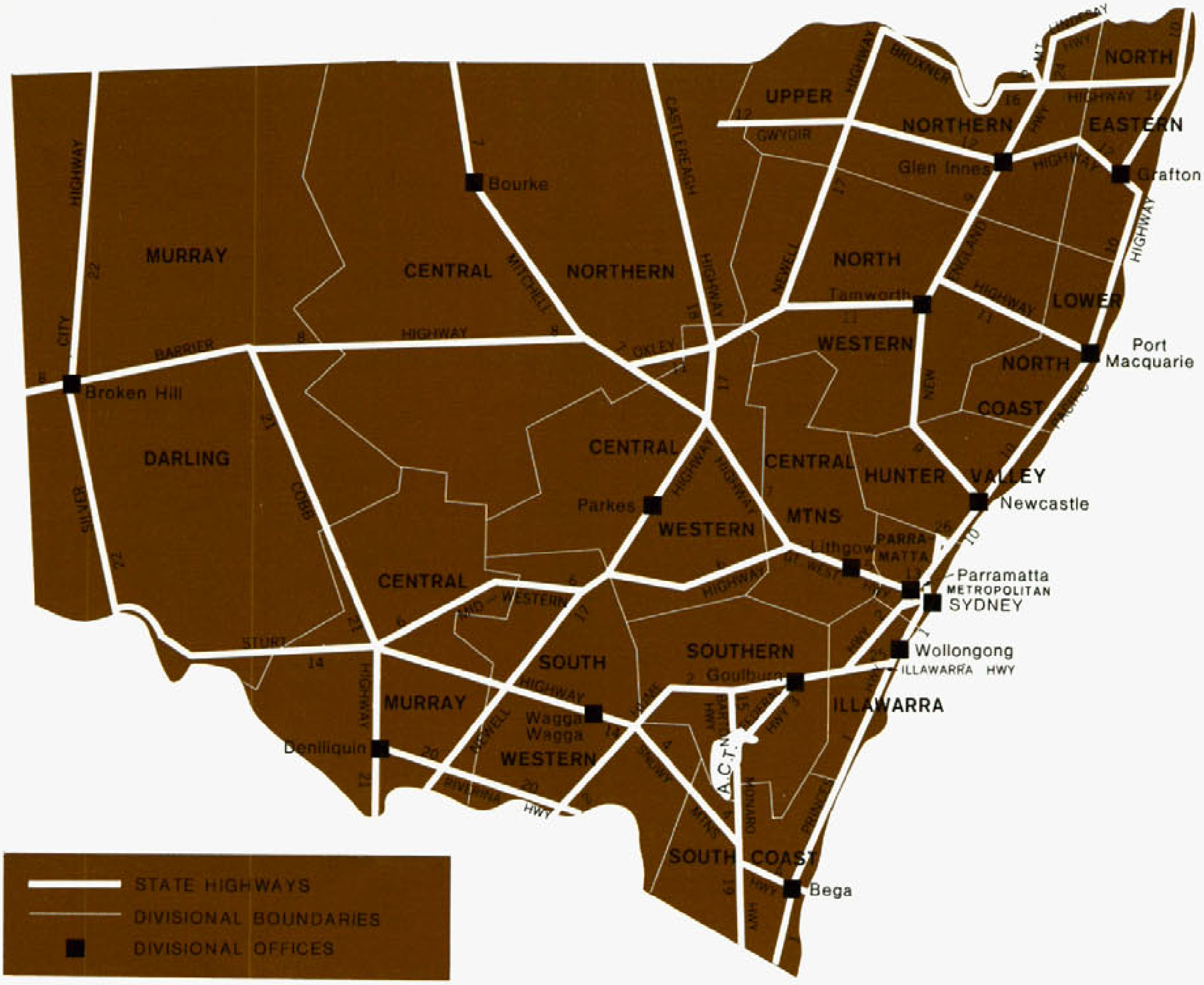
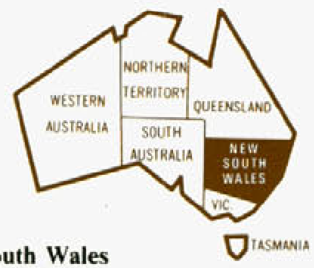
MAIN ROADS

MARCH 1978





New South Wales

Area—801 428 km²

Population as at 30 June, 1977—4 956 700

Length of Public Roads—208 804 km

*Number of Motor Vehicles registered as at 30 September, 1977—2 271 500**

** This figure has been obtained from the Australian Bureau of Statistics. It should be noted that, due to the exclusion of certain categories of vehicles (such as tractors and trailers), etc., this figure is considerably lower than the statistics published prior to December, 1974, which were obtained from the New South Wales Department of Motor Transport.*

ROAD CLASSIFICATIONS AND LENGTHS IN NEW SOUTH WALES

The lengths of roads within various classifications and for which the Commissioner for Main Roads was responsible as at 30 June, 1977 were:

Freeways	127
State Highways	10 478
Trunk Roads	7 075
Ordinary Main Roads	18 365
Secondary Roads	287
Tourist Roads	403
Developmental Roads	3 618
Unclassified Roads	2 478
TOTAL	42 771 km

MAIN ROADS

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CONTENTS

Front cover: Old truck — old bridge. A recent scene recalling old days and old ways of getting over the First Moonbi Hill, just north of Tamworth, via the Monier Bridge over Moonbi Creek (see article beginning on page 83).

Back cover: Construction of the new Foreshore Road, skirting the north eastern side of Botany Bay, is well advanced (see article beginning on page 66).

ANOTHER EXCITING EPISODE

In the days before television, a quiet evening at home generally meant sitting on the lounge and listening to a favourite radio programme. Jack Davey's "Give It a Go" Show, Dick Fair's "Amateur Hour" and John Dease's "Quiz Kids" entertained us for hours, while day and night there was a regular outpouring of serials.

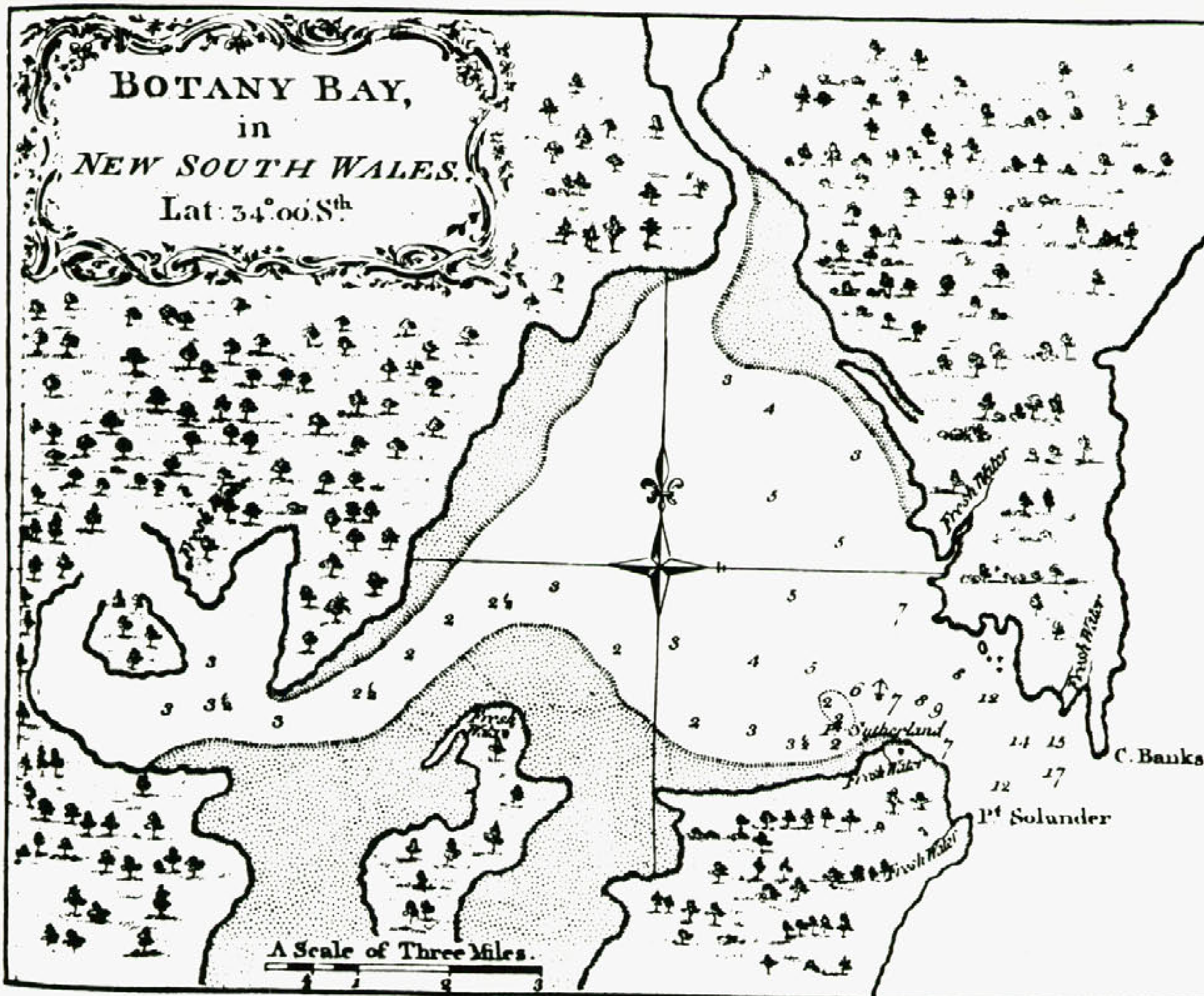
Names like 'Dad and Dave", "Martin's Corner" and "The Search for the Golden Boomerang" should be enough to bring memories floating back. Many serials imitated life so well that, like it, they just went on. . . and on. "Blue Hills" became a classic of its kind with 5,795 episodes going to air between 1949 and 1976.

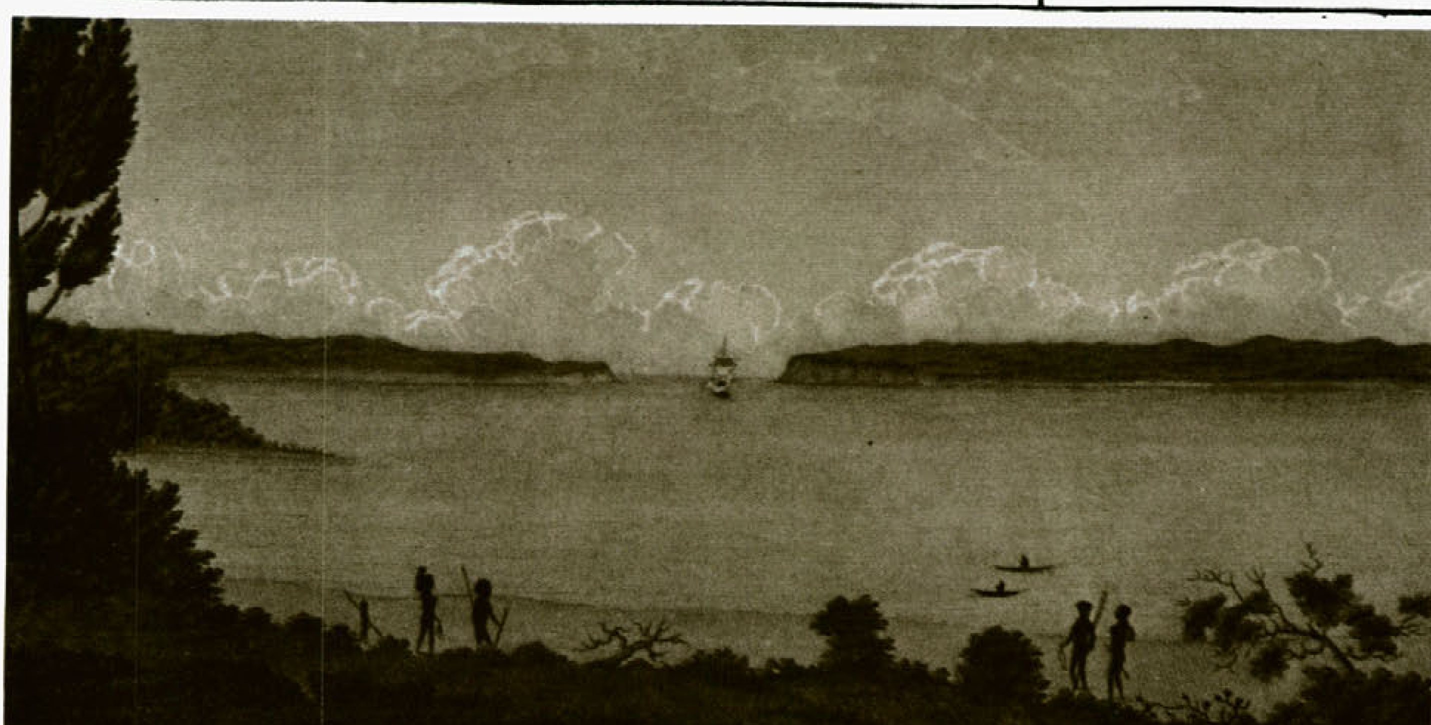
At the "flicks" on Saturday afternoon, movie serials acted like magnets to draw children back each week. Left in cliff-hanging suspense about our hero's fate, we usually dreamed a fearful variety of endings until the next week's episode resolved that dilemna but then posed another.

With the advent of T.V., the serial blossomed as shows like "Bellbird", "The Waltons", and "The Restless Years" have brought us the same people in the same setting each week. Other productions with less attempts at continuity, have focussed more on showing plenty of action, as in "Kojak" and "Charlie's Angels".

The work of the Department has its similarities with serials. Our activities are only another instalment in a drama that goes back to the foundation of the colony. In this issue, the continuity of our work is particularly apparent. In the Botany Bay article (p. 66), the new Foreshore Road is seen as a link with our beginnings here in Cook's time. In "Roads on Black Soils" (p. 74) we see today's road building problems as an echo of the teamsters' woes last century. Similarly, the Moonbi Ranges article (p. 83) shows our current work as a fourth major step in a "continuing saga" of road improvements. Stories about bridges are always popular so we've included three in this issue (pp. 72, 88 and 94).

Although the work of the Department is not as exciting as "Starsky and Hutch", nor as much zany fun as "M.A.S.H.", we still have as much concern for people's welfare as Marcus Welby, M.D. and we face our problems as confidently as did Perry Mason. Our projects are part of the continuing story of this State and we hope you await with eager anticipation — the next exciting episode. ●


BOTANY BAY,
in
NEW SOUTH WALES.
Lat: 34°.00'.Sth
Fresh Water
Pt Sutherland
C. Banks
Pt Solander
A Scale of Three Miles.



PORT BOTANY

A NEW-OLD GATEWAY INTO AUSTRALIA

DEPARTMENT'S PART IN DEVELOPING PORT

First impressions

"Now all you young dookies and duchesses
Take warning from what I've to say
Mind all is your own as you touchesses
Or you'll join us in Botany Bay".

So ran the words of a popular London music hall song of the 1880's. In fact, no convicts ever ended up landing on the shores of Botany Bay. Regardless of the early enthusiasm of Captain James Cook, who rested there for eight days – from 29 April to 6 May 1770, while charting the east coast of the continent – Botany Bay had many short-comings as a harbour.

In spite of reporting that on 5 May *"the wind would not permit us to sail"*, Cook's comments about the bay were generally favourable. He described it as *"a capacious, safe and convenient harbour"* and wrote of a sandy cove on the northern shore where a ship *"might lay almost land locked"*, while *"wood for fuel may be got everywhere"*. Excursions into the nearby countryside revealed woods which were *"free from underwood of every kind, and the whole country, or at least great part of it, might be cultivated without being obliged to cut down a single tree"*.

Above left: An early chart of Botany Bay, reproduced from "Hawkesworth's Voyage", courtesy of Mitchell Library.

Left: "Botany Bay Harbour. . . with a View of the Heads. Taken from Cook's Point. Dedicated to his Excellency Lachlan Macquarie, Esq., Governor of New South Wales. Published Novr. 30th, 1812, by A. West, Sydney. Drawn by J. Eyre. Engraved by W. Prefston." Reproduced by courtesy of the National Library of Australia, Canberra.

Cook changed his mind about a name for the bay. His original journal entry for 6 May reads *"The great quantity of this sort of fish found in this place occasioned my giving it the name of Sting Rays Harbour"*. Fortunately, he later altered parts of this comment so that it became first *"Botanist Bay"* and then *"Botany Bay"* because of *"the great quantity of plants Mr. Banks and Dr. Solander found in this place"*.

A second opinion

Eighteen years later, Governor Arthur Phillip penned a very different opinion of Botany Bay. Concerned with growing crops quickly to feed almost 1,500 raw "colonists", he was very disappointed with the soil and vegetation around the bay. Furthermore, according to Phillip, *"though extensive,* (it) *did not offer shelter to ships from the easterly wind, the greater part of the bay being so shoal that ships of even moderate draught of water are obliged to anchor with the entrance to the bay open and are exposed to a heavy sea that rolls in when it blows hard from the east wind"*. Port Jackson (or Sydney Harbour as we usually call it), on the other hand, he described as *"the finest harbour in the world"*.

For nearly two centuries, this latter judgment has proved correct. But strangely enough, the very facts that have in the past made Port Jackson such an efficient and beautiful harbour have now weakened its worth as the principal port of entry to Australia's largest city and to the nation itself.

A perfect port – once

As a glance at a map will show, Port Jackson is a complex of bays, headlands, rivers and inlets. Its waters run deep and its tides are moderate. It has many nooks and crannies which offer safe shelter to ships of deep draught during the worst weather.

In the days of sail, and well into this century, those virtues were vital to a port. Sydney grew around its harbour, but now, the city has begun to outgrow its harbour facilities. The piers and wharves that served an earlier time have been crowded in by both residential and commercial developments. Many wharves are located on narrow necks of land and lack the space they need for the efficient handling of cargo – including its unloading, sorting and temporary storage awaiting distribution by road and rail.

Busy harbour

While the number of commercial ships sailing in and out of Sydney Ports (Port Jackson and Botany Bay) has not increased in recent years, cargo tonnage has been steadily rising. Much of this increase is due to the fact that container ships are much more efficient carriers than the traditional types of cargo ships. At the present time, about 90% of container traffic is handled by Port Jackson.

The steady growth in the number of pleasure craft has also played its part in congesting Sydney Harbour. Registrations of power craft capable of at least 10 knots are rising by 11% per annum and at the latest count – in June 1977 – had reached 76,000 for the whole of the State, a large proportion being based in Sydney. This figure does not include lower-powered vessels or sailing craft, which are a traditional part of the crowded Sydney Harbour scene.

New cargo methods

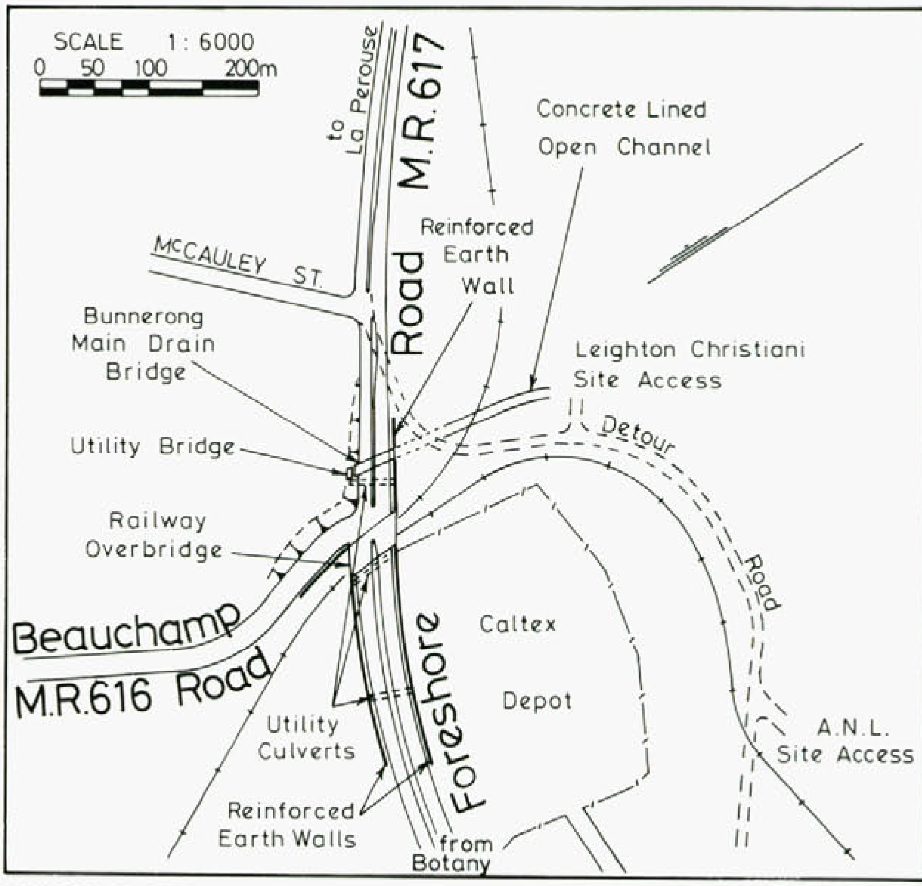
The "containerisation" of cargoes has brought its own problems, along with its many benefits. It offers more efficient stowage and thus greater carrying capacity per ship. It allows faster loading and unloading and thus shorter turn-around times for ships, which earn their keep only while on the move. In fact, while conventional cargo vessels can spend up to half their time at moorings, container ships can reduce this to less than a quarter.

However, containers also require extensive wharf storage and sorting space, as well as special handling equipment to make best use of their advantages. They are large (the standard size is 6 by 4.5 by 4.5 metres, while the "forty-footers" are twice as long) and they are heavy (weighing up to approximately 20 tonnes).

On the move again

While Sydney grew around its harbour, Botany Bay remained a relative "backwater" for a century. From 1880, coal from Newcastle was unloaded at a jetty built in what is now the suburb of Banksmeadow.

The real turning point in the bay's history came in 1930 when an oil terminal was established by H.C. Sleigh Ltd. Since then refineries have been established at



Above right: Diagram showing the layout of the junction of the new Foreshore Road and Beauchamp Road. This diagram covers much the same area as the photograph below.

Right: Aerial view looking east along the route of the new Foreshore Road showing in the foreground the section of Beauchamp Road which has been closed while construction of a new link proceeds. The detour of Botany Road comes in from the right, above the Caltex depot while the Sydenham – Botany railway line curves from the bottom left to the top right corner of the photograph.

Matraville and Kurnell, the first by BORAL, now operated by Total Refineries Australia Ltd., the second by Australian Oil Refining Pty Ltd. Botany Bay has become one of Australia's major oil ports.

In 1961, Botany Bay came under the control of the Maritime Services Board of New South Wales and investigations were begun into the feasibility of developing it as a supplementary port for the Sydney region. Construction of new port facilities began in June 1971, when the first dredging commenced.

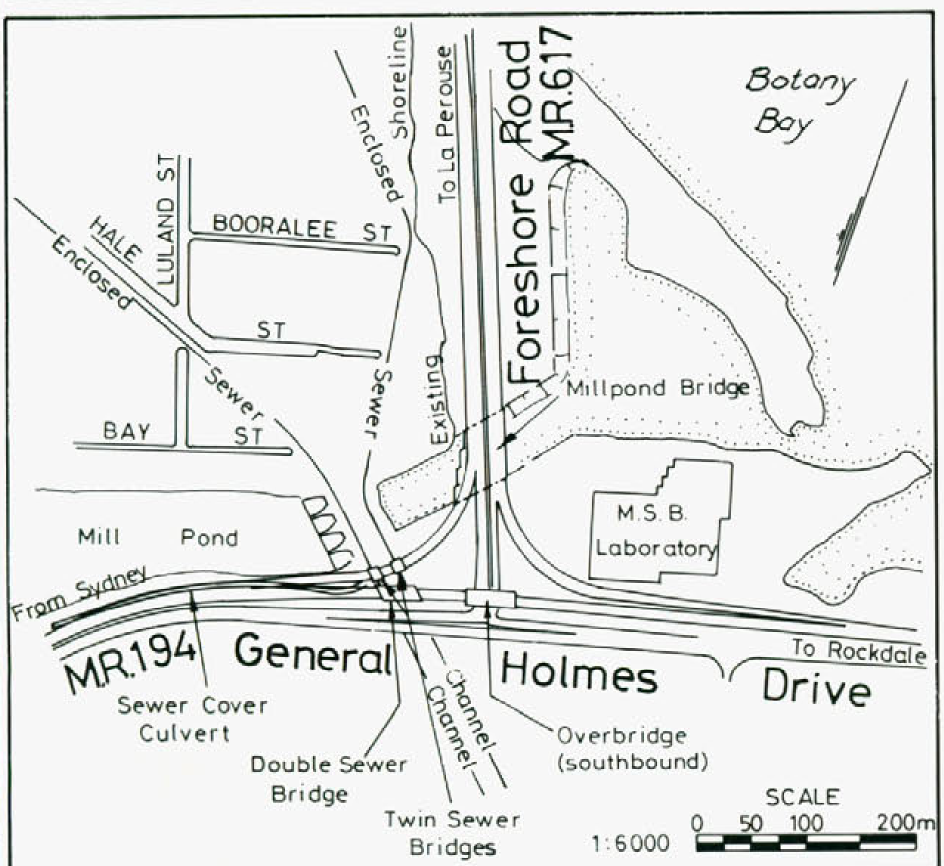
Unique solution to old problem

One big problem to be solved was the one Governor Phillip had commented on in 1788, concerning the great waves that swept in from the entrance when the wind blew strongly from the east. During some very severe storms, these waves have been known to reach nine metres in height!

The problem has been solved chiefly be dredging a V-shaped channel in the mouth of the bay. As well as deepening the entry for deep-draught ships, this special configurational dredging, the first of its type in the world, absorbs much of the wave force and deflects most of the remainder onto an armoured revetment or sea wall. A scenic roadway along the top of this wall will be open to the public and will provide a vantage point for splendid views of the surrounding area.

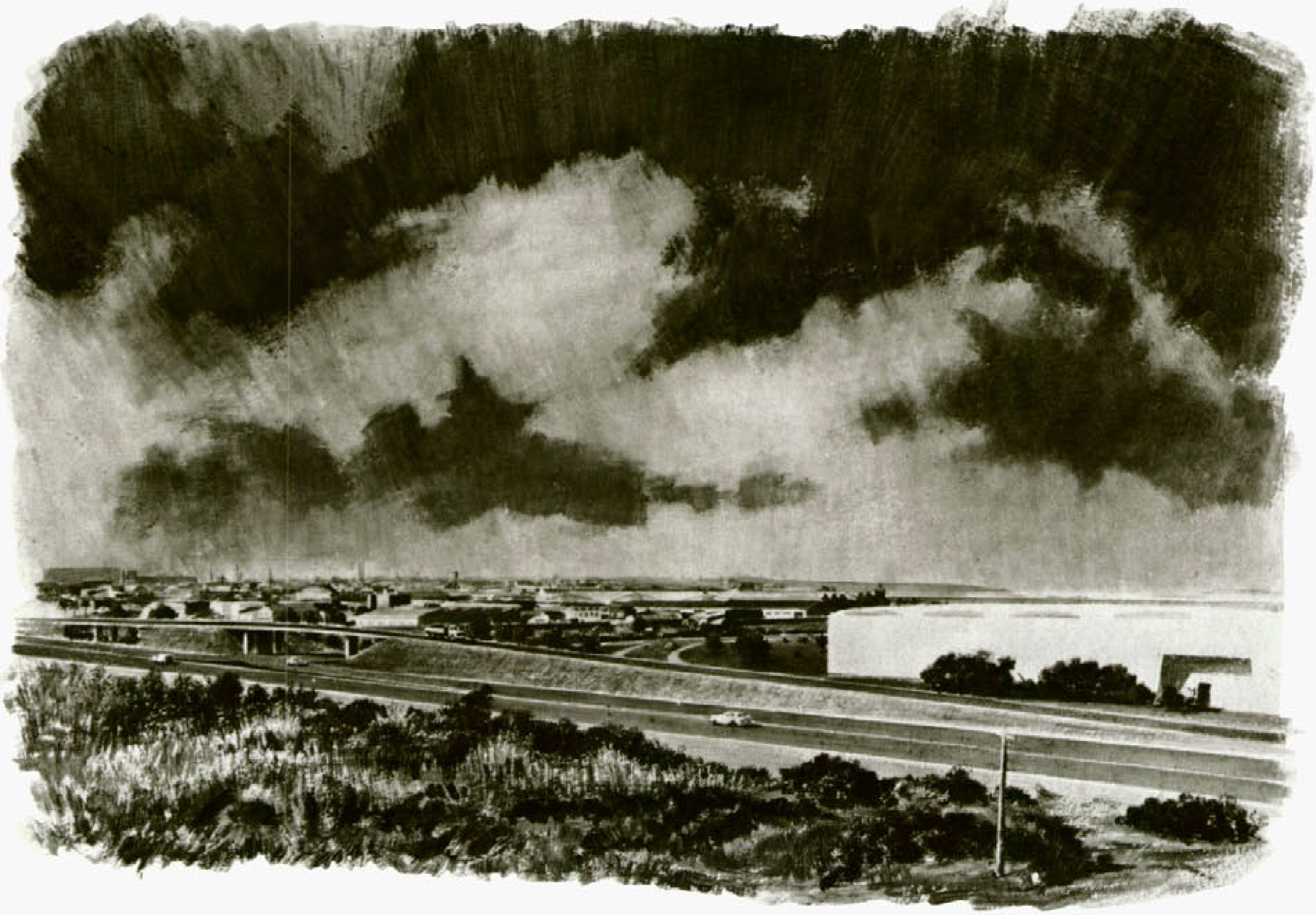
New Foreshore Road

While the Department of Main Roads is not directly concerned with the port facilities themselves, it is engaged in an extensive plan of roadworks to improve traffic flow in the area. Another purpose of the roadworks is to provide routes for heavy traffic that will allow it to by-pass residential streets as much as possible.



Above left: Aerial view showing General Holmes Drive in the foreground and the site of the interchange with the new Foreshore Road. In the centre can be seen the site of the new bridge over Millpond Creek.

Left: Diagram showing the layout of the junction of General Holmes Drive and the new Foreshore Road. This diagram covers much the same area as the photograph above.



An artist's impression of the junction of the new Foreshore Road and General Holmes Drive. It shows the bridge which will carry the southbound carriageway of General Holmes Drive over the access links between the northbound carriageway and the Foreshore Road. The building on the right is the Maritime Services Board laboratory.

One of the projects is the construction of a new 3.8 km long Foreshore Road on land reclaimed by the Maritime Services Board. The road will be the divided carriageway type with two lanes in each direction. Provision has been made for an additional lane in each direction when future traffic demands this.

The new road will serve as a collector/distributor of traffic moving in and out of the port area and will not interfere with any existing residential, commercial, industrial or recreational area.

Connecting it up

At its eastern end, the Foreshore Road (already designated Main Road No. 617) will merge into Botany Road (Main Road No. 170) between Beauchamp Road (Main Road No. 616) and Banksmeadow Park.

Botany Road is being widened to six lanes, from Foreshore Road to the Bumborah Point Road junction, linking with the six lanes already constructed and in use between Bumborah Point Road and Bunnerong Road (Main Road No. 171).

At the western end the Forshore Road will meet General Holmes Drive (Main Road No. 194) in a carefully planned partial interchange. This facility will be located just east of the tunnel that allows General Holmes Drive to pass under the airport's major north-south runway. The interchange will mean that traffic entering or leaving the port area will be able to do so smoothly and safely, without interruption to through traffic along General Holmes Drive.

Bridging works

The interchange will be a major project in itself, involving the construction of a number of bridges. One will carry southbound traffic on General Holmes Drive over 'on' and 'off' access lanes connecting with the new Foreshore Road. The 'on' ramp from General Holmes Drive to the Foreshore Road will also feature twin bridges over the southern outfall sewer channels, and a sewer cover culvert, 300 m long.

Other bridges associated with the interchange include a crossing over the two southern outfall sewer channels for southbound traffic on General Holmes Drive. To the east of the interchange another new bridge is being built to carry the Foreshore Road over Mill Pond.

At the eastern end of the Foreshore Road, a six-lane overbridge will be used to carry Botany Road over the Sydenham-Botany railway line. With a minor realignment of Beauchamp Road, two level crossings will thus be eliminated.

This project is already under way and a section of Botany Road has been closed and a detour has been built to take traffic around the work. This detour starts at McCauley Street, arcs south of the Australian Oil Refineries Terminal and rejoins Botany Road west of Beauchamp Road via Penrhyn Road.

The existing Bunnerong Outfall Canal Bridge is to be reconstructed and widened, to carry Bumborah Point Road (Main Road No. 616). This road is being reconstructed to six-lane dual carriageway standard on the approaches to the bridge.

As well as a large box culvert built at Springvale Drain, there are about 15 pipe culverts along the Foreshore Road. The outlets for these culverts, which would be blocked by the reclaimed land, have to be carried through to the new shore-line from beneath the new Foreshore Road. The design and construction of these culverts will be carried out by the Department.

The work involves locating and identifying each culvert, planning its most suitable outlet point on the revised shoreline and extending it to that point, all the while ensuring it is protected from the heavy machinery used in land reclamation and other works.

Reinforced earth method used

The retaining walls on the approaches to the railway overpass bridge and Bunnerong Main Drain Bridge at the eastern end of this work are of the "reinforced earth" type. The earth forming the bridge approach embankments is retained between tile-like precast concrete slabs placed to form a continuous vertical wall.

Galvanised steel straps attached to the concrete slabs extend about 6 m into the embankment fill which is compacted. These hold the slabs in position. The system allows economical building of vertical earthfill retaining walls and embankments, permitting considerable savings in land required for road purposes. (See article entitled "Reinforced Earth – Pioneered in Australia by D.M.R." in the September 1977 issue of "Main Roads", Vol. 43, No. 1, pages 10-13).

Out of sight but not out of mind

A great deal of the Botany area is highly developed industrially. This means that property adjustments are more expensive than they would be in unoccupied or even residential land. For instance, the work involves re-locating a rail head and the main access to the Caltex terminal. Australian Paper Manufacturers' fire training track (where their mobile firefighting teams do their practising) has had to be broken up and another built in a new location.

But those are only surface problems. Throughout the area there is a maze of underground utilities. These include ducts for power and communications cables, sewer mains, stormwater drains, water pipes and pipelines for a diverse range of other fluid materials, such as petroleum, fuel oil, gas and caustic soda. Many of these have to be relocated along new alignments, carried over bridges and under roads. This has to be done with as little interruption to the services they provide as possible. It is indeed a massive planning job requiring close co-ordination among many State Government bodies, local government authorities, and the private companies directly concerned.

The trouble with sand. . .

In their work, both the Maritime Services Board and the Department have been faced with the problem of sand suppression. The material used to build up reclaimed land and for much of the roadworks is sand dredged from Botany Bay. From the dredges this was pumped ashore through a pipeline nearly 2 km long. Here earthmoving machinery has spread and levelled it to build up the "new" land. Stockpiles have also been set aside for the Department's use.

Wet sand is dense and has high cohesion. Once the surface dries out, however, it is swirled around the construction site by winds whipping off the bay. The State bodies themselves, as well as local residents, were concerned about this. Consequently, much research and experimentation has been carried out to find ways to avoid inconvenience and discomfort caused by windblown sand.

One solution has been the spraying of the sand with a stabiliser, which coats the sand with a light but firm crust.

Hessian covered fences were also erected on both sides of the Foreshore Road to keep sand off it as much as possible and also to preserve the amenity of nearby houses. Later, a man-made dune stabilised with grass and shrubs will provide a more aesthetically pleasing form of control.

Special concrete pavement

All but the eastern end of the road construction comprises a continuously reinforced concrete pavement, and it is only the second such pavement to be constructed by the Department.

A continuously reinforced concrete pavement, as its name implies, is a concrete road which has no transverse joints, so eliminating the most adverse feature of the conventional concrete pavement. The result is a structurally stronger pavement with improved riding qualities and reduced maintenance costs. (See article on similar pavement on Pacific Highway at Clybucca Flat, north of Kempsey in "Main Roads" December 1975 issue, Vol. 41, No. 2, pages 58-59).

Because of the novel nature of this work, a separate article will be featured in a forthcoming issue of this Journal, describing it in detail.

Botany Bay is again the focus of much attention, and there is no doubt that the final port development will bring many community benefits. The new Foreshore Road and other access improvements will help to ensure that the additional traffic generated by the port will be adequately catered for. ●

The special bi-centenary issue of "Main Roads" in June 1970 Vol. 35, No. 4) included three articles with historical information and colour photographs which readers may wish to refer back to. Firstly "Botany Bay as Cook described it ... and how it has developed since" pages 92-93. Secondly, "Botany Bay – Birth Place of Australia" pages 94-95. Thirdly, "Botany Bay, 1770-1970" pages 96-97.

The new Birks Bridge over Jilliby Jilliby Creek, with its simple uncomplicated lines, provides a functional crossing of this waterway.

SMALL BRIDGE MAKES A BIG DIFFERENCE — DOWN DOORALONG WAY

In bridge building, as in countless other of life's activities, it is often inferred that "biggest is best". There is no doubt that record-breaking structures are newsworthy and in the June 1977 issue of "Main Roads" (Vol. 42, No. 7, pp 112-113, 117-120) we gave considerable coverage to the construction of the Sheahan Bridge over the Murrumbidgee River at Gundagai, which is the longest bridge ever built by the Department. And now in this issue, in an article on pages 88-93, we look at the world's longest bridges and the longest bridge spans in Australia.

But, lest we should be accused of being interested only in the big ones, the following article is about a small bridge in a quiet rural region on a *back* road used by few vehicles other than those of the local residents. The location is specific but the story is typical of many other places throughout the State where small bridge improvements bring big benefits.

Our story is about the simple structure across Jilliby Jilliby Creek, just north of Dooralong, on the Dooralong Road, which runs northwest of Wyong from Old Maitland Road (Main Road No. 217) towards the Olney State Forest.

The new bridge is a single lane, reinforced concrete structure and replaced an old low level timber beam bridge built in 1921. The condition of the old bridge had deteriorated markedly over recent years.

The new three span bridge is 27.4 metres long whereas the bridge it replaced was only 8.1 metres in length. A feature of the bridge is the extension of the guardrail across the structure from approach to approach, to provide visual guidance for the safety of road users.

A single lane bridge is still sufficient for the traffic needs at this point in the area's development since it is used by only approximately 40 vehicles a day, mostly moving to and from the nearby Wyong and Olney State Forests and the farms of the area.

The ceremony held on 27 January 1978 marking the official opening of the bridge was doubly significant. For the dairy farmers and other rural producers of Dooralong, Jilliby and other settlements in the vicinity, the new bridge is important because it is a safer, stronger, higher and more convenient aid to the efficient functioning and continued economic viability of their individual properties. It is, in fact, a bridge nobody has to worry about any more — especially in times of flooding — as the new deck level is more than 2 metres higher than the previous bridge deck and 1.8 metres above the highest known flood level.

The ceremony was also significant insofar as this was the first official bridge opening at which Mr. B. J. Sexton has participated following his appointment as Commissioner for Main Roads in October 1977.

When opening the bridge Mr. Sexton noted that its construction had demonstrated the interest which the Government and the Department of Main roads have in the transport needs of the man in the country. In the event of increasing economic activity in the area, he pointed out, the bridge could

To ensure uniform spreading of the lime or cement, special wooden "rakes" were made with roofing nails (clouts) protruding a predetermined length. This resulted in an even layer of stabiliser being left behind after the rake was dragged over the pavement.

Following spreading, the gravel was bladed and tyned with a medium/heavy grader to dry mix the stabilising material with the gravel. The pavement was shaped and rolled, and about 3 per cent of water added.

Immediately following the water carts, two large rotary mixers commenced mixing the pavement material. To prevent excessive loss of moisture and to maintain the shape of the pavement, drawn rollers followed about 6 metres behind the rotary hoes.

This procedure was carried out a second and third time and water added where required. The field optimum moisture content was achieved before the last mixing. A fourth mixing was carried out only if mixing was uneven after the third pass. Final compaction was achieved between 2 and 3 hours after the initial addition of water.

The section from 70.4 km to 71.2 km (which was stabilised with 3 per cent cement) was to be scarified and recompacted 24 hours after initial compaction. However, following recompaction it was found that the shape of the pavement was unsatisfactory on some sections. To correct these defects the section was scarified and recompacted a second time on the day following the first recompaction.

The section from 72.0 km to 72.8 km (which was stabilised with 3 per cent lime) was to be scarified and recompacted 24 hours after initial compaction. After stabilisation, however, cracks appeared in the pavement—first in a longitudinal direction then transversely. Following further laboratory testing, restabilisation was carried out with the addition of 2 per cent cement.

Equipment and protection

The major items of mechanical equipment required for the work were:

- 3—Medium/heavy graders
- 2—Rotary mixers
- 1—12-ton pneumatic-tyred roller
- 1—30-ton pneumatic-tyred roller
- 2—Smooth-wheel drawn vibrating rollers
- 2—Water carts

Fair to good weather conditions were experienced during the work. Days were mostly fine, wind conditions varied from calm to moderate breezes and overnight rain fell on three occasions.

Above: Placing bags of lime in position on the gravel pavement prior to spreading.

Right: Workman wearing a respirator while spreading lime with a wooden rake.

Below: Cement being spread using hand rakes and graders.

additives can compensate for these deficiencies and so overcome the natural weaknesses.

Stabilisation changes the characteristics of the gravel so that its grading deficiencies or moisture susceptibility (i.e., the loss of strength with increasing moisture content) are reduced to the extent required to achieve the necessary load-bearing capacity.

Test sections

Crossing these black soil plains are a number of important highway routes which carry substantial volumes of interstate tourist and heavy industrial traffic as well as local traffic. Approximately 1,400 vehicles use the Newell Highway north of Moree each day and about 150 heavy transports are scattered throughout this volume of vehicles.

A few years ago, it became necessary to reconstruct the Newell Highway north of Moree to meet the needs of increasing traffic. In planning the work, it was found that there were no naturally occurring gravels which met the Department's specifications for pavement construction. To produce an acceptable base material, gravels from three different pits were hauled to the work site, spread on the sub-base in predetermined proportion and then were mixed using rotary hoes. This was an expensive process, as some of the gravel had to be hauled up to 45 km, greatly increasing costs.

To reduce costs it was decided to use a locally-occurring material, ironstone gravel, stabilised with lime or cement. Accordingly, test lengths of cement and lime stabilised pavements were constructed in 1972. These lengths totalled 4.8 km and were laid on the Newell Highway at the following distances north of Moree.

69.6 km–70.4 km
Control Section, unstabilised ironstone gravel.

70.4 km–71.2 km
Ironstone gravel, stabilised with 3% cement, scarified and recompacted 24 hours after mixing and initial compaction.

71.2 km–72.0 km
Ironstone gravel stabilised with 3% cement.

72.0 km–72.8 km
Ironstone gravel, stabilised with 3% lime, scarified and recompacted 24 hours after mixing and initial compaction (i.e. after initial shrinkage has occurred).

72.8 km–73.6 km
Ironstone gravel stabilised with 3% lime.

73.6 km–74.4 km
Control section unstabilised ironstone gravel.

"Across the Black Soil Plains" by George Lambert, reproduced with permission of the Art Gallery of New South Wales.

The reason for scarifying and recompacting some sections 24 hours after initial compaction was to see if the rectangular "block" type shrinkage cracking (which is characteristic of some cement stabilised pavements) could be eliminated or reduced by breaking the initial cement bond and thus reducing the effects of shrinkage.

The gravel used on the test lengths was an ironstone gravel from the Nulla Nulla Pit. This gravel was quite variable in grading and, to improve uniformity of the material it was thoroughly mixed in stockpiles before being placed on the road.

Construction

After the pavement gravel was placed on the road, it was worked by grading and rolling to break it down to sizes of 20 mm or less.

On the day preceding stabilisation, the pavement was shaped and lightly rolled after ripping, and water was added to bring the moisture content to between 6 and 8 per cent.

The stabilising chemical (i.e., lime or cement) was hand spread from bags accurately placed in a specific pattern on the pavement.

ROADS ON BLACK SOILS

Where and why

On the western plains of New South Wales *black soils* occur in the vicinity of Moree and Inverell. Around Narromine and Trangie they are grey in colour while nearer to Warren and Nyngan they are brown. They have all left their mark on the history of transportation. They could be rough to cross in the dry due to deep cracks and the uneven "gilgai" surface. After rain, the heavy clay bogs anything trying to move across its surface on wheels.

These soils have accumulated on the relatively flat western plains during the late Tertiary and the Quarternary periods. The black earths are believed to be related to basalts.

The material of which they are formed shows little resemblance to their parent rocks, because any coarse particles have been left behind as the rivers in flood slowed down during their outflow onto the plains. Only the finer silt and clay fractions have remained in suspension long enough to reach the western plains in New South Wales.

There these sediments have provided nutrient for a rich growth of ground vegetation which has added organic matter to the soil thus giving it progressively a brown, then grey and finally black colour.

Similar soils occur on the Steppes of Russia, and are known as *Chernozems.*

The distribution of these soils in Australia is shown in the map on the right.

The black soil plains have a high primary production capacity and support large numbers of people.

Gravel for roads

These "heavy" soils have a high shrinkage rate and water holding capacity. These characteristics, which are due to their active clay content, make them a very poor foundation for a road. They present particular problems for road construction and trials have been carried out and extensive research is in hand in New South Wales into the stabilisation of locally occurring material for roads built on black soils.

Gravels used in the construction of road pavements usually consist of a coarse fraction and a soil mortar. Coarse aggregate and sand provide structural strength and hardness, fine sand adds embedment support to the coarse sand and silt acts as a filler to prevent the granular particles from rocking. Clay particles carry electrical surface charges which provide the force of cohesion. Dry clay is stronger than wet clay.

Where a gravel is deficient in one or more of these qualities it becomes more prone to deformation under traffic loads. However, mechanical stabilisation or stabilisation with lime, cement, tar bitumen or chemical

Generalised map of Eastern Australia showing areas of black soil in black and areas of grey and brown soils in brown.

be widened or duplicated should the traffic growth on Dooralong Road warrant such an improvement.

In the history of the road, there have been three earlier structures at this crossing of Jilliby Jilliby Creek. The first was a causeway with logs built about 80 years ago by Mr. Birk, a shingle cutter who lived just west of here and needed a crossing to get his bullock team over the creek. Like its predecessor, the new bridge is known as Birks Bridge and perpetuates the name of this early pioneer.

The new bridge was constructed by a local firm, Beattie and Frost Pty Ltd of Gosford, which employed local people on the job. Mr. Sexton pointed out that this meant that a considerable amount of finance was circulated locally for the benefit of the area. The final cost of the bridge and approaches was $96,000 and was funded from a grant of $183,000 made available to Wyong Shire Council through the Department of Main Roads, specifically for work on rural local roads. This grant was part of a total sum of over $23 million allocated to local government authorities throughout New South Wales in the 1977/78 financial year for works on rural local roads. This work includes such benefits as improvements to railway level crossings, construction of bridges, road maintenance and restoration of flood damage.

Appropriately, the aboriginal words "jilliby jilliby" are said to mean "where two creeks meet", apparently referring to the junction of Jilliby Jilliby Creek and Little Jilliby Creek near the settlement of Jilliby, south of Dooralong. Although by many standards, the new bridge is undeniably small and perhaps even inconsequential, it is bigger than the one before and for this reason alone it means better day-to-day road communications for the farmers and other rural workers in the area. ●

Top: Mr. B.J. Sexton, Commissioner for Main Roads (on the right) unveils a plaque at the official opening while Councillor F.N. Farrell, President of Wyong Shire Council looks on.

Centre: Councillor F.N. Farrell, President of Wyong Shire Council, addressing guests and visitors at the official opening of the new bridge on 27 January 1978.

Below: Part of the considerable crowd of people who came from the surrounding district to watch the official opening ceremony which was organised by Wyong Shire Council.

WHEN ROADS WERE

"The worst in all creation"

In November 1831, following his appointment as Surveyor-General in 1828, Major (later Sir) Thomas Mitchell led his first inland expedition northwards from Sydney through known country to the vicinity of present-day Tamworth. From there, Mitchell explored to the Namoi River and followed it down as far as Narrabri. He then cut across the plains to the Gwydir River near Moree. The party then spent several weeks charting the tributaries between the Gwydir and Barwon Rivers. In February 1832, after Aboriginals had killed two of his party and plundered the stores, Mitchell returned to Sydney.

Development of the area followed gradually and in 1851, the first store was established at the site of Moree. In 1859 town layouts at both Moree and Narrabri were surveyed.

Settlement then advanced at such a rate that by 1884 a mail coach service travelled four times weekly between Narrabri and Moree. The coach service usually took fifteen hours and ran on roads which were formed on the black soils.

The Australian Town and Country Journal of 7 June 1884 reported that *"the Moree district offers many attractions to the free selector, and the township is the centre of a fast increasing population. There is a handsome bridge at the approach to Moree and another at the exit; and they both lead the way onto roads which, in anything like damp weather, are about the worst in all creation".*

The roads across the black soil plains of north western New South Wales and western Queensland have been described as the most treacherous road surface on the many routes traversed by the coaches of Cobb & Co.

When dry the black soil provided good going but after only a few points of rain it turned into a black spongy glue which clung tenaciously to the wheels of the coaches. The heavier the rain the deeper the wheels sank into the black mire until eventually the axles were covered and the body of the coach sat on the mud.

The 1884 report mentioned above paints the picture in graphic detail.

"The black clay clings to the wheels in great masses until the tires reach six times their ordinary size. It clings to the horses' feet, and each piece as it fasten on picks up another piece, until the unfortunate animals walk with each foot enveloped in gluey mud to the weight of from 5 lb. to 15 lb. The driver gets down to walk, and his feet pick up the glue also, and he has to take a tomahawk every few yards and chop it off his boots. Then the wheels sink into a particularly soft spot somewhere, and the team comes to a standstill. The driver cracks his whip and thrashes the horses, and shouts and swears; but the load is immovable. He cuts a sapling and endeavours to lever the wheel out, but the ground is rotten and he can get no purchase. If he has one he gets out a shovel and digs a trench before the wheel. Then he cracks his whip again and shouts, and the horses pull with a mighty effort, and move the waggon a few feet forward, when it sinks again deeper than ever. Perhaps he digs another trench and if he is lucky he may pull out. If not, he remains bogged in the mud for days until the ground hardens and another team comes along and pulls him out."

In his poem "The Teams", Henry Lawson wrote of the similar plight of bullock-hauled waggons caught in rain that turned blinding dust into binding mud.

"The rains are heavy on roads like these
And, fronting his lonely home,
For days together the settler sees
The waggons bogged to the axletrees,
Or ploughing the sodden loam.

And then, when the roads are at their worst,
The bushman's children hear
The cruel blows of the whips reversed
While bullocks pull as their hearts would burst,
And bellow with pain and fear.

And thus — with glimpses of home and rest —
Are the long, long journeys done;
And thus — 'tis a thankless life at the best —
Is Distance fought in the mighty West
And the lonely battle won."

Reproduced from "Poetic Works of Henry Lawson" by David Wright, courtesy of Angus and Robertson Ltd.

Even with such vivid descriptions, in a world where high-powered air-conditioned sleeper-cabined semi-trailers can carry huge loads and move their overall weights of up to 36 tonnes with reasonable ease at speeds of up to 80 km per hour, it is hard to fully realise just how incredibly slow and painstaking it was to haul goods across the black soil plains in days gone by. Nevertheless it is good to ponder the perseverance of our early pioneers in their tenacious struggle to open up new areas of our State. ●

To minimise the effect of rain, the completed but unprimed sections of the pavement were treated with a dust coat of one part bitumen emulsion to five parts water, sprayed on at the end of the day.

Spreading of dry stabilising materials, especially lime, becomes difficult on windy days and there can be an appreciable loss during placing and mixing under adverse wind conditions.

Protective equipment, in the form of respirators and protective cream, was issued to employees working on the project.

Tentative assessment

While it is still very early in the expected life of the road pavement to accurately assess the final results, regular inspection reports on the condition of the various test sections describe the standard as ranging from good to very good.

A further inspection following flooding in February 1976 showed that no damage was sustained by the work. The stabilised shoulders stood up well, although some minor scouring of the unstablised shoulders occurred.

It is clear that well designed and constructed pavements incorporating stabilised bases produce roads which are durable and require low maintenance expenditure.

There is an enormous dependence in Australia on the motor vehicle for the movement of people and goods. Low cost roads therefore are important because of the vast distances, small population and limited funds available for road construction.

The existing economic climate, which will probably continue for some years to come, has provided an added impetus for these construction techniques which will provide roads at a reasonable cost, to a standard, sufficient to cater for traffic requirements during the expected life of the road—with the absolute minimum expenditure on maintenance.

Investigations into the stabilisation of soils, both in the laboratory and in the field, are being carried on throughout New South Wales as an ongoing programme of research to solve road construction problems particularly in areas where there is a deficiency in suitable gravels. •

The following articles about roads on the black soil plains and stabilisation have appeared in earlier issues of "Main Roads"

Bitumen Surfacing Across Black Soil Plains, December 1959, Vol. 25, No. 2, pp. 50-2.

Some Examples of Pavement Stabilisation on Country Main Roads, June 1960, Vol. 25, No. 4, pp. 126-9.

Castlereagh Highway, Reconstruction Coonamble to Walgett, March 1969, Vol. 35, No. 3, pp. 73-4.

Newell Highway Reconstruction Narrabri to Moree, March 1966, Vol. 31, No. 3, pp 91-93.

Newell Highway Fully Sealed, December 1973, Vol. 39, No. 2, pp 42-45.

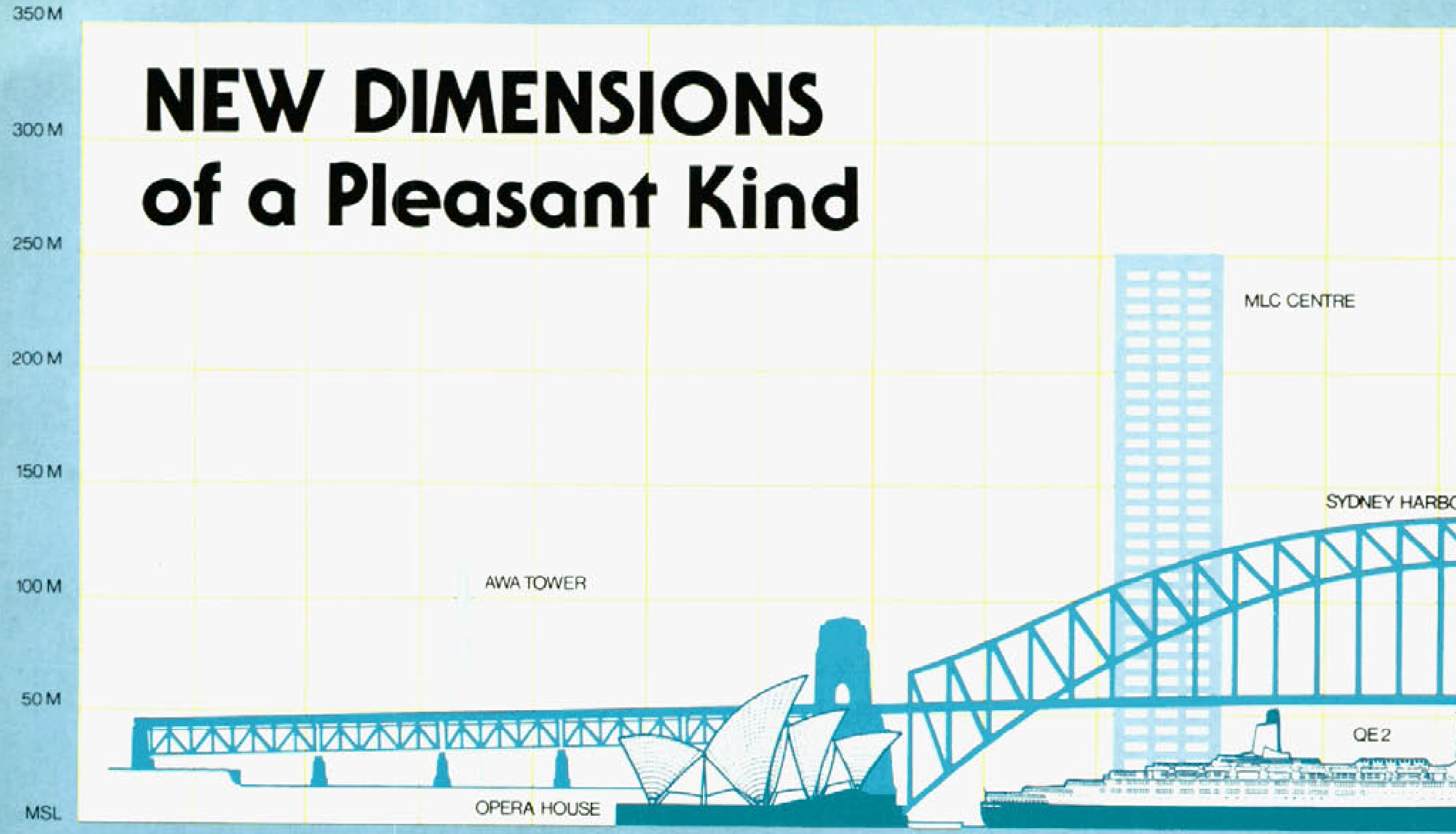
Soils and Rocks in Road Construction in N.S.W.
Pt. I June 1956, Vol. 21, No. 4, pp 112-116
Pt. II September 1956, Vol. 22, No. 1, pp 9-16
Pt. III June 1957, Vol. 22, No. 4, pp 120-123
Pt. IV September 1959, Vol. 25, No. 1, pp 26-30.

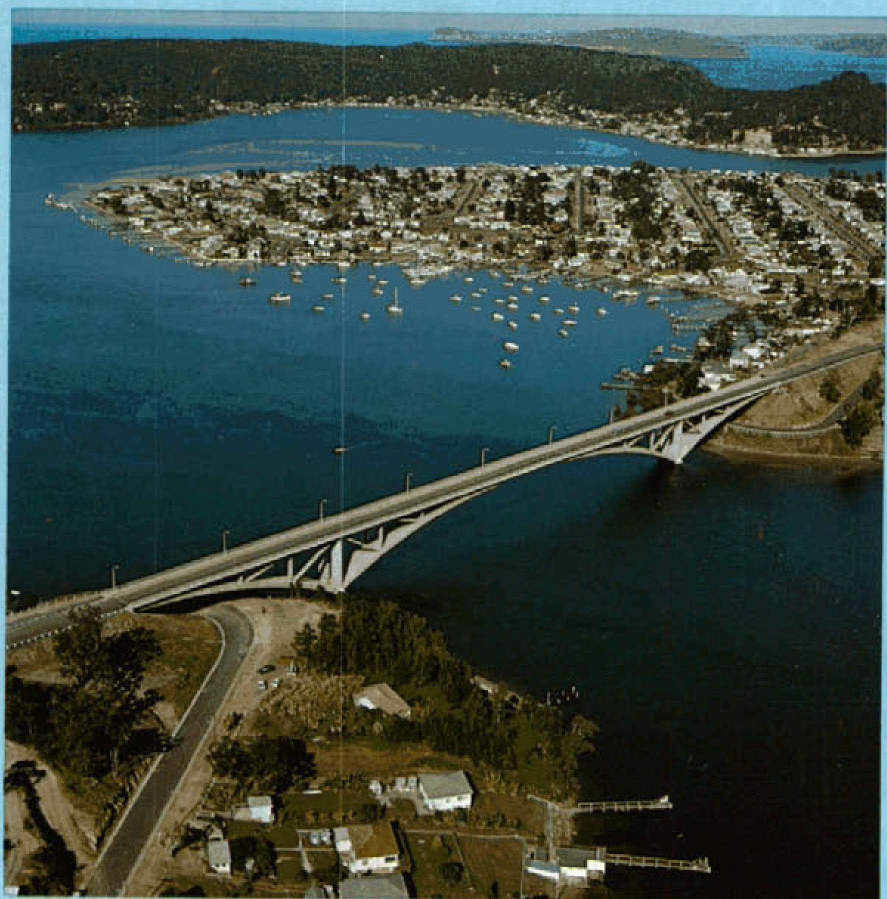
Above: A rotary mixing machine being used to mix the pavement materials for a second time.

Left: A coat of bitumen emulsion being applied to protect the compacted pavement against traffic and weather.

A grader mixing lime into gravel to form a stabilised road surface on the Newell Highway between Moree and Boggabilla.

NEW DIMENSIONS of a Pleasant Kind





Left: The attractive and unique design of t in this aerial view.

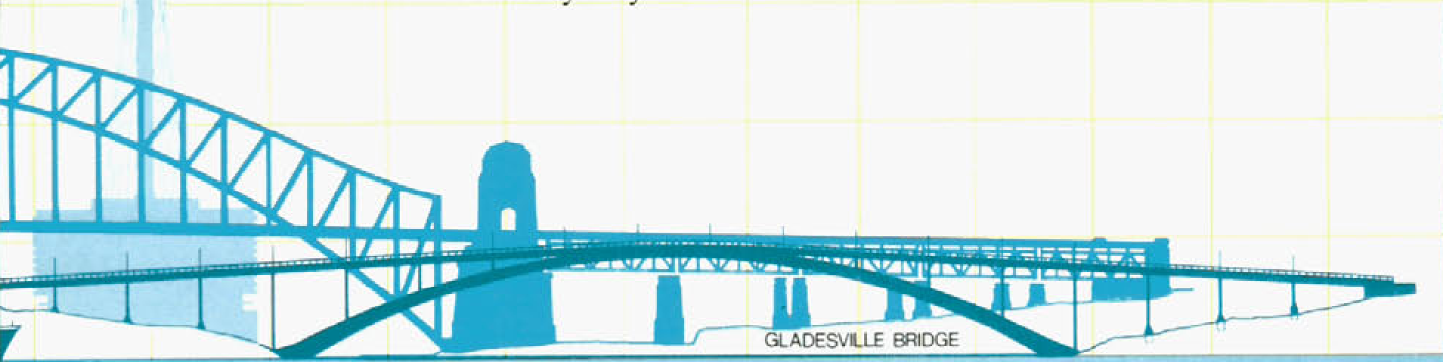
Below: The Macarthur Bridge carries the at Camden. Opened on 26 March 1973, it

Right: On the South Coast at Bega, this 6 River.

Many people take a special interest in comparing the size of things. Dimensions can be fascinating – in engineering as much as in other professions. . . or pastimes.

There is a certain compelling attraction in ascertaining what is the longest or the highest in some category. If such statistics interest you, don't miss

- the article about bridge spans and overall lengths on pages 88-93, or
- the following article on page 94 about the comparative size of some of the Sydney landmarks shown in this illustration.

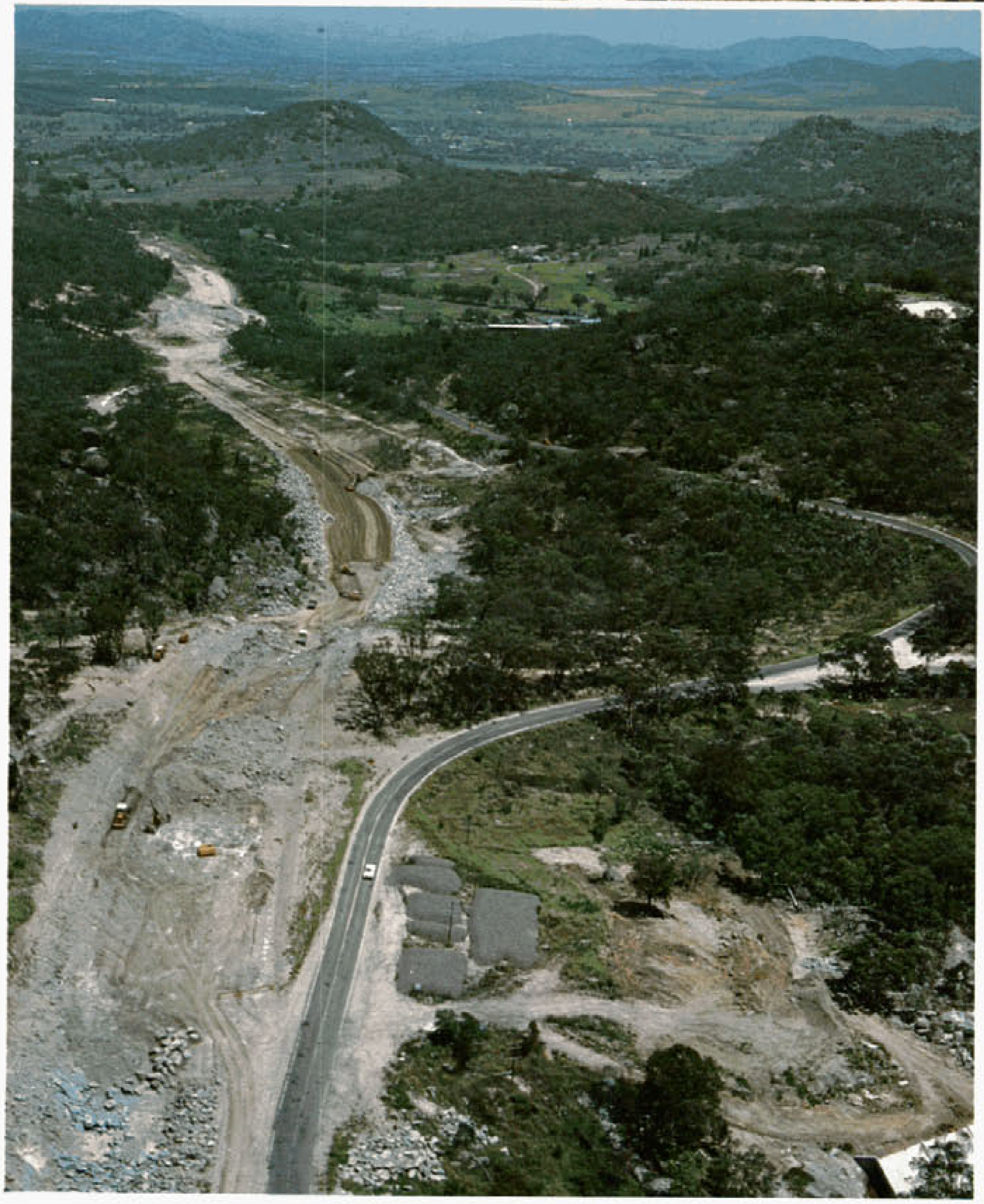


bane Water at The Rip is clearly seen

cross the Nepean River and its flood plain longest road bridge.

kes the Princes Highway across the Bega

Two views of the reconstruction in progress. In the aerial photograph, which looks south, the existing highway route can be seen on the right.



NEW ROAD THROUGH RUGGED MOONBI RANGES

FOURTH ROUTE FOR SECTION OF NEW ENGLAND HIGHWAY

A rugged barrier

In his poem "Over the Range", Andrew "Banjo" Paterson (who also wrote our most famous ballad "Waltzing Matilda") referred to a range of mountains known as the Moonbis to symbolise the barrier between earthly life and heavenly promise.

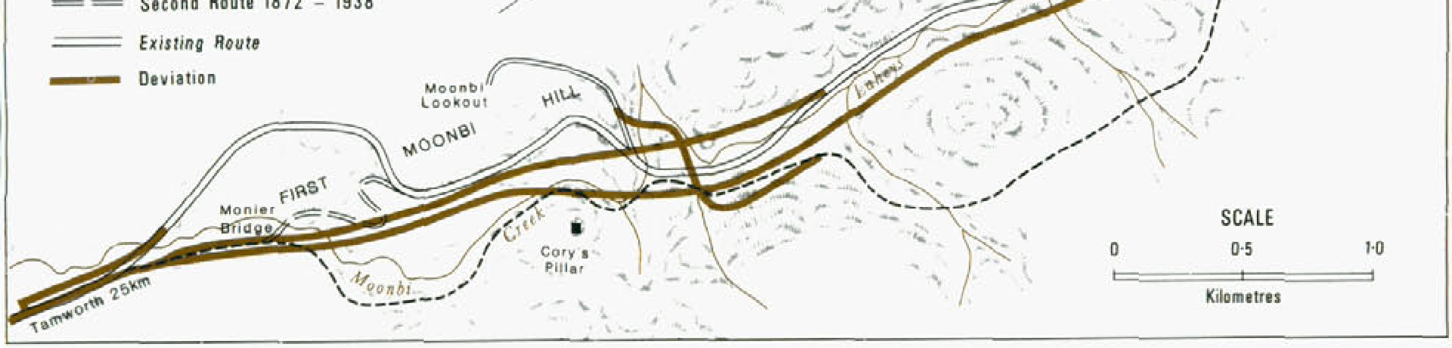
To people living in the Tamworth region, the Moonbi Ranges were a formidable obstacle to trade and travel between them and the fertile tablelands of New England.

When Paterson wrote that poem around the turn of the century, the original Great Northern Road which traversed those mountains had already been resurveyed and to a large extent rebuilt along a better route than the original one. The new way avoided the worst stretches of the first. It was still, however, a very rugged road with some tortuous bends and many rough sections.

An important trade link

But in 1864, when Banjo Paterson was born, the Great Northern Road was still in its original condition. A trip along it tested the mettle of even the hardiest, including the teamsters who carried manufactured goods north to the New England district and primary produce south to market.

The road generally followed the trail blazed in 1832 by Edward Gostwyck Cory. His feat is commemorated by the balanced lump of granite called Cory's Pillar (sometimes Cory's Pillow or Cory's Nightcap) where he is believed to have sheltered overnight during his explorations.



Overgrown with grass and moss, this section of a basalt slab table drain bears testimony to the workmanship of early road builders.

Difficult ascent, dangerous descent

Before the second route bypassed it in 1872, the main subject of the teamsters' curses was the feature known as "The Pinch". This was a pass over the First Moonbi Hill near the site of Cory's Pillar. Although it ran between the highest ridges, it still involved a steep climb of about 200 metres.

So steep was it, in fact, that teamsters used to pool their horsepower (or bullockpower) to climb the rise. They would camp and wait at the base until they could hitch two or more teams together to haul their waggons up in turn. In the summer, they waited for the cool of night so that both men and beasts could give of their best . . . and, of course, moonlit nights were particularly helpful.

Coming down the hill loaded, they often dragged felled trees behind them to brake their descent down the precipitous slopes.

"Moonboys"

It is said that the Moonbi Ranges were named after a local aboriginal tribe. However, the "Moonbi" name may have been coincidentally reinforced by a custom the teamsters are said to have had. On those nights when the moon would rise, the first man to spot its glow over the hills would call out "Moon boys!" as a signal to hitch up for the night's ascent. Possibly, knowing the local name, they developed the custom out of a sense of humour.

Early improvement

During 1859, tenders were called for clearing, draining and ballasting and the erection of culverts on the Great Northern Road near Tamworth and Moonbi Village and Moonbi Pass. Later, the tender of William Dowel for the Tamworth work and of John Cock, a Tintinhull farmer, for the Moonbi work, were accepted.

The estimates of 1860 included £1,000 to be spent on the "Bendemeer Tamworth Road". As a result, Capt. B. H. Martindale (Commissioner for Internal Communication) in his fourth report in 1860 was able to refer to *"2 miles* (of) *new road at the Moonbi's Pass which has been greatly improved".*

Work began in 1863 on metalling the Great Northern Road. By 1865, the section between Tamworth and Bendemeer had been cleared and fenced while that between Bendemeer and Armidale was partly metalled.

Road contractors for this section included Thomas Hobbs, and members of his family. Some local residents can apparently remember a very dedicated Mr. Cavanagh who, around the year 1900, had the care of the road between Moonbi and Bendemeer. At various points along the road he had made tracks leading to the hills, along which he could wheel his barrow to get supplies of small stones to fill up holes in the road. It is said he would lovingly sweep the road surface with a broom!

Where "The Pinch" was blue

Since "The Pinch" was the most difficult section of the route, the original metalling was confined to that part and it extended for about 400 m from the bottom. Most of the metalling consisted of small knapped (hand-broken) stonework, but a foundation of larger stones was laid on the steepest section. These were of basalt and no record of where they were obtained has been traced. Because of their blackish-blue colouring, they contrasted with the lighter tones of their surroundings, and consequently, this section was sometimes called "The Blue Pinch".

"Fossils" of a road

Even though much of the original route through the Moonbis has been abandoned for over a century, it is still possible to trace some sections. This is partly due to the fact that, for many years, timber-getters and stockmen travelled the old path as a matter of convenience, thus keeping it more or less cleared.

About half-way up "The Pinch", there are still to be seen the remains of a wooden culvert, some pieces of stonework, a hand-packed retaining wall and two logs that presumably had been placed to mark the way and confine the traffic.

Just north of the culvert is the steepest part of the pass. Here there are still some of the table drains built along both sides of the road. Constructed of squared basalt slabs, the drains are still fairly well preserved in their original positions, except for some places where scouring has undermined them. The drains continue up the pass for about 40 m to where the road crosses a gully that is one of the sources of Moonbi Creek. There was no bridge across this gully, but filling stones had been placed in it.

At the top of "The Pinch", the road reverts to its northerly direction and, although the grade for this last 100 metres is fairly gentle, the road is very badly eroded and bears only little evidence of having been metalled.

The "S-Bend" deviation

Early in the 1870's, a second route was found through the Moonbis. This eliminated the steep and daunting climb of "The Pinch", but produced a sharp S-bend snaking through the hills.

The date of the original survey for what became known as the "S-Bend" deviation is not known, however it may have been one of the several roads surveyed in 1869. We do know that George Loder surveyed the road from Moonbi to Bendemeer between 25 June and 9 July 1879. In that survey, he marked the Blue Pinch as "Old Road", while the "S-Bend" route is shown as in existence.

The "S-Bend" deviation left the road leading to "The Pinch" about 400 metres up Moonbi Creek from the present highway. The place where it forded Moonbi Creek was probably at or near the Monier Bridge (see below). After two difficult "S-bends", it followed the course of the present highway.

A bridge that now goes nowhere

A notable feature of the old route is the Monier Bridge over Moonbi Creek. Built of concrete blocks, this single span arch bridge is thought to have been built shortly before World War I, but records of its design and construction appear to have been lost. Any information from our readers would therefore be appreciated. The name appears to perpetuate the N.S.W. State Monier Works or the Frenchman, Joseph Monier (1823-1906), who late last century pioneered new techniques in concrete casting and reinforcing.

The wooden handrails of the bridge's 10 m length are now gone, but the basic structure seems sound and it should stand for many more years, providing it is not damaged by "off-road" vehicles.

A matter of names

In May 1929, the Great Northern Road, from Wisemans Ferry to the Queensland border west of Tenterfield, was renamed the Great Northern Highway. The section from Hexham north to the Queensland border retained that name until on 24 March 1933 it was re-named the New England Highway, as the major through route between the central coast, the New England tablelands and Queensland.

Another deviation

A new route to eliminate the earlier "S-Bend" deviation and a steep grade on a 7 mile (11.2 km) long section was built north from the village of Moonbi and was opened on 3 February 1937. The whole work cost approximately $37,000 including $7,000 for "tar surfacing".

The major portion of the work was carried out by Cockburn Shire Council by "day labour", that is, using their own workmen under the supervision of the Shire Engineer. The section at the foot of the Range was constructed by Messrs. Fretus and Jenkins under contract to the Council and at a contract price of £5,506.9s.10d.

Further improvements have been undertaken over the years, including the provision of a third lane to allow faster vehicles to pass slower ones negotiating the steep climb.

Route number four

With aerial photography and associated photogrammetric methods, surveying and map-making are both faster and more accurate than in the past. Modern machinery and methods also allow major construction work that would at one time have been too difficult and expensive to even contemplate. Together, these factors have permitted the planning and the current execution of a greatly improved fourth route through the Moonbis.

The first Moonbi Hill, due to its very rugged character, has always been more notorious than the Second Moonbi Hill. It was on the First Moonbi Hill that reconstruction began in June 1975 and continues now on a 5 km section, from approximately 25 km to 30 km north of Tamworth. Plans are in hand for the continuation of the work over the Second Moonbi Hill.

This 1975 photograph repeats a familiar sight of the late 1920's. A Chevrolet truck of the period chugs its way along the old road between the S-bend and the Monier Bridge.

The timing of this work is, of course, dependent on the continuing availability of funds. As a declared National Highway, the New England Highway is now funded throughout its length by the Commonwealth Government. This fact recognises its importance as an interstate trade artery. Movement along the New England Highway is not just between New South Wales and Queensland, but through its connection with the Oxley Highway and thereby to the Newell and Barrier Highways, it provides a link for traffic going to and from South Australia, Victoria and Western Australia, as well.

At present, work is at an advanced stage on the two sections that make up the whole of the First Moonbi Hill roadworks. The first section involves the construction of new northbound and southbound carriageways from 24.8 km to 27.6 km north of Tamworth. The second stage entails the construction of a new southbound carriageway from 27.6 km to 30.05 km, and the reconstruction of part of the existing highway to improve and incorporate it as the northbound carriageway of the new route.

Taking care

The Department undertook an environmental impact study before construction work commenced and, as much as it can, it has tried to avoid changing the natural ecology of the region in any way. Trees and undergrowth are being left undisturbed except where their removal is absolutely necessary for construction or safety reasons. Such plant life keeps the soil stable and provides food and shelter for animal life as well. Native trees and plants also bring colour and variety to the traveller's eye. Planting and landscaping will be undertaken by the Department to restore those parts which have been affected in any way by the roadworks.

Preserving the past

The same care is being taken with those relics which remain to remind us of the pioneers of our past. The landmark of Cory's Pillar has been left untouched. In fact, while blasting and other heavy work was carried out in that vicinity, the Pillar was supported with sandbags to hold it in place and protect it from possible damage.

Most of "The Pinch" itself remains unaffected for future generations to explore and study, although the new southbound carriageway cuts through it at one point.

Unfortunately, it has also been necessary to locate a short section of the northbound carriageway across part of the old "S-Bend" deviation. But, again, the major point of interest—the Monier Bridge—will not be affected.

A happy medium

Generally, in major road improvements, the aim is to reduce the grades and smooth out the curves. The material which is excavated from the ridges and peaks is often used to fill in the low areas between them, thus averaging out the extremes of grade. As a result of these aims, most of the new route through the Moonbis will be a pleasant path of sweeping curves and moderate grades.

The Department is keenly aware that steep climbs are costly to road users, both in terms of fuel consumption, and increased vehicle wear. On the other hand, steep descents can

Large boulders pushed aside more than one hundred years ago still line part of the route of the old road over the First Moonbi Hill.

be dangerous, as gravity adds impetus to a freely-moving vehicle. Experienced drivers know how insidiously speed builds up on a long smooth downhill run. The less experienced, however, need to be protected.

Consequently, on the new work the average grade will be 5%, although on the northbound carriageway a short 600 m length will be 9.6% and on the southbound carriageway a 725 m length will be 9.4%.

To counteract, at least in part, the dangers of brake failures and other similar emergencies, three safety ramps are being built on this First Moonbi Hill section.

Culvert crossings

Extensive drainage operations on the work include a large box culvert at Moonbi Creek under both carriageways. This culvert will be 52 m long with three 2.4 m × 2.4 m cells.

Another culvert at 28.6 km on the northbound carriageway is already finished. An extension to the Lahey's Creek culvert 29.8 km from Tamworth is also being built. A total of 1230 m^3 of concrete will be used in the major culverts.

Massive earth moving

The line up "The Pinch" is still a worthy adversary of man the road builder, although the fight was harder in the old days of pick, shovel and animal power.

In the current work at the First Moonbi Hill, over 400000 m^3 of earth and rock will eventually be moved, using both mechanical and explosives techniques. The biggest single cut on the project involves the removal of 94000 m^3, the vast majority of this material being solid granite. This is to make a cut 19 m deep for the southbound lanes.

The hard granite is still not easy to move and over 100 tonnes of ammonium nitrate and fuel oil mix, with gelignite boosters, will be needed to shift 182000 tonnes of material.

At the present time there are over 20 major items of plant and equipment, valued at about $1,250,000, operating on the site, some belonging to the Department and some hired. These include a variety of dozers, loaders, graders and large rollers of different types, as well as such auxiliaries as air compressors and pneumatic drills, small rollers and concrete mixers.

A considerable concentration of technology and expertise has been brought to bear in this latest round to subdue the mighty Moonbis—a legendary locality in our pioneering past and a formidable obstacle in our continuing quest for better roads.

Modern machinery makes road building an easier task and helps provide far better travelling conditions.

The task of giving today's road-users an up-to-date, safe, fast and dependable way through this notorious range is the biggest, toughest and most expensive job ever undertaken by the Department in its North Eastern Division, centred at Tamworth. When it is finished it will be $5,000,000 very well spent. •

The Department wishes to thank Mr. L. Green of the Tamworth Historical Society for his assistance in making available much of the historical information for this article.

More history on the whole of the New England Highway is available in an article in the March 1952 issue of "Main Roads", Vol. 17, No. 3, pp 68-76. This article is available on request as a separate reprint.

Back in the May 1937 issue (Vol. 8, No. 3, pp 106-7) an article described reconstruction through the Moonbi Ranges at that time.

An aerial view of recent reconstruction through the Moonbis appeared in colour on the back cover of the December 1976 issue (Vol. 42, No. 2).

RECORD MAKING AND BREAKING

A LOOK AT SOME FAMOUS BRIDGES AND THEIR DIMENSIONS

Starting an argument

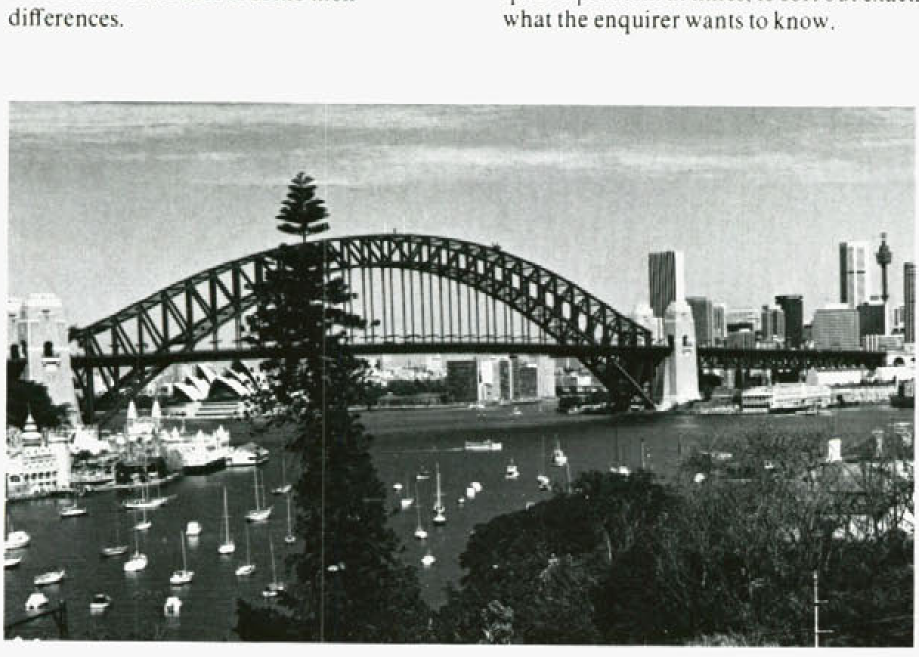
There is a practically infallible method for starting a lively discussion, if not a heated argument, in almost any gathering. Simply bring up the subject of records and record-breaking in just about any field. The "Guinness Book of Records" and its variants have proved a huge publishing success due to the propensity for impromptu debaters to demand final and authoritative arbiters to settle their differences.

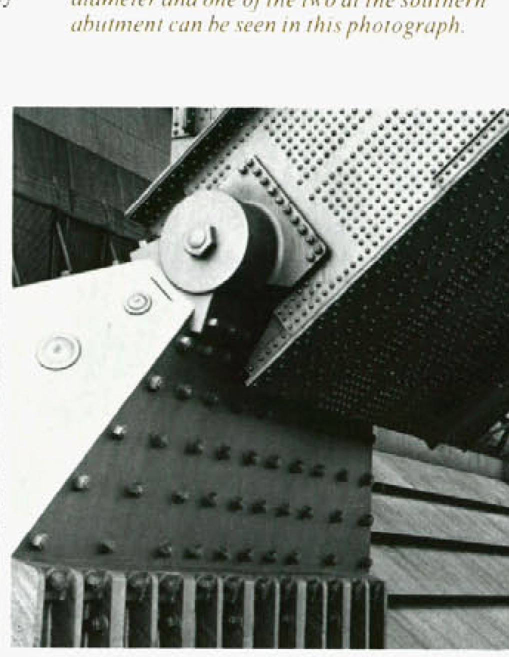
The subject doesn't seem to matter. Sport, natural history, famous "firsts", engineering feats—they all provide rich sources for disagreement. Departmental officers suspect that many questions they receive on historical and "dimensional" matters are intended to settle friendly, and perhaps sometimes not-so-friendly, bets.

Quite often the answers are easy; it is the questions that are hard . . . for it can be quite a problem at times, to sort out exactly what the enquirer wants to know.

Below left: Looking southeast across Lavender Bay to the arch span of the Sydney Harbour Bridge, still the city's best-known symbol. Towards the right-hand edge are some of the new buildings marking the city's soaring skyline (see pages 80-81 and 94).

Below: The mass of the Sydney Harbour Bridge arch span and its load of vehicles and commuters is supported by four hinge pins or bearings. These hinges are only 368 mm in diameter and one of the two at the southern abutment can be seen in this photograph.





Above: An artist's impression of the central portion of Melbourne's new 2583 m long West Gate Bridge, which is due to be opened late this year, and is already a dominant feature of the skyline at the mouth of the Yarra River. This will be Australia's second road bridge with a cable-stayed span, and will also be the country's second longest single span.

How big is a bridge?

A good example of this terminological difficulty is the general subject of the Sydney Harbour Bridge or "The Crown of the Harbour" as at least one journalist referred to it on its opening day, 19 March 1932. Nowadays it is best-known by the somewhat irreverent but affectionate nickname of "The Coathanger".

One frequent question is "How long is the Harbour Bridge?" Simple enough it seems, but what does the caller or writer actually mean by the term "Harbour Bridge"?

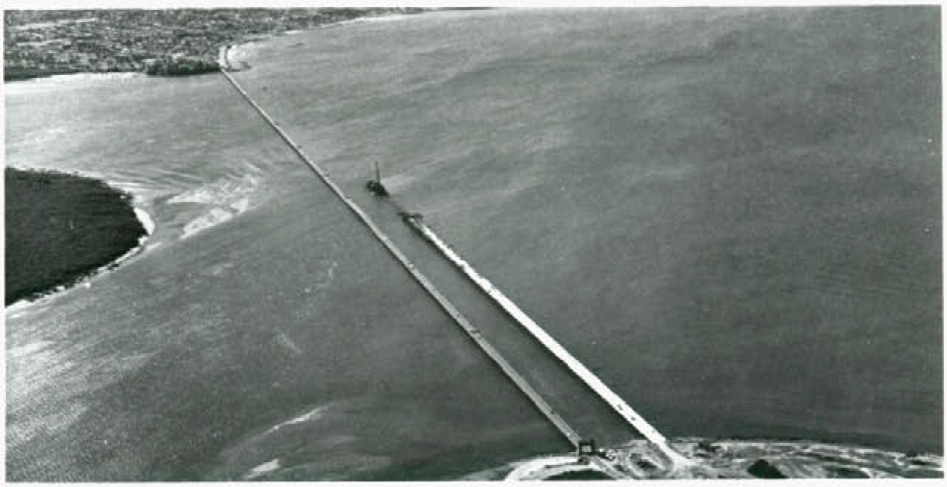
Strictly speaking, the Sydney Harbour Bridge consists of five approach spans on each side of the Harbour, with a single 502.9 m central arch span linking Dawes Point on the south side to Milsons Point on the north. The total length of the structure is 1 149 m.

However, since the arch is the most spectacular and distinctive aspect (and the feature which presented the greatest engineering challenge during its construction), that is what most people seem to mean when they speak of the "Sydney Harbour Bridge". So let us consider a few facts about this arch.

The generally accepted convention for specifying steel arch span lengths is by stating the horizontal distance between the centres of the bearings. These are the giant hinge-type supports which transfer the mass of the arch, the decking and the traffic loads, to the abutments at each end. The bearings allow a certain degree of flexibility in the vertical plane. This is needed to allow for adjustments during construction and later to accommodate movements brought about by temperature changes and by variations in "live" loading from traffic. A photograph of bearings at the southern end of the Sydney Harbour Bridge arch is shown on page 88.

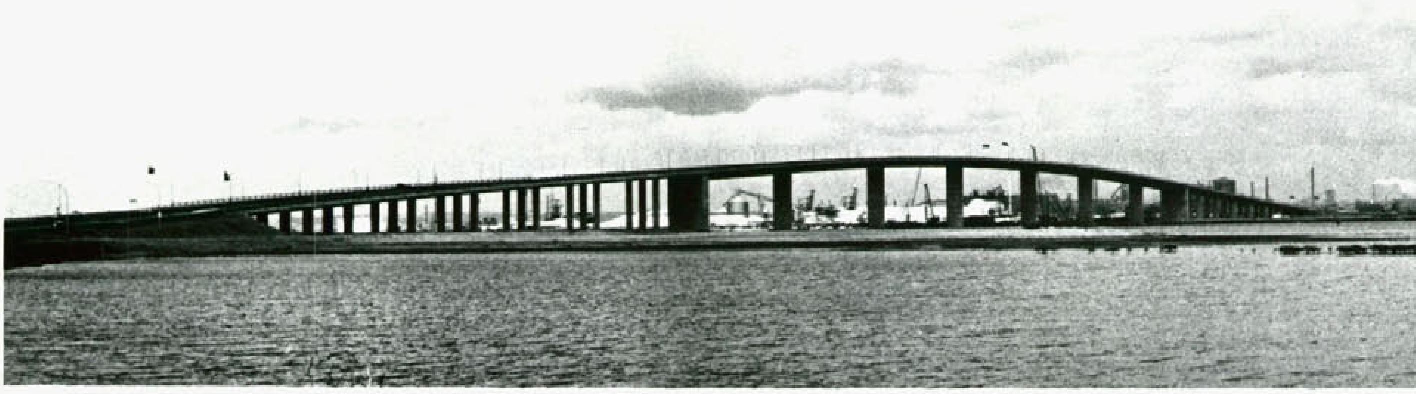
Below: Australia's longest bridge, opened in 1935, is the Hornibrook Highway Viaduct over the Pine River about 20 km north of Brisbane. Its present record length of 2 682 m will be exceeded by 34 m when it is duplicated by the Houghton Highway Viaduct, shown here growing across the river mouth. Being built at the approximate rate of one span a week, the 99-span bridge is expected to be ready for traffic in early 1980.

Bottom: As mentioned in the text, the Walter Taylor Bridge in the Brisbane suburb of Indooroopilly is one of the few suspension bridges in Australia and incorporates some of the cables used in the construction of the Sydney Harbour Bridge. Its functional cable support towers also provide storage and staff accommodation.



Above: Gladesville Bridge is another record-holder — being the world's longest concrete arch span with a leap of 305 m. The bridge was opened on 2 October 1964 and is shown here specially floodlit for the opening of the Sydney Opera House in 1973.

Below: This view shows the attractive bridge over the North Arm of the Hunter River linking the industrial area of Kooragang Island and Stockton, north of Newcastle. This 1023 m long structure was opened on 1 November 1971 and is the fourth longest road bridge in the State.



Not the longest

Many Australians, especially Sydney-siders, long believed that the Sydney Harbour Bridge boasted the longest arch span in the world. Unfortunately as it may seem to some, this was never so. But those who believed the claim can be consoled by the knowledge that quite a few reference works made the same error, including the first edition of one commonly used as a record of "records".

About four months before Sydney's famous bridge was opened on 19 March 1932, the Bayonne Bridge, joining New York State and New Jersey over the Kill van Kull, went into service. Its arch span measures 503.6 m (just 700 mm more than "Our Bridge"!) and its total length is 1 762 m.

An interesting sidelight to this story of friendly rivalry concerns the golden scissors used in the official ribbon-cutting ceremony to open Sydney Harbour Bridge. These had been used at the Bayonne Bridge opening and were lent to the New South Wales Government by the New York Port Authority.

So, until this year, the Bayonne Bridge held the honours in the arch length stakes, with the Sydney Harbour Bridge running a very close second.

World's new longest steel arch

Recently, a bridge was completed in the United States of America to take the title. This is the New River Gorge Bridge near Charleston, West Virginia, with an arch span of 518 m, out of a total length of 924 m. Unlike the other two mentioned, the New River Gorge Bridge carries its road deck *over* the arch, not suspended under it, as in the case of many other steel arch bridges.

Big where it counts

However, in other dimensional aspects, the Sydney Harbour Bridge main span still holds some first places. For instance, it is the widest long-span bridge of any type in the world, with a total width of 48 m and, after all, it is the width of Sydney Harbour Bridge which has made it so efficient as a harbour crossing for almost fifty years.

As originally built, the bridge had capacity for six lanes of road traffic, four sets of railway lines and two footways. The easter rail lines were never used for that purpose, but carried trams until they were phased ou and replaced by bus services in 1958. On 2 July 1959, conversion of the section previously used by the trams was complete and two additional lanes were made available to road traffic. Thus today's arch span carries eight road traffic lanes, two set of railway tracks, one footway on the eastern side and a cycleway on the west.

If not the longest, the Sydney Harbour Bridge arch span is by far the largest in sheer mass, with over 39 000 tonnes of steel in it, including the deck. The striking appearance of Sydney's bridge, which for many years has stood as a symbol of the cit itself, is enhanced by the huge granite-face pylons at each end.

The size of the reinforced concrete arch span beneath the deck of Northbridge "Suspension" Bridge can be appreciated from this photograph. The original bridge was built by a private company about 1892. When the Department found the suspension cables to be corroded, it converted the bridge to an arch structure in 1937-39.

The pylons themselves are sometimes the subject of enquiries, the most common of which is "Do they serve any functional purpose"?

Yes and no

Again there is no simple answer. The base of each forms part of the abutment, through which the great hinge pins transfer the load of the arch to the bedrock below. Up to road deck level, each abutment tower is an end pier, supporting the outermost end of the final approach span.

Above deck level, during construction, the partly-built pylons acted as rigid supports (unaffected by wind and temperature) for cranes, bracing struts and support cables. The latter passed from the growing arch halves over the pylon towers and through tunnels cut through the bedrock some distance behind the abutments. The cables supported the two half arches leaning over the harbour towards each other until they were finally and permanently joined on 19 August 1930.

In a paper written in 1932, Dr. J.J.C. Bradfield (who was Chief Engineer, Sydney Harbour Bridge and Metropolitan Railway Construction, and drew up the general plans and specifications for which tenders were called in 1923) explained that "these pylons . . . by their weight, steepen the resultant arch thrust, and so minimise the size of the skewback foundations".

From a visual point of view, the pylons provide a good aesthetic balance to the huge steel arch.

Double support

During the erection of the Sydney Harbour Bridge arch span, a common comment in engineering circles was that the temporary support cables would have sufficed for building a suspension bridge. Interestingly enough, this idea was actually carried out a few years later. Some of the erection cables were used as the permanent support cables of a 183 m long suspension bridge across the Brisbane River at Indooroopilly, near Brisbane. It is known as the Walter Taylor Bridge and shares fifth place with two others in the list of longest single spans in Australia (see list on page 93).

World's longest bridge spans

As far as single span lengths of all types are concerned, arches come pretty far down the world list. For example the world's longest bridge arch – that is, the main span of the New River Gorge Bridge in America – rates only 29th in the world listing of single spans of all kinds.

With their supporting cables wholly in tension suspension bridges take full advantage of the fact that steel is more efficiently used in tension than in compression. As a result, considerably wider gaps can be spanned by suspension bridges than other methods.

The following table lists the world's five longest spans, as well as the bridges' total lengths. They are all suspension bridges.

THE FIVE LONGEST SINGLE SPANS IN THE WORLD

Bridge	Length of Main Span (in metres)	Total Length of Bridge (in metres)
1. *Humber River Bridge, U.K.	1410	2220
2. Verrazano – Narrows Bridge, New York City, U.S.A.	1298	4176
3. Golden Gate Bridge, San Francisco, U.S.A.	1280	2737
4. Mackinac Straights Bridge, Michigan, U.S.A.	1158	5854
5. Bosporus Straights Bridge, Istanbul, Turkey	1074	1560

*Under construction

World's longest bridge

As a matter of interest, the longest bridge in the world is alongside the runner-up. The longest, at 38 422 m, is the second Lake Pontchartrain Causeway, completed in 1969. It is a road bridge and joins Lewisberg and Metairie, in Louisiana, U.S.A. The second longest is the first causeway which was built in 1956. It measures 38 353 m, just 69 m short of the record.

The longest leap down under

Let's now take a look at the situation within Australia.

THE LONGEST BRIDGE SPANS IN AUSTRALIA

	Bridge	State	Road or Rail	Length of Span (in metres)	Total Length of Bridge (in metres)
1.	Sydney Harbour Bridge	N.S.W.	Road and rail	503	1149
2.	Westgate Bridge, Yarra River	VIC.	Road	336	2583
3.	**Gladesville Bridge, Parramatta River**	**N.S.W.**	**Road**	**305**	**580**
4.	Batman Bridge, Tamar River	TAS.	Road	206	432
5A	Captain Cook Bridge, Brisbane River	QLD	Road	183	555
5B	**The Rip Bridge, Brisbane Waters**	**N.S.W.**	**Road**	**183**	**330**
5C	Walter Taylor Bridge, Brisbane River	QLD	Road	183	225
6.	Westgate Bridge, Yarra River	VIC.	Road	144	2583
7.	Victoria Bridge, Brisbane River	QLD	Road	142	313
8.	Hawkesbury River, Brooklyn	N.S.W.	Rail	136 (two spans)	785
9.	**Hawkesbury River, Peats Ferry**	**N.S.W.**	**Road**	**134** (two spans)	**602**
10.	*Brisbane River Bridge, South Brisbane to Roma Street Rail Link	QLD	Rail	133	779
11.	*Westgate Bridge, Yarra River	VIC.	Road	112	2583
12.	**Northbridge "Suspension" Bridge, Cammeray**	**N.S.W.**	**Road**	**111**	**152**

*Under Construction.
The bridges shown in bold type were built by the Department of Main Roads.

Last on our list, the Northbridge "Suspension" Bridge needs a brief word of explanation. Originally built as a private enterprise venture in 1892, this structure was taken over by the State Government in 1912 and became a responsibility of the Department in 1935. Shortly after this time inspection showed severe corrosion in the support cables and other steelwork, and the bridge was closed to all but pedestrian traffic.

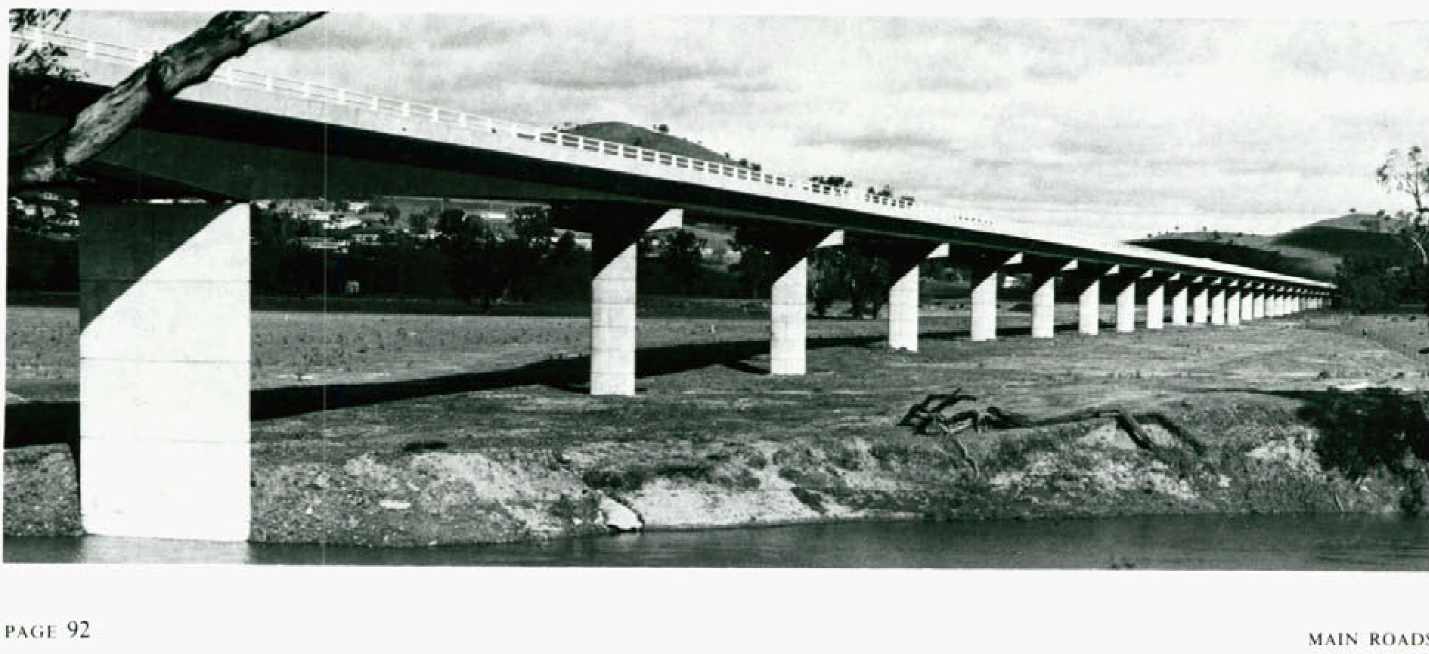
Over the next couple of years, the Department replaced the original suspended deck with one supported on a modern reinforced concrete arch. The original castellated towers were left in place, while the new abutments, although cast in concrete and not carved in stone, were fashioned by the Department to blend in with the old Norman Gothic style. The "new" bridge was opened again to vehicular traffic on 9 September 1939.

(See articles in the following issues of "Main Roads" August 1937, Vol. 8, No. 4, pp 152-155; August 1938, Vol. 9, No. 4, pp 146-147; August 1939, Vol. 10, No. 4, pp 113-116.)

Our nation's longest bridges

In conclusion let's look at how bridges throughout Australia compare in overall length.

The Department's newest big bridge is across the Murrumbidgee River and its flood plan at Gundagai. This 1141 m long giant was completed last March and is the second longest road bridge in New South Wales. It is 214 m longer than the old Gundagai Bridge located nearby.



THE LONGEST BRIDGES IN AUSTRALIA

	Bridge	State	Road or rail	Length (metres)
1.	Houghton Highway Viaduct, Pine River	QLD	Road	2716
2.	Hornibrook Highway, Pine River	QLD	Road	2682
3.	Westgate Bridge, Yarra River, Melbourne	VIC.	Road	2583
4.	Murrumbidgee River, Narrandera	N.S.W.	Rail	1872
5.	Tasman Bridge, Derwent River, Hobart	TAS.	Road	1388
6.	South Eastern Freeway, Yarra River and Gardiners Creek, Melbourne	VIC.	Road	1197
7.	Sydney Harbour Bridge	N.S.W.	Road and rail	1149
8.	**Murrumbidgee River, Gundagai** (new)	**N.S.W.**	**Road**	**1141**
9.	Home Hill Bridge, Burdekin River	QLD	Road and rail	1091
0.	**Macarthur Bridge, Nepean River, Camden**	**N.S.W.**	**Road**	**1030**
1.	Viaduct approaching Murrumbidgee River, Wagga	N.S.W.	Rail	1024
2.	**Stockton Bridge, Hunter River, North Arm**	**N.S.W.**	**Road**	**1023**
3.	Murrumbidgee River, Gundagai (old)	N.S.W.	Road	927
4.	Murrumbidgee River, Gundagai	N.S.W.	Rail	922
5.	**Harwood Bridge, Clarence River**	**N.S.W.**	**Road**	**895**
6.	Bribie Island Bridge, Pumicestone and Passage Rivers	QLD	Road	836
7.	Peel River, Tamworth	N.S.W.	Rail	830
8.	Temporary Bailey Bridge, Derwent River, Hobart	TAS.	Road	788
9.	Hawkesbury River, Brooklyn	N.S.W.	Rail	785
0.	*Brisbane River Bridge, South Brisbane to Roma Street Rail Link	QLD	Rail	779
1.	Snowy River Flats Bridge, Caulfield – Orbost Line	VIC.	Rail	770
2.	Spencer Street – Flinders Street Viaduct, Melbourne	VIC.	Rail	760
3.	Bethanga Bridge, Murray River Hume Dam	N.S.W.	Road	736
4.	Kings Bridge, Yarra River, Melbourne	VIC.	Road	697
5.	Storey Bridge, Brisbane River, Brisbane	QLD	Road	693
6.	Murray River, Robinvale	N.S.W./VIC.	Road and rail	664
7.	Phillip Island Bridge	VIC.	Road	640
8.	**Wallamba River, Forster-Tuncurry**	**N.S.W.**	**Road**	**632**
9.	**Bega River, Bega**	**N.S.W.**	**Road**	**624**
0.	**Hawkesbury River, Sydney – Newcastle Freeway**	**N.S.W.**	**Road**	**614**
1.	**Macquarie River, Dubbo**	**N.S.W.**	**Road**	**614**

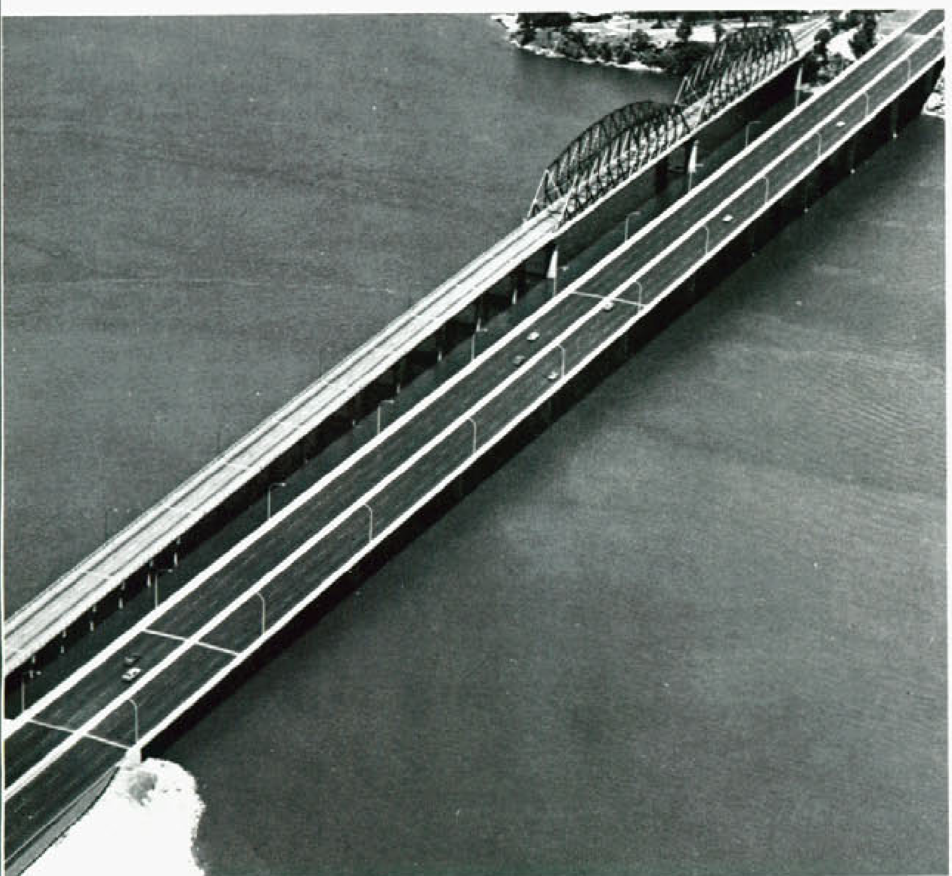
*Under Construction.
The bridges shown in bold type were built by the Department of Main Roads.

Engineers do not strive specifically to make or break records when designing their structures. A bridge's function is simply to span a gap or leap over an obstacle. The designer's job is to ensure that this is done as efficiently and economically as possible, having due regard for aesthetic considerations. If a record is set by the resulting structure, that is a side benefit which will earn it a place in the history books. . . at least for a while. It will probably also mean that the bridge will become a frequent topic in many informal debates. Such is the "eternal" role of all record makers . . . in whatever category they lead. ●

Articles on Departmental bridges mentioned in this article have appeared in the following issues of "Main Roads". Sydney Harbour Bridge; Construction, Pt. 1 March 1972; Pt. 2 June 1972. Traffic, December 1976
Forster-Tuncurry Bridge, September 1959
Captain Cook Bridge, Taren Point, June 1965
Gladesville Bridge, December 1964
Harwood Bridge, September 1966
Dubbo Bridge, September 1969
Stockton Bridge, March 1972
Macarthur Bridge, Camden, June 1971, December 1972 and March 1973
Hawkesbury River Bridge, March 1970, December 1971, June 1973 and December 1973
Bega Bridge, March 1974 and December 1975
Rip Bridge, Brisbane Water, September 1974
Sheahan Bridge, Gundagai, March 1974 and June 1977

• • •

The following publications on bridges are available free of charge from the Department's Public Relations Section.
"All About Bridges"
"The Story of Sydney Harbour Bridge"
"Sydney Harbour Bridge" by Dr. J.J.C. Bradfield, 1932.
"Bridge Building in N.S.W. 1788-1938"
(Reprint of three Journal articles)



The bridges which carry the Pacific Highway (left) and the Sydney – Newcastle Freeway (right) across the Hawkesbury River at Peats Ferry, near Brooklyn are more famous for the depth of their foundations than for their overall lengths (602 and 622 m). It is understood that the new bridge has the deepest driven pile foundations of any bridge in the world. They extend to solid sandstone bedrock 84.7 m below water level.

Sizing things up

A comparative look at some Sydney landmarks and the QE2

It wasn't very long ago that the AWA Tower in York Street, Sydney, and the Central Railway Station clock tower were quoted as scale standards when discussing the dimensions – especially the heights and lengths – of buildings, bridges and other structures.

Reaching for the sky

The building boom of the past couple of decades has put such landmarks in the shade, sometimes quite literally. Even the summer sun now casts shadows from new structures to eclipse many buildings that once used to dominate the city skyline.

Sydney's newest record-holder for height is Australia's tallest building, Centrepoint Tower (between Pitt and Castlereagh Streets near Market Street) with its telecommunications facilities reaching 283.4 m above Sydney Harbour's *mean sea level.*

Tower tops rival

Later this year, the turret of Centrepoint Tower will be jacked up to surpass the topmost level of its closest rival, the MLC Centre (which fronts Martin Place, Castlereagh and King Streets). The MLC Centre's building height is 250.1 m above *mean sea level,* topped by 18.9 m lightning conductors.

In comparison, the crown of the arch of Sydney Harbour Bridge is 134 m above *mean sea level,* while the tip of the top sail of the Sydney Opera House is only 57 m high.

Mean sea level, the mid-point between highest and lowest tides, has been chosen as the standard base point for our diagrammatic illustration on pages 80 and 81 which vividly shows the relationship between the heights of various structures.

Unexpected links

Besides being both largely constructed of steel, the longest (Sydney Harbour Bridge – 1,149 m) and tallest (Centrepoint) structures in Sydney share another aspect. The Engineering Consultants to the contractors for Centrepoint Tower are Redpath Dorman Long (Contracting) Ltd. This company is closely related to the original Dorman Long and Co. Ltd., who were contractors for the construction of the Bridge. The tender for that job was accepted by the New South Wales Government 54 years ago on 24 March 1924.

Caution – low clearance

The measurements of the luxury cruise ship Queen Elizabeth II, familiarly known as the QE2, allows some useful comparisons. The QE2 is the largest passenger liner in the world and paid its first visit to Sydney in February 1978.

If this latest of the famous Queens had to pass under the Sydney Harbour Bridge, it would be best to make the passage at low tide with a very calm sea. At *mean sea level,* the QE2's masthead, just over 52 m above its waterline, would have less than 1 m clearance beneath the bottom of the bridge deck.

To negotiate the channel under Gladesville Bridge, the ship would have to be stripped of both mast and funnel to get under that bridge's *mean sea level* clearance of just under 41 m.

The draught of the QE2 is nearly 10 m and, if the water under the Sydney Harbour Bridge were deep enough all the way across, the 292.5 m long ship could float lengthwise under the 502.9 m Bridge arch span with plenty of room to spare. It needs to be remembered, though, that the arch abutments of the Bridge are set back some distance from the water's edge at each end.

What's the difference

The mass of steel in the arch span of the bridge including the deck, is 39 000 tonnes. All of it, plus the load of constant road and rail traffic, is supported by just four 368 mm diameter hinge pins!

In contrast, the QE2 is not a "self-supporting" structure, but its gross 65 800 tonnes is buoyed up by water along its whole waterline length. If supported just by its ends it would collapse. For this reason, dry-docking of ships requires careful cradling and they tend to break up easily when run aground. They are not designed to cross water in the same way that bridges are.

Nevertheless, ships like bridges are people-oriented "inventions", which come in a multitude of shapes and sizes. In the final analysis, they are both variations of the same type of communications link which helps to get people to where they want to go.

In the case of the QE2, it is 2 025 passengers per cruise while in the case of the Sydney Harbour Bridge, it is more than 55 million vehicles every year, more than 150,000 vehicles each day and more than 9,800 vehicles each morning peak hour.

So, when you next talk statistics, remember – that's about the size of it! •

We wish to thank Australian Mutual Provident Society, Lend Lease Development Pty Ltd, Cunard International Travel Service and the Sydney Opera House Trust for their assistance in the preparation of this article.

R.J.S. Thomas

It is with regret that we announce that a previous Commissioner for Main Roads, Mr. Russell Thomas died on 9 October 1978. Mr. Thomas retired in August 1974, after a total of more than 48 years service.

Russell John Starr Thomas was born at Harris Park, Sydney, on Christmas Day, 1909. His father was a former Mayor of Parramatta. He attended Canterbury High School for three years and passed the Intermediate Certificate examination in 1925. Mr. Thomas joined the Main Roads Board on 3 May 1926 at the age of 16 and was employed as a casual junior draftsman on a salary of £1 a week.

In 1933, Mr. Thomas completed the Diploma of Local Government Engineering at Sydney Technical College and gained his Local Government Engineers Certificate in 1937. In the mid 1930's Mr. Thomas progressed from Engineering Draftsman to Assistant Engineer. He was Acting Officer-in-Charge at the Department's Gloucester Local Office and served at several other locations around the State, including Mummulgum and Tamworth where he supervised roadworks on the Liverpool Range.

His war service commenced in July 1940, when he enlisted in the 2nd A.I.F. as a Lieutenant in the Royal Australian Engineers. After serving in the Middle East and through the Pacific Islands, Mr. Thomas retired at the completion of hostilities with the rank of Major. He was "mentioned in despatches" for distinguished service while in the South West Pacific zone.

On his return to service with the Department of Main Roads, Mr. Thomas became Supervising Engineer in the South Coast Division with headquarters at Bega. For part of this time he was in charge of the roadworks carried out by the Department in connection with the Snowy Mountains Hydro-Electric Authority's projects.

In 1955, Mr. Thomas was appointed as the first Divisional Engineer at Broken Hill, to establish the Murray Darling Division. In 1957 he became Divisional Engineer of the North Eastern Division at Grafton.

Following his transfer to Head Office in 1961, Mr. Thomas was appointed Assistant Highways Engineer and Executive Engineer before being appointed Assistant Commissioner on 20 April 1962.

Mr. Thomas made several overseas visits to attend conferences and study road construction practices. In 1961 he attended a traffic engineering conference in Washington D.C., U.S.A., and spent four months studying overseas practice in the maintenance and construction of roads in the United States of America, Great Britain, and Europe. He again visited these areas in 1966 to attend a conference of the International Road Federation in London and study developments in road engineering practice since his earlier visit.

On 26 August 1967, Mr. Thomas was appointed Commissioner for Main Roads to succeed Mr. J.A.L. Shaw who had retired. After serving the full seven-year term as Commissioner, Mr. Thomas retired on 26 August 1974, to be succeeded in turn by Mr. A.F. Schmidt.

Mr. Thomas was intimately associated with the work of Legacy and during 1966-67 was the President of the Legacy Club of Sydney, having at that time been a member of the Club for 19 years and Vice President for 3 years. He was a Fellow of the Institution of Engineers, Australia, a Fellow of the Chartered Institute of Transport, a member of the Royal Australian Historical Society and a member of the Blue Mountains National Park Trust.

With a keen sense of history, Mr. Thomas initiated and guided the preparation of the Department's extensive historical book "The Roadmakers".

As Commissioner for Main Roads, Mr. Thomas assumed membership of the National Association of Australian State Road Authorities, the Australian Road Research Board, the State Planning Authority, the County of Cumberland Passenger Transport Advisory Committee, the Traffic Advisory Committee, and the Road Safety Council. In addition he became an adviser to the Parliamentary Standing Committee on Road Safety.

During the term of office of Mr. Thomas, a number of major road and bridge works were completed and opened to traffic. These included . . . the first sections of the Warringah Freeway, the Western Distributor, the Western Freeway and the South Western Freeway, as well as additional sections of the Southern Freeway and the Sydney-Newcastle Freeway . . . bridges at The Entrance, Wentworth, Deniliquin, Murwillumbah, Dubbo, Forbes, Raymond Terrace, Macksville, Camden, Stockton, Telegraph Point, The Rip and Alfords Point.

Mr. Thomas guided the Department with a high standard of engineering and administrative skill. He was dedicated to the improvement of roads throughout the State and he was concerned both for the people who used them and the people whose task was to build them. He was proud of the energy and expertise of Departmental officers but was unassuming about his own role. At his farewell he said *"I only play the part of one ten thousandth of this organisation. I have a particular job with a particular task that has come my way and I have accepted the challenge and have tried to execute the responsibilities in a responsible way".*

Those in New South Wales, in other States and in other countries who knew Russell Thomas will regret his passing so soon after his retirement and will join in extending deepest sympathy to his wife, Margaret, his daughters Jean and Alex and to other members of his family. ●

Due to the present late production of the Journal this article has been included in this issue rather than in the December 1978 issue.

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $20,000) for road and bridge works were accepted by the Department for the three months ended 31 December 1977

Road No.	Work or Service	Name of Successful Tenderer	Amoun
			$
F5 South Western Freeway	City of Campbelltown. Construction of twin bridges over Main Southern Railway Line at 56.7 km south of Sydney.	Pearson Bridge (N.S.W.) Pty Ltd	949,510.0
State Highway No. 1	Princes Highway. Shire of Shoalhaven. Construction of bridge over Shoalhaven River at Nowra.	Codelfa Construction Pty Ltd in conjunction with Cogefar Construction Pty Ltd	2,645,000.0
State Highway No. 2	Hume Highway. Shire of Gundagai. Construction of twin bridges over Jones Creek on deviation around Gundagai.	Siebels Concrete Construction Pty Ltd	181,109.5
State Highway No. 2	Hume Highway. Shire of Kyeamba. Construction of bridge over Keajura Creek, 9.9 km south of Tarcutta.	Siebels Concrete Construction Pty Ltd	248,393.1
State Highway No. 2	Hume Highway. City of Goulburn and Shire of Mulwaree. Supply, delivery and laying of asphaltic concrete for construction of 3.5 km dual carriageway on northern approach to Goulburn.	Pioneer Asphalts Pty Ltd	183,495.0
State Highway No. 2	Hume Highway. Shire of Gundagai. Supply and delivery of up to 8,000 tonnes of fine crushed rock pavement material between 28.0 and 37.0 km south of Gundagai.	F. A. Delaney & Co. Pty Ltd	46,960.0
State Highway No. 5 & Trunk Road No. 55	Great Western Highway. City of Greater Lithgow and Shire of Evans. Supply and delivery of 14mm sealing aggregate to various stockpile sites.	Blue Metal & Gravel Pty Ltd	44,409.5
State Highway No. 5 & Trunk Road No. 55	Great Western Highway. City of Greater Lithgow. Supply and delivery of 14mm sealing aggregate to various stockpile sites.	Newbolds General Refractories	36,203.0
State Highway No. 5 & various roads	City of Blue Mountains, City of Greater Lithgow, City of Bathurst and Shire of Oberon. Supply and delivery of 10mm, 14mm and 20mm sealing aggregate to various stockpile sites.	Blue Metal & Gravel Pty Ltd	104,936.0
State Highway No. 9	New England Highway. City of Tamworth. Widening of bridges over Goonoo Goonoo Creek and Barnes Gully south of Tamworth.	A. R. Dickinson Pty Ltd	261,788.0
State Highway No. 9	New England Highway. Shire of Uralla. Construction of reinforced concrete box culvert over Uralla Creek at Salisbury St, Uralla.	Enpro Constructions Pty Ltd	208,899.0
State Highway No. 9	New England Highway. Shire of Denman. Supply and delivery of up to 7000 m^3 of upper course natural gravel between 4.0 and 6.8 km west of Muswellbrook.	E. H. & P. A. Clifford	24,500.0
State Highway No. 9	New England Highway. Shire of Denman. Supply and delivery of up to 10000 m^3 of lower course natural gravel between 4.0 and 6.8 km west of Muswellbrook.	E. H. & P. A. Clifford	35,000.0
State Highway No. 9	New England Highway. Shire of Singleton. Supply and delivery of up to 12000 m^3 of sub-base gravel between 38.9 and 44.4 km west of Maitland.	Les Russell & Son Pty Ltd	40,200.0
State Highway No. 9	New England Highway. Shire of Singleton. Supply and delivery of up to 9000 m^3 of base gravel between 38.9 and 44.4 km west of Maitland.	Les Russell & Son Pty Ltd	30,150.0
State Highway No. 9	New England Highway. City of Maitland. Supply and lay up to 1200 tonnes of 10mm asphaltic concrete for construction of dual carriageways between 25.9 and 28.5 km west of Newcastle.	Bitupave Ltd	40,200.0
State Highway No. 9	New England Highway. City of Maitland. Supply and lay up to 1200 tonnes of 20mm asphaltic concrete for construction of dual carriageways between 25.9 and 28.5 km west of Newcastle.	Boral Resources (N.S.W.) Pty Ltd	39,480.0
State Highway No. 10	Pacific Highway. Shires of Gosford and Hornsby. Repainting of bridge over Hawkesbury River at Peats Ferry.	Kada Painting Contractors Pty Ltd	194,490.0
State Highway No. 10	Pacific Highway. Shire of Ballina. Strengthening of nine existing dolphins and replacement of dolphin No. 8 on bridge over Richmond River at Wardell.	Kennedy Bros.	188,348.0

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $20,000) for road and bridge works were accepted by the Department for the three months ended 31 December 1977

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
State Highway No. 10	Pacific Highway. Shire of Lake Macquarie. Supply and delivery of up to 15,000 m³ of filling material between Docker St. and Soldiers Rd, Marks Point.	R. A. Gilford Pty Ltd	29,550.00
State Highway No. 19	Monaro Highway. Shire of Monaro. Construction of bridge over Bredbo River at Bredbo.	Nelmac Pty Ltd	424,715.50
Trunk Road No. 95	Shire of Wollondilly. Construction of bridge over Nepean River at Maldon.	John Holland (Constructions) Pty Ltd	1,884,500.00
Main Road Nos. 194 & 617	Municipality of Botany. Construction of bridges over sewer mains on southbound carriageway of General Holmes Drive and off-loading ramp to Foreshore Road.	Pearson Bridge (N.S.W.) Pty Ltd	380,373.00
Main Road Nos. 194 & 617	Municipality of Botany. Construction of bridge to carry southbound carriageway of General Holmes Drive over Foreshore Road.	Hornibrook Group (Southern Division)	339,406.00
Main Road Nos. 194 & 617	Municipality of Botany. Manufacture, supply and delivery of precast prestressed concrete bridge planks for cover structure over Main Southern Suburbs Sewer on southbound carriageway of General Holmes Drive and off-loading ramp to Foreshore Road.	Rescrete Industries Pty Ltd	66,567.00
Main Road No. 616	Municipality of Randwick. Construction of bridge over Bunnerong Outfall Canal on Bumborah Point Rd, Matraville.	Newnham Techint	194,583.00
Main Road No. 617	Municipality of Botany. Construction of bridge over Millpond Creek on Foreshore Road.	Pearson Bridge (N.S.W.) Pty Ltd	396,360.00

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $20,000) for road and bridge works were accepted by Councils for the three months ended 31 December 1977

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Balranald	Various	Supply of bitumen.	Emoleum (Australia) Ltd	64,178.00
Boorowa	Main Road No. 241	Construction of bridge over Ryans Creek in Pudman St, Boorowa.	R. C., P. M. & R. G. Murray	86,490.90
Boorowa	Main Road No. 248	Construction of bridge over Gunnary Creek, 16.5 km east of Boorowa.	R. C., P. M. & R. G. Murray	97,206.90
Goulburn	State Highway No. 2	Reconstruction of Cowper St. between Clinton St. and Finlay Rd.	Pioneer Asphalts Pty Ltd	33,000.00
Hay	Various	Bitumen spraying work.	Emoleum (Australia) Ltd	34,276.40
Parry	Various	Supply and spray bitumen and precoating material.	Boral Road Services	30,465.22
Port Macquarie	State Highway No. 11	Construction of bridge over Kooloonbung Creek, Port Macquarie.	C.T.K. Engineering Pty Ltd	188,902.00
Tallaganda	Main Road No. 271	Construction of bridge over flood creek at Braidwood.	R. Orford	46,886.00