne and away from a town of any size. From 1952 to 1959, rural traffic increased by only 43 per cent. at these four stations, compared with an increase of 106 per cent. for the urban stations.

4. *Traffic Index.*—A rural highway traffic index is calculated each year from traffic volumes obtained at the annual census at 76 State highway stations outside urban areas. The base figure, 100, represents the average traffic for the years 1933 and 1934. The index for 1959 is 583, and Fig. 6 shows the indices since 1946 together with an estimate for future years.

5. *Traffic Study, Princes Highway East.*—Following the completion of the duplication of the Princes Highway between Oakleigh and Dandenong, a study was made of the travelling time between these two points, 8·47 miles apart. Comparison was then made with a similar study carried out in 1956 when only two lanes were available to traffic. Two vehicles were used, one a car moving as closely as possible with the stream of car traffic, and the other a van moving at the speed of truck traffic. Times were recorded by observers in each vehicle using a stopwatch, readings being taken at ten points along the route. Both the " before " and " after " studies extended over about ten hours on one day in mid-December, each vehicle making as many trips as possible during this period. Comparison of results of the 1956 and 1958 studies is as follows :—

—	1956 (Two Lanes).	1958 (Four Lanes).
Traffic volume (annual average day)	15,000 vehicles	20,000 vehicles
Average speed (cars) ..	33·2 m.p.h.	38·2 m.p.h.
Average speed (trucks) ..	30·0 m.p.h.	32·3 m.p.h.

As a result of the duplication, average speed of cars was increased by 5·0 m.p.h. and trucks by 2·3 m.p.h., even though the average daily traffic increased from 15,000 to 20,000 vehicles.

The saving to vehicle owners due to the reduction in operating costs of vehicles and time saved have been calculated as over £100,000 per annum, or if time saved by passengers in cars is disregarded, £28,000. These savings capitalized at 6 per cent. per annum over a 20-year period, would amount to £1,192,000 and £321,000 respectively. The cost of 8½ miles of the additional two-lane pavement was about £340,000, so that it may be said that the work has almost paid for itself if the time saved by passengers is regarded as valuable.

An investigation into accident records of this road showed that, although average speeds had increased by 5·0 miles per hour for cars and 2·3 miles per hour for trucks, the number of accidents had remained proportional to the traffic volume.

6. *Vehicle Placement Study.*—To determine the effect of painted lane lines, a placement study was made on the out-bound carriageway on the railway overpass in Heidelberg-road, Clifton Hill. This carriageway is 26 feet wide, bounded on the left side by an 8-in. high kerb, laid back 2 inches, with a further clearance of 1 ft. 6 in. to a concrete and steel handrail. On the right-hand side is a 4-ft. median, 5 inches high with the kerbing laid back 6½ inches. The median surface is composed of precast concrete slabs, and there are lighting poles in the centre of it.

Two conditions were studied, firstly, with no lane lines, and secondly, with two dashed lane lines (18-ft. line, 22-ft. gap) to divide the carriageway into three lanes, 9 ft. 6 in., 8 ft. 6 in., and 8 feet wide respectively from the left kerb.

For comparison, two other sections of the main Heidelberg-road, just east of the Clifton Hill overpass, were studied.

(*a*) A study was made on a section where the median is 25 feet wide with high stone kerbs enclosing a plantation. The plantmix seal is 30 feet wide, leaving a 5-ft. shoulder on the median side and a 12-ft. shoulder on the footpath side. This section was studied with no lane lines and with two lane lines marking the 30-ft. wide seal into three equal 10-ft. lanes.

(*b*) On the approach to the Merri Creek bridge, where the plantmix pavement is 26 ft. 6 in. wide between kerbs, and is divided into lanes 9 ft. 3 in., 9 ft. 6 in., and 7 ft. 9 in. respectively from the left kerb. The median here is 2 feet wide.

Traffic volumes during the tests were from 1,800 to 2,800 vehicles per hour in one direction. Speed of the majority of vehicles was 30 to 35 m.p.h.

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Conclusions reached were as follows:—

(1) Where the carriageway was 26 feet wide without lane lines, a satisfactory two-lane pattern of flow was adopted by drivers.

(2) Where the carriageway was 26 ft. 6 in. wide and marked into three approximately equal lanes, a pattern very similar to the two-lane distribution is adopted. The narrow lanes are not acceptable to drivers.

(3) Where the pavement is 30 feet wide, with three equal lanes and adequate shoulders, the provision of lane lines altered the distribution only a little. Both before and after marking, a heavy stream used the left lane, a weaker stream the right lane, and an odd distribution in between. The distribution was not a satisfactory three-lane one.

After the studies were completed, the 26-ft. wide carriageway over the Clifton Hill overpass, which had been marked into three lanes for the tests, was restriped into two lanes.

7. *Signs.*—During the year some changes have been made in the design of certain signs, particularly with regard to reflectorization. All permanent warning signs now being constructed have the background reflectorized, whereas previously, those with a written legend had "in-line" reflectorization in the letters. In areas where street lighting is provided, "in-line" reflectorization of letters in advance direction signs is also being replaced by reflectorization of the background—black letters on a white ground.

Two reasons made the change-over desirable. Firstly, in both warning signs and advance direction signs with in-line reflectorization there is a colour change when viewed at night. The warning sign which appeared as black letters on a yellow background in the daytime, becomes white on black at night. Similarly, the advance direction sign changes from black on white in daylight to white on black at night. Secondly, as a result of this reversal effect, there is a time when, due to extraneous light from street lighting or other car headlamps, the background is as bright as the reflecting portion of the letters and the sign becomes practically illegible.

Route marking signs have now been erected along National Route 79, which generally follows the line of the Calder Highway from Melbourne to Mildura.

8. *Plans and Surveys.*—During the year the following major projects were either completed or were in various stages of design:—

King-street bridge, approaches and associated works in Flinders-street and various streets in the cities of Melbourne and South Melbourne.

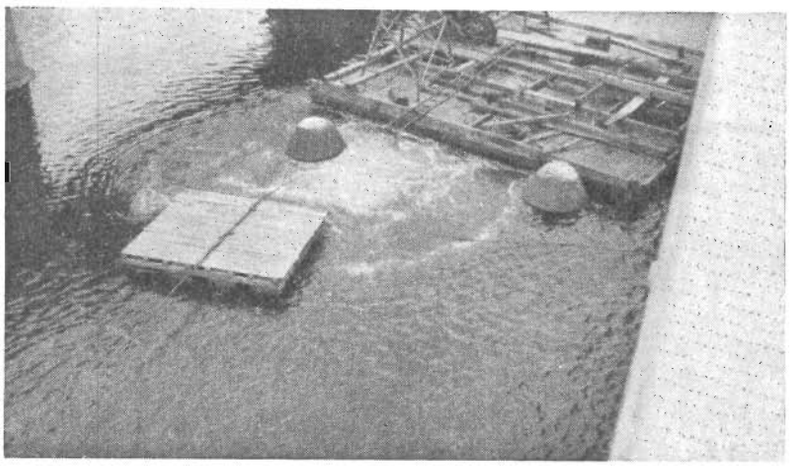


Plate 5.—Underwater Demolition—Bridge over Mitchell River at Bairnsdale.
(Note ring of air bubbles.)

Eildon–Jamieson-road.

Werribee by-pass.

Whitelaw by-pass.

Club Terrace deviation, on the Princes Highway East, Section 5.

Duplication of Princes Highway East, Section 1, between Foster-street, Dandenong, and a point just beyond the Dandenong–Frankston-road, and from the South Gippsland Highway to beyond General Motors-Holden's Ltd.

In addition, plans were completed for 75 projects involving the preparation of approximately 1,000 final plans for construction works over a wide area of the State. Many of the projects were of a complex nature involving preliminary investigations, close study in the field and the office, and detailed design to ensure the best construction results. Because of the requirements of high standard geometry, land acquisition, access control, public utility services, liaison with planning and other public authorities and the consideration of public and private interests, the time required to prepare plans and other preliminary information to the point where construction can start, often exceeds the actual construction period. It is becoming more evident that on the majority of projects it is only by forward planning and making field surveys well ahead, that delays in starting works at a desired date can be minimized or eliminated entirely.

Continued use is being made of aerial photography and photogrammetry in order to minimize field work and to accelerate projects. In the endeavour to expedite ground control for photogrammetry, use has recently been made of a hired tellurometer for the measurement of horizontal distance by radar methods.

During the year a total of 165 specifications were prepared for the supply and delivery of roadmaking materials and for road construction works.

9. *Highway Record Surveys.* — During the 1958–59 financial year, 139 miles of the North Western Highway record survey were completed and printed. The Glenelg Highway record survey was then commenced. Due to major deviations and realignments at Flagstaff Hill, Cherry Tree Hill, Pittong, Langi Willi, and Wickliffe since the aerial strip photographs were flown, it was considered necessary to remeasure the Glenelg Highway with the Board's odometer. Measured miles were marked by divisional survey parties at the 73-mile post on the Western Highway, and at the 173-mile post on the Glenelg Highway for calibration purposes. The Highway was then remeasured and the mile posts are now being moved and erected at the new positions, leaving a marker in the form of short posts at the old sites.

On the finished record plan the new mileages will be indicated by a solid number and the old mileage positions by dotted numbers.

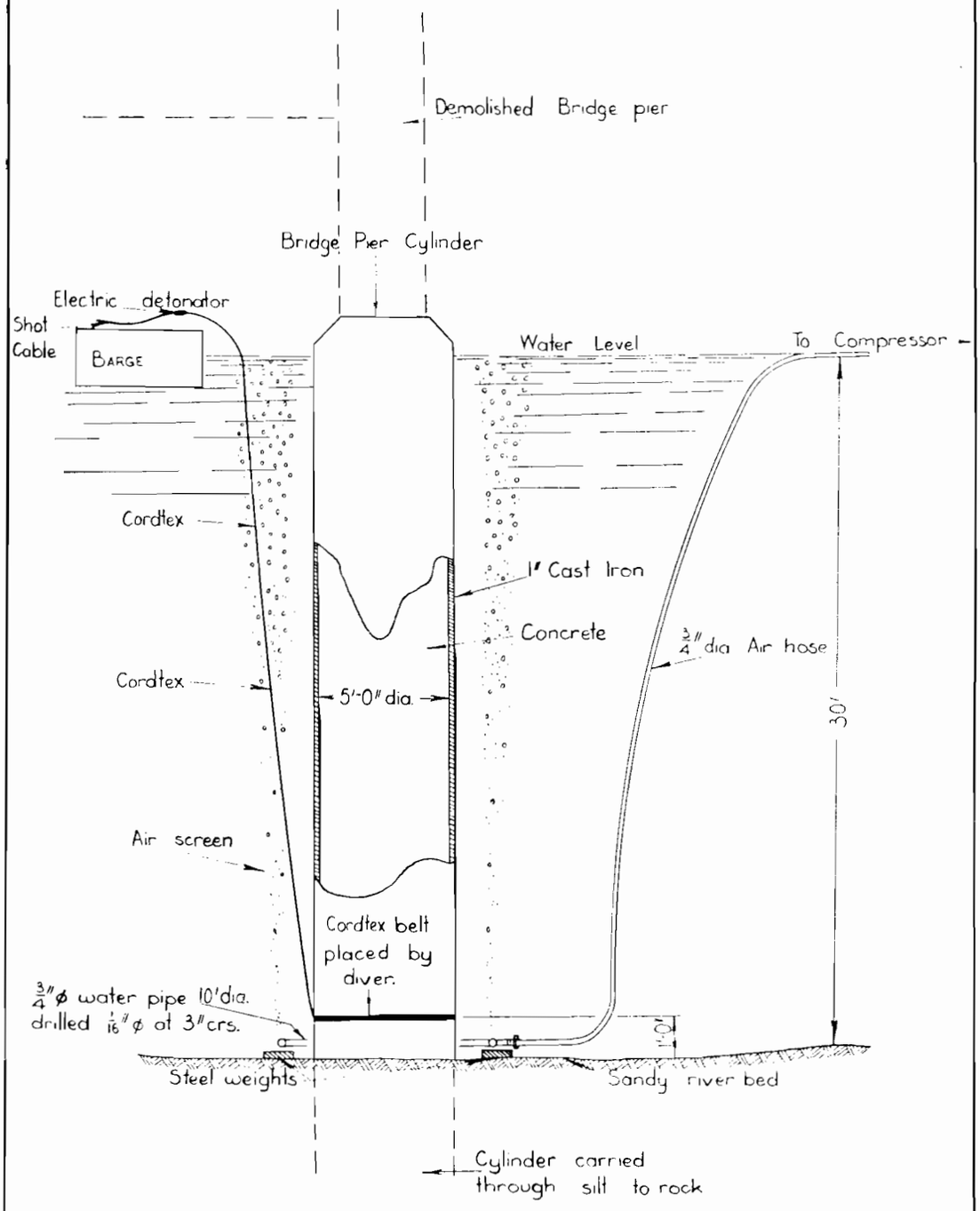
10. *Title Surveys.*—There are five title survey parties on the Board's staff who carry out approximately one-third of the total amount of title survey work necessary. The remainder of the surveys is carried out by private surveyors. A total of 420 title surveys was completed during the year. As these surveys are becoming more involved, and the costs of private surveys increasing, it is anticipated that in future it will be economical to increase the proportion of title surveys carried out by the Board's staff.

BRIDGE DIVISION.

1. *Prestressed Concrete.*—The development and use of precast prestressed concrete slabs and beams, mentioned in previous reports, has been carried further during the past year. Several bridges are now in course of construction, using prestressed concrete units weighing up to 10 tons each.

Details of the 3¼-ton hollow prestressed concrete slab 30 feet long, referred to in the previous report, are shown on the accompanying plan. (Fig. 7.) A number of these slabs has been produced during the year, and several bridges are now being constructed by the Board and by other authorities in Victoria and New South Wales using the slabs. In addition, a design has been produced and a contract let for casting 35 60-ft. prestressed concrete beams weighing 10 tons, and several bridges are now being constructed by the Board using spans of 40-ft. and 60-ft. prestressed concrete beams.

2. *Underwater Demolition.*—Completion of the new bridge over the Mitchell River at Bairnsdale permitted the demolition of the old bridge. The river piers of the old bridge in depths of water up to 30 feet were founded on 5-ft. diameter cast iron cylinders 1 inch thick sunk through the river bed silt to rock, and filled with concrete. Removal of similar cylinders elsewhere by breaking out the concrete and cutting the 1-in. thick cast iron shell had proved slow and costly, so it was decided to try the use of explosives in cutting the remaining cylinders at river bed level. The amount of explosive which could be used was limited by the proximity of the reinforced concrete piles of the new bridge.



COUNTRY ROADS BOARD		
PRINCES HIGHWAY EAST SEC.3 MITCHELL RIVER BRIDGE PIER CYLINDER DEMOLITION		
DRAWN D.J.N	CHECKED	REF NO 4921
TRACED L.F.B.	DATE	

Fig. 8.

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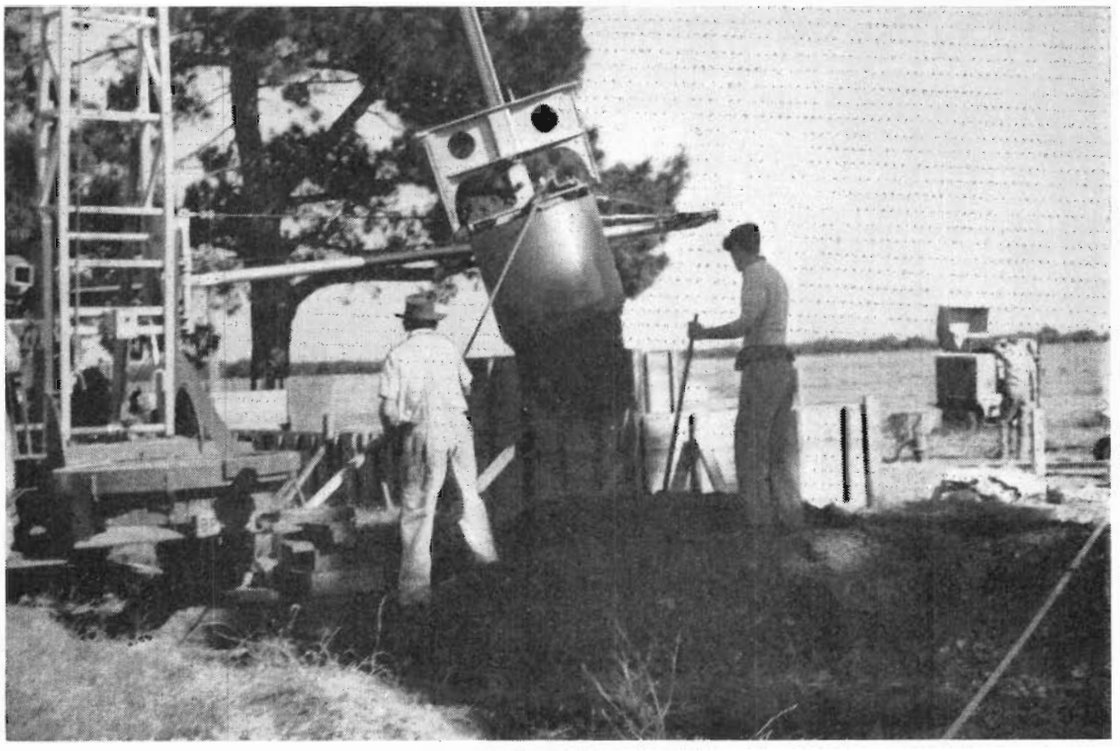

Plate 6.—Truck Mounted Auger.

Cordtex was used as the explosive, for its safety value under water, and for its high cutting effect. A belt of three lines containing 6 ounces of the explosive was tied around the cylinders at river bed level by divers using self-contained breathing apparatus. To reduce shock effects on the new bridge, a compressible screen of air bubbles was provided by a 10-ft. diameter ring around the base of the cylinder and fed by a 120-c.f.m. compressor at approximately 100-p.s.i. air pressure, as shown in Fig. 8 and Plate 5. The effect of the air bubble screen was tested by placing sealed thin wall glass test tubes in pairs at 3-ft. intervals up to 18 feet out from the explosion zone. Table 12 shows the results of the test.

TABLE 12.

Horizontal distance from explosion ..	3 ft.	6 ft.	9 ft.	12 ft.	15 ft.	18 ft.
Test tube	1 broken 1 intact	All test tubes intact				

In a similar test without the air bubble screen, test tubes were broken at distances up to 30 feet from the explosion. After successfully cutting off cylinders some distance from the old bridge, and in view of the success of the air bubble screen, the technique was finally applied to the last cylinder, which was only 4 feet from a reinforced concrete pile of the new bridge. After removal of the cylinder, careful underwater inspection showed no damage to the new pile.

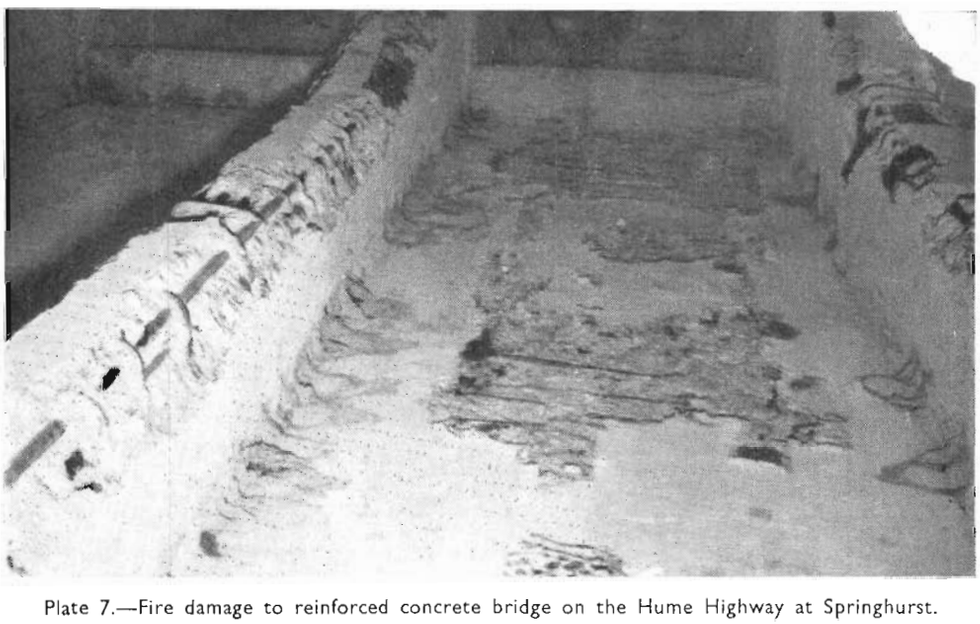

Plate 7.—Fire damage to reinforced concrete bridge on the Hume Highway at Springhurst.

3. *Truck Mounted Auger.*—During the year a truck-mounted earth drill, capable of drilling holes from 15 inch up to 10 feet in diameter and to depths up to 200 feet, was tried in the excavation of foundations for two of the Werribee by-pass bridges. The rig consists of a truck-mounted motor driving a bevel gear to a ring gear. The ring gear turns a yoke through which slides a square "kelly". The kelly is attached to a 3-ft. diameter bucket which has two sets of digging teeth on the base (see Plate 6). When full, the bucket is lifted, swung to one side and emptied. In order to dig to a greater diameter than 3 feet, a reamer is pulled out from the top of the 3-ft. bucket. The operation is done manually, the reamer being returned before the bucket is emptied. The rates quoted for various diameter holes were—

3-ft. diameter £1 10s. per foot,

5-ft. ,, £2 2s. per foot,

7-ft. ,, £3 15s. per foot,

whilst estimated costs for hand excavation were

5 ft. 6 in. x 4 ft. 6 in. holes (equivalent to 5-ft. diam.), £2 18s. per foot,

6 ft. 6 in. x 6 ft. 6 in. holes (equivalent to 7-ft. diam.), £6 per foot.

Use of the machine also allowed a saving in construction time of at least four weeks on each of the jobs. The rates are to an extent governed by the ease of access of the drilling rig to the site, and by its manoeuvreability. In the above case both access and movement of the drilling rig were easy.

4. *Fire Damage to Reinforced Concrete Bridge.* A reinforced concrete bridge on the Hume Highway at Springhurst was extensively damaged by fire to such an extent that it had to be demolished, and is now replaced. (See Plates 7 and 8.) The bridge consisted of two reinforced concrete continuous T-beam spans of 55-ft. total length, and 22 feet between kerbs. A 2,000-gallon tanker truck, containing one of the acetate solvents, crashed through the approach fence to the bridge in an attempt to miss a vehicle in front of it, overturned, spilt its contents under the bridge and burst into flames. The flames were reported to have risen to 60 feet in height. The fire caused intense heat which produced innumerable cracks over practically the whole of the structure. Cracks extended across the deck and down the full depth of the beams, and resulted in large lumps of concrete spalling off the structure in many places. Almost all surfaces not spalled off were "drummy", indicating their separation from the inner core of concrete. A load passing over the bridge later caused deflections of some inches in the beams. The bridge had to be closed to all traffic, which was detoured for approximately 2 miles. A temporary crossing was constructed adjacent to the bridge in six days. The new bridge was open to traffic nine weeks after the old bridge was damaged.

5. *King-street Bridge.*—The last annual report (1957–58) referred to the acceptance of the tender of Utah Australia Limited for the construction of the King-street bridge (Plate 9) and gave some details of the preliminary work.

(*a*) *River Bridges and Elevated Carriageway.*—During this year all the 123 foundation cylinders, 5 feet in diameter, required for the bridge were sunk by the "Benoto" method (see Plates 10, 11, 12). At the peak of the work, two machines were in operation, the contractors having secured the machines, with operators, direct from France. The steel cylinders were lined with $1\frac{1}{2}$-in. thickness of concrete to obtain extra weight at the same cost as a thicker steel lining. The steel cutting edges at first were $1\frac{1}{4}$ inch thick but were subsequently increased to $1\frac{3}{4}$ inch, due to their tendency to buckle under certain conditions. The shells were left in position and not retracted as in the normal Benoto method.

The rates of sinking these cylinders averaged 5 feet per hour through silt, 4 feet per hour through the sand and gravel layers, and dropped to under 1 foot per hour when in the Silurian siltstone. The rock breaker, shown in Plate 13, was used in the Silurian strata to help in the process of excavation.

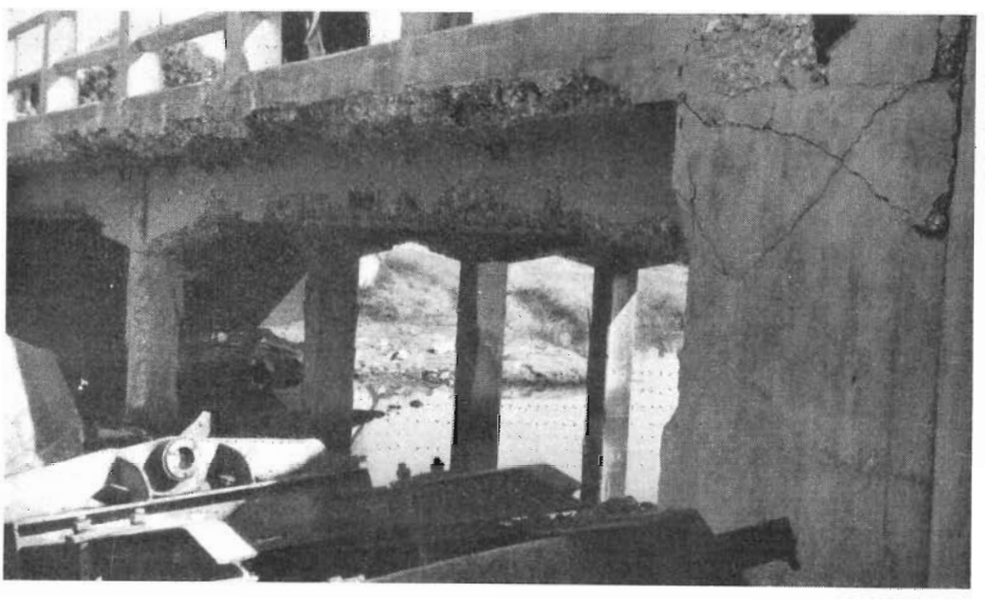

Plate 8.—Fire damage to reinforced concrete bridge on the Hume Highway at Springhurst.

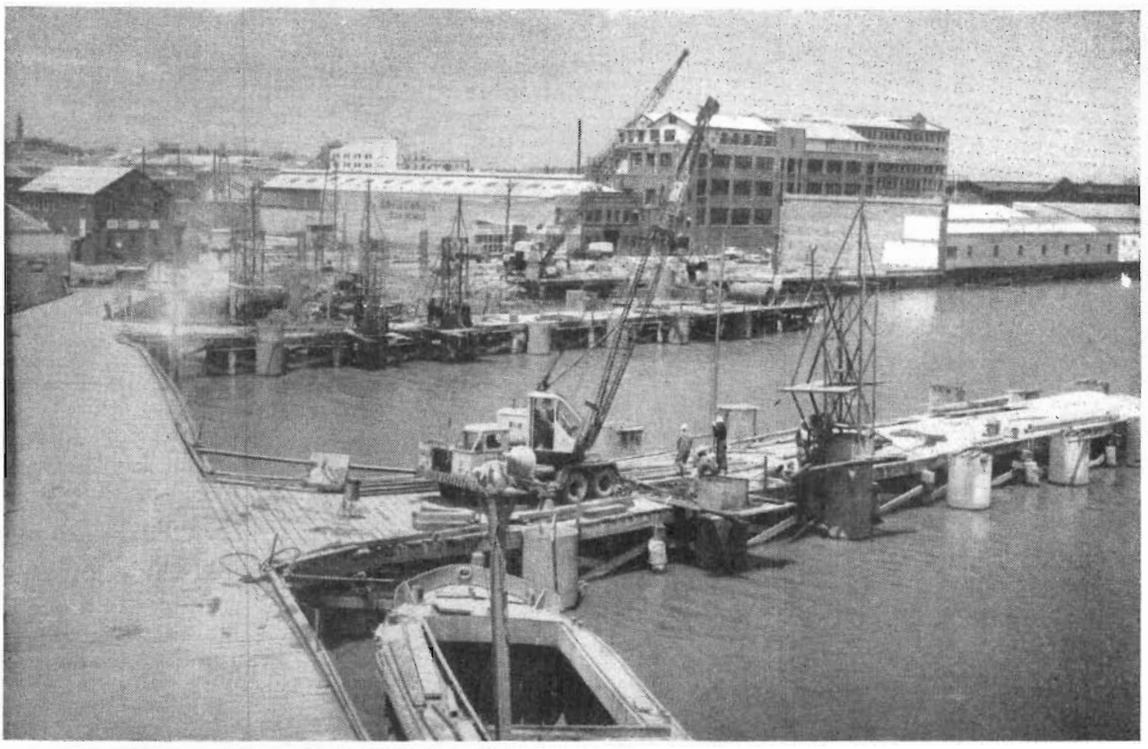

Plate 9.—King-street Bridge Project—Timber Access Bridge.

The material being excavated was examined and when it appeared that a bed satisfactory for founding was reached, the cylinder was pumped dry, the bottom cleaned out and inspected. Generally, one or two pumps only were sufficient to cope with the inflow of water. If the material was inadequate to take the load on a diameter of 5 feet and cores from adjacent bores indicated that no better material was available at an economical depth, the foundation was " belled " out to provide a greater bearing area. The lower portions of the cylinders were concreted under water by means of a tremie to make an adequate plug. The cylinder was then pumped out and the remainder cast in the dry.

On some cylinders where it was necessary to stop excavation, movement of the cylinders could not be restarted and steel liners were used with hand excavation

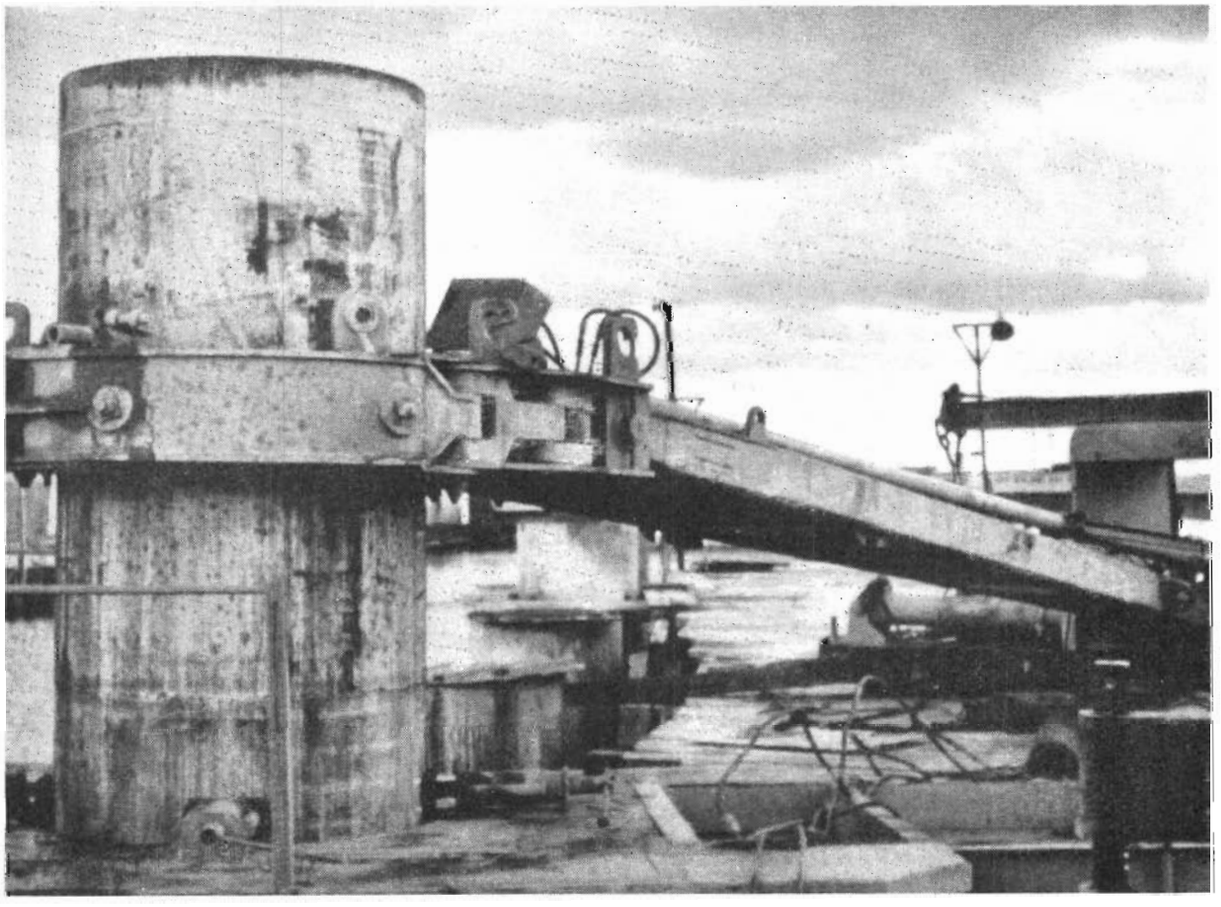

Plate 10.—Benoto Machine.

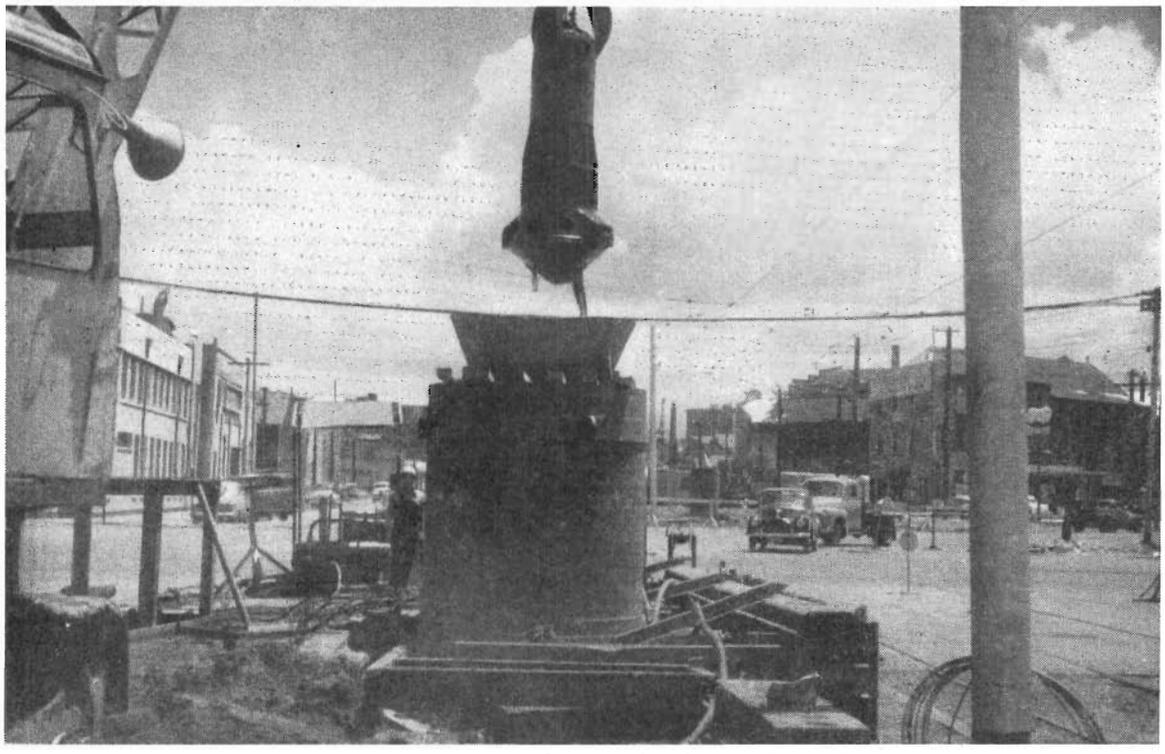

Plate 11.—King-street Bridge Project—Cylinder and Benoto Bucket.

if the extension was small. Where the extension was 15 feet or more, an inner Benoto cylinder 4 feet in diameter was sunk inside the 5-ft. diameter cylinder.

(*b*) *Flinders-street Overpass.*—The contractor, in the preliminary design, proposed to use precast concrete driven piles for the foundations of the overpass. This would have required deviation of the main M. and M.B.W. sewer in Flinders-street and, apart from the cost involved, would have interfered with the works programme of the Board of Works and probably caused delay. In addition, driven piles were considered to be a less satisfactory solution at this site as the batter piles would tend to wander on encountering basaltic boulders and also to suffer damage by being driven into such hard material.

The core recovery from the diamond drilling at the proposed pier positions had been poor, particularly at the eastern end of the overpass, but it was apparent that the rock consisted of basaltic boulders of variable size separated by clay seams of different thicknesses. As the substructure was designed as a series of lateral and longitudinal concrete frames, differential settlements in excess of $\frac{1}{8}$ inch could not be tolerated, and it was decided to use cellular construction for a length of 100 feet at the extreme eastern end of the overpass, cast on top of the existing concrete roadway. The remainder of the pier foundations consisted of 4 ft. 6 in. square shafts sunk by ordinary shaft sinking methods. They were founded on basalt and this method enabled visual inspection of the foundation material to be readily carried out.

At the western end of the overpass the effect of thin clay seams between the boulders was investigated by means of two load tests. One test load of 240 tons, 163 per cent. of the total net design load, applied for

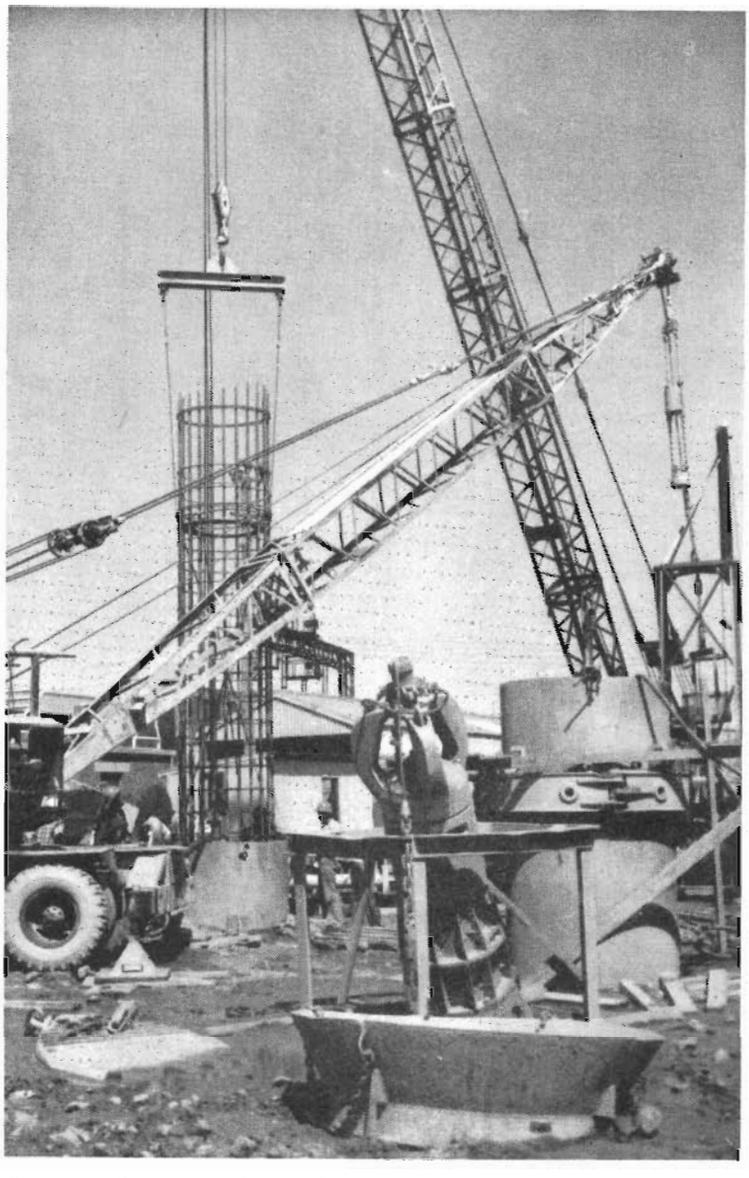

Plate 12.—King-street Bridge Project—Cylinders and Benoto Bucket in foreground.

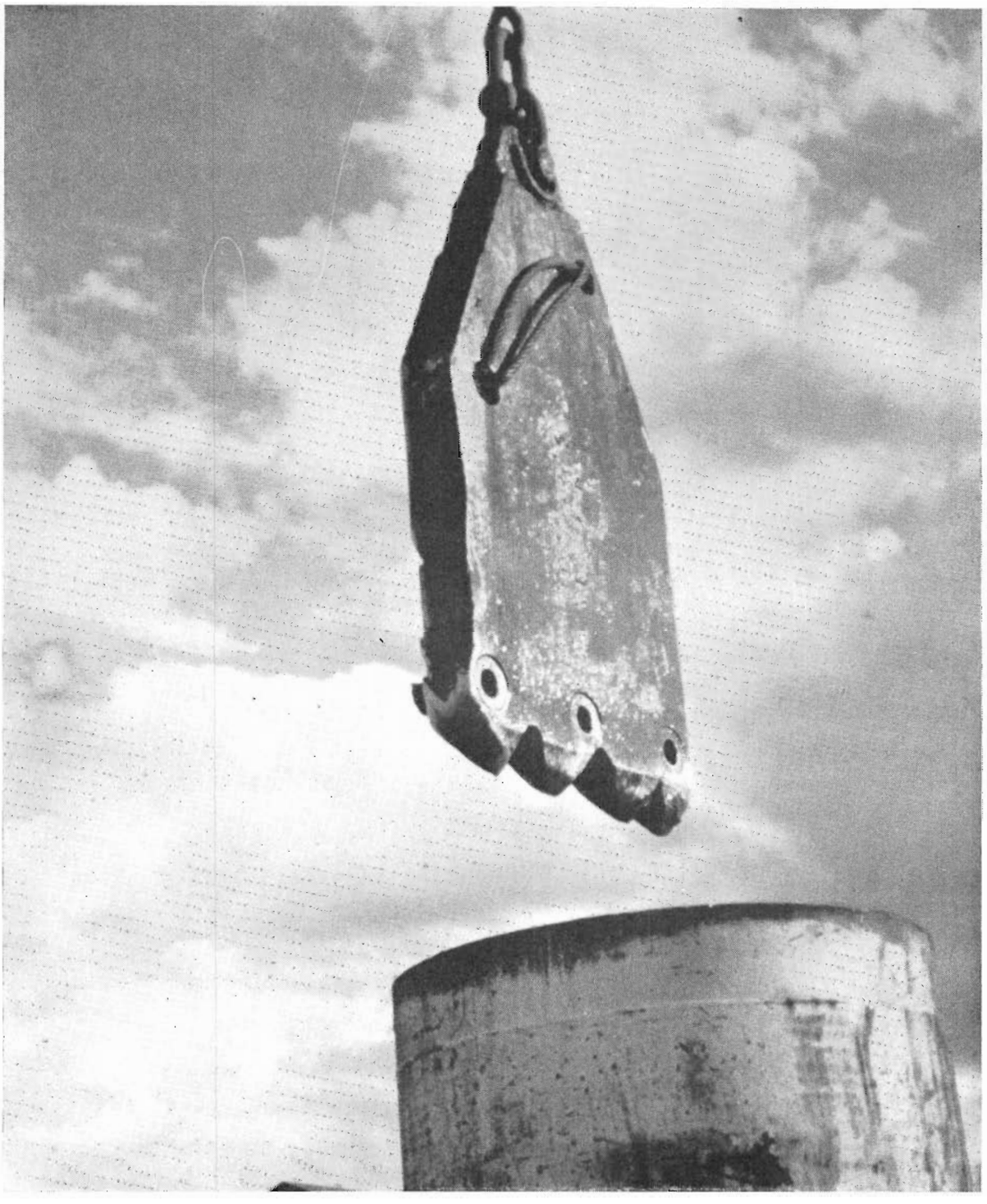

Plate 13.—Rock Breaker.

five days, produced a settlement of approximately 1 mm. Another, a test load of 333 tons, 114 per cent. of the total net design load, applied for 36 days, also caused a settlement of 1 mm.

In six shafts, west of King-street, the bases of the shafts were enlarged by horizontal drives to reduce the bearing pressure to 2½ tons per sq. ft., as the boulders were small and the clay seams thick. A test load of 225 tons, 150 per cent. of the design load, applied for seven days caused a settlement of 1 mm.

The substructure for the first stage of the overpass had almost been completed and 30 precast prestressed concrete beams had been placed in position by 30th June.

PUBLICATIONS.

During the year, the following papers were presented by members of the staff :—

Paper.	Author.
Institution of Engineers, Australia, Melbourne Division, Ballarat Convention, 1958 : Symposium on the Management Aspects of a Large Engineering Project comprising—	
(1) Managerial decisions in relation to the Clifton Hill overpass	H. P. George, A.M.I.E. (Aust.), C.E., F.A.P.I., A.M.I.T. (Lond.), Cert. H.T. (Yale)

PUBLICATIONS—*continued.*

Paper.	Author.
(2) Planning the project to implement the management decisions—	
(*a*) Road system and layout	G. J. Dempster, B.C.E., A.M.I.E. (Aust.), C.E., M.A.P.I.
(*b*) Design and planning ..	C. A. Masterton, M.C.E., C.E., A.M.I.E. (Aust.)
Report submitted to the Permanent International Association of Road Congresses, 11th Congress, Rio de Janeiro, 1959: The economics of legal limitations of axle loads	H. P. George, A.M.I.E (Aust.), C.E., F.A.P.I., A.M.I.T. (Lond.), Cert. H.T. (Yale)
Report submitted to the Committee on Quality of Traffic Flow, Highway Research Board, Washington, D.C., January, 1959: Congestion and travel time	H. P. George, A.M.I.E. (Aust.), C.E., F.A.P.I., A.M.I.T. (Lond.), Cert. H.T. (Yale), and N. S. Guerin, B.C.E., C.E., E.W.S., A.M.I.E. (Aust.), Cert. H.T. (Yale)
Institution of Automotive and Aeronautical Engineers Journal XIX., January, 1959: The maintenance of road construction plant	G. M. Langham, B.Mech.E., A.M.I.E. (Aust.), A.I.A.A.E.
Institution of Engineers, Australia, Melbourne Division, May, 1959: Symposium on the King-street Bridge Project—	
(1) Development of project ..	D. V. Darwin, M.M., M.C.E., M.I.C.E., C.E., M.I.E. (Aust.), F.A.P.I.
(2) Specification for tendering ..	J. Mathieson, M.C.E., C.E., M.I.E. (Aust.), M.A.P.I.
(3) Foundation investigations, requirements, and their evaluation	C. A. Wilson, B.C.E., A.M.I.E. (Aust.)
Institution of Engineers, Australia, Highways and Traffic Engineering Division, July, 1958: The quarrying and production of screenings from a quartz porphyry quarry near Stawell	A. J. Pryor, B.C.E., A.M.I.E. (Aust.)
Highways and Traffic Engineering Branch of the Melbourne Division of the Institution of Engineers, Australia, 1st April, 1959: Highway capacity	N. S. Guerin, B.C.E., C.E., E.W.S., A.M.I.E. (Aust.), Cert. H.T. (Yale)
Lectures in Highway Engineering, with foreword by D. V. Darwin, M.M., M.C.E., M.I.C.E., C.E., M.I.E. (Aust.), F.A.P.I. (Delivered at the University of Melbourne during 1957 and 1958)	C. G. Roberts, M.C., B.Sc. (Eng.), A.M.I.C.E., M.I.E. (Aust.); J. Mathieson, M.C.E., C.E., M.I.E. (Aust.), M.A.P.I.; H. P. George, A.M.I.E. (Aust.), C.E., F.A.P.I., A.M.I.T. (Lond.), Cert. H.T. (Yale); G. J. Dempster, B.C.E., A.M.I.E. (Aust.), C.E., M.A.P.I.

The following Engineering Notes were issued during the year:—

No.	Title.	Date.
63	Removal of white lines using Mirror "M" paint stripper	5th August, 1958
64	Water tankers—sprinkler bar protection	10th February, 1959

STAFF.

Shortage of staff is still proving a handicap. The volume and complexity of the work undertaken is increasing steadily without a commensurate increase in the numbers of those available to do it. This throws an added burden on all, particularly the more senior members of the staff who have administrative responsibilities as well as their engineering duties to see to.

Four engineers are at present overseas, three in Canada and the United States, and one in England. The experience they are gaining should be of great value both to themselves and the Board.

The excellent work done by all is much appreciated.

J. MATHIESON, M.C.E., M.I.E. (Aust.),
C.E., M.A.P.I., Chief Engineer.

By Authority: A. C. BROOKS, Government Printer, Melbourne.