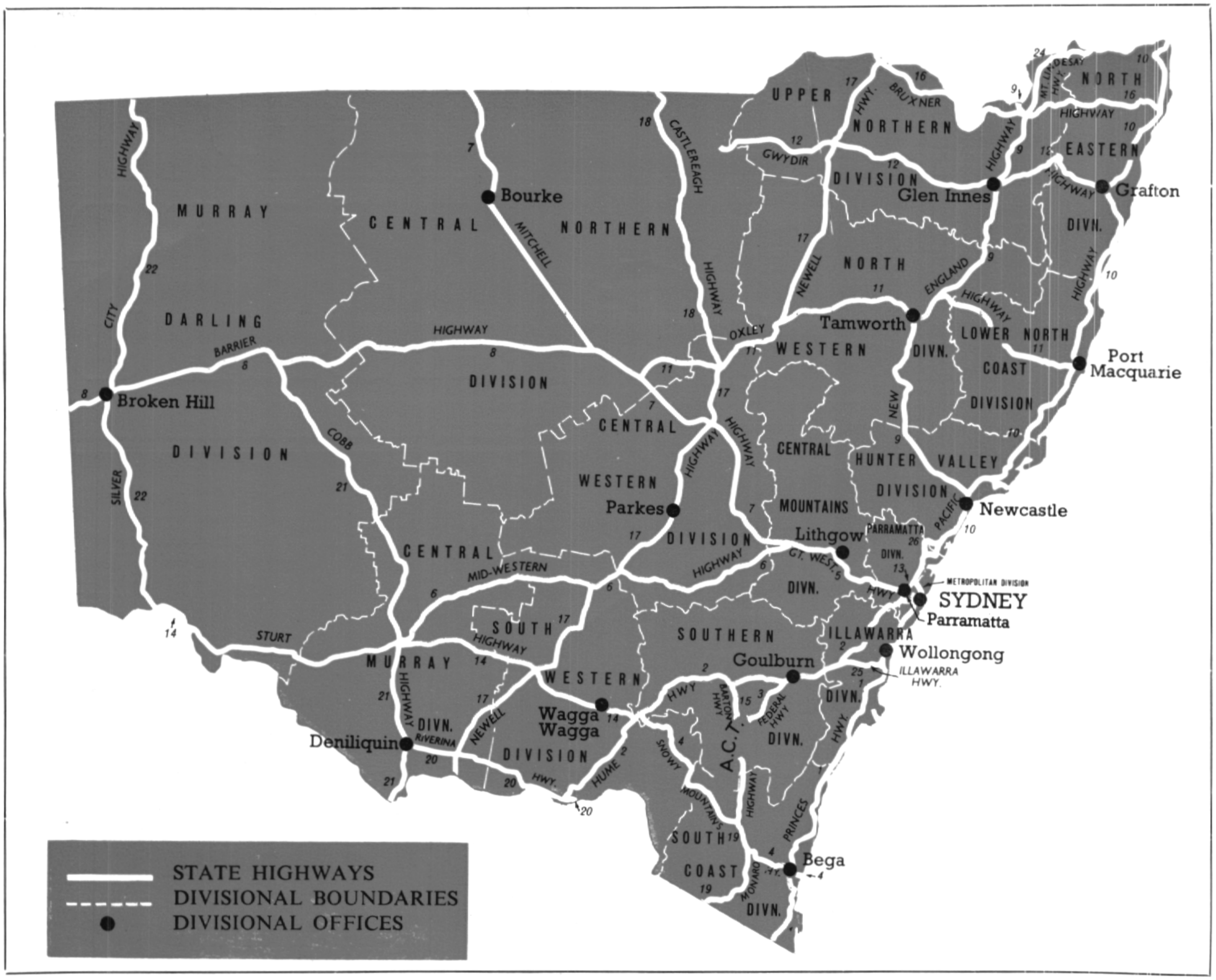
MAIN ROADS

DECEMBER
1972



Area of New South Wales—309,433 square miles

Length of public roads within New South Wales—129,715 miles

Population of New South Wales at 31st March, 1972—4,671,800 (*estimated*)

Number of vehicles registered in New South Wales at 31st July 1972—2,218,451

ROAD CLASSIFICATIONS AND MILEAGES IN NEW SOUTH WALES

Mileage of Main, Tourist and Developmental Roads, as at 30th June, 1972

Expressways	30
State Highways	6,535
Trunk Roads	4,375
Ordinary Main Roads	11,513
Secondary Roads (County of Cumberland only)	177
Tourist Roads	251
Developmental Roads	2,553
	25,434
Unclassified roads, in western part of State, coming within the provisions of the Main Roads Act	1,490
TOTAL	26,924

MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES

DECEMBER, 1972

VOLUME 38 NUMBER 2

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CONTENTS

* * * * *

Front Cover: Barrier Highway

Top Left: Straight, smooth section, at forty miles east of Cobar

Centre Right: A "rockbuster" in operation during construction of Macculochs Range

Bottom: New bridge over Tallyawalka Creek, 22.5 miles east of Wilcannia

* *See also centre page illustrations and articles beginning on pages* 34 *and* 41

Back Cover: Construction of the new bridge over Brisbane Water at "The Rip".

BREAKING BARRIERS

It was really not so long ago—in 1947—that man first flew faster than the speed of sound. For test pilots of supersonic aircraft, breaking the sound barrier must initially have been an awesome experience. Now it is commonplace, but then it was a step into the unknown that called for courage, determination, and endurance.

With similar determination, at the recent Olympic Games, athletes from all nations pitted themselves in contest against each other and against man's old enemy "Time". In swimming and track events the greatest challenge was to *beat the clock* and world records fell with remarkable rapidity as contestants set out to beat the old barriers . . . and did.

Such talk of attitudes and barriers is not as unrelated to roads and driving as it may seem, insofar as there is, within many of us, a sort of psychological barrier that makes us feel that long stretches of gravel road are too much for us to cope with. We often baulk at the prospect of driving on anything but bitumen.

To be outback on a dirt track, or even on a freshly graded highway, might mean adventure to some, but to many—especially those on business and not on holiday—it brings feelings of uneasiness, isolation, and irritation. City dwellers frequently become impatient when their link with *civilization* is restricted to a rough road and they are generally eager to "get off the gravel". In contrast, a return to "the bitumen" induces feelings of comfort and closeness—in spite of long distances. Besides other benefits, there is something satisfying about a bitumen surfaced road that brings a sense of certainty, safety and confidence.

Obviously the answer to these attitudes is not a call for less timid drivers but the provision of more sealed routes. The solution thus depends not on the motorist's frame of mind but rather on the Department's determination, capabilities, and capacity for continued exertion. If adequate funds are available, there is no limit to what can be done. In a vast state like New South Wales and in a society so set on individual vehicular travel, the community relies on bitumen surfaced roads to reduce slow travelling times, to defeat the *tyranny of distance*, and to dispel the dilemma of having to drive on gravel—or not at all.

The completion of the sealing of the Barrier Highway last October, and of another three highways within the next 12 months (see articles on pages 34, 51 and 53), will at least in some areas take the trauma out of travel for those who are understandably reluctant to try unsealed roads.

The surfacing of the last links on these important highways will heighten our State's tourist potential, open up new possibilities for caravanners and *pave the way* for the easier distribution of produce and livestock. Thereafter, motorists on these routes will be released from the frustrating and inhibiting limitations of gravel and dirt pavements. Without the old barriers, they will find that, on sealed roads, *getting there* can be half the fun.

THE BARRIER HIGHWAY

Bitumen Sealed From End to End

The Barrier Highway, principal overland route through the central western district of New South Wales, has now been bitumen surfaced over its entire 400 mile length.

Extending from Nyngan in central New South Wales to the South Australian border via Cobar, Wilcannia and Broken Hill, the Barrier Highway forms part of National Route No. 32. A bitumen surface is now provided over the full length of this National Route which connects Sydney and Adelaide via Bathurst, Dubbo, Broken Hill, (in New South Wales), Oodlawirra, Burra and Gawler, (in South Australia).

EARLY DAYS ALONG THE ROUTE

The route of the Barrier Highway was proclaimed in 1929 and named in 1959 after the Barrier Range from which ore is mined at Broken Hill.

Explorer Charles Sturt named the Range in November 1844, at first calling it Stanley's Barrier Range after Lord Stanley, then principal Secretary of State for the Colonies. Writing later in his Journal, Sturt shortened the name to Barrier Range.

The early 19th century explorers of western New South Wales generally confined their journeys to the lands adjoining the Lachlan, Bogan and Darling Rivers, along which they travelled. It was left to the graziers and shepherds who followed to explore further into the vast tract of country through which the Barrier Highway now runs.

At first settlement expanded into the area along the route of the Murrumbidgee River to its junction with the Murray River and then northeast along the Darling River. Some settlers had moved into the Wilcannia district by 1850. However, the absence of permanent water on land away from these rivers made settlement over wide areas hazardous. Squatters were reluctant to take up land away from the river frontages because of the difficulty of moving sheep and cattle across wide stretches of waterless country. It was not until the 1860's that general settlement reached the land between the Darling River and the South Australian border.

For many years the Darling River was the most important supply route for western settlers and their only outlet for produce. The first steamer (the "Albury", piloted by Captain Francis Cadell) navigated the Darling River as far as Mt Murchison (Wilcannia) in 1859, commencing a river trade which remained vigorous for many years. As late as 1890, over ninety steamers were regularly employed on the river.

The development of the road system in the west was given impetus by the discovery of copper at several places during the 1860's. Ore needed transportation from the mines for treatment and routes from mineheads to river wharves were soon established by "bullockies" and their teams.

In 1871, a road was marked out from the copper field at Cobar to Bourke and water supplies for the use of teamsters were provided by the sinking of tanks. A coach service was established from Hillston to Bourke in 1875, giving a north-south crossing of the country now traversed from east to west by the Barrier Highway.

By this time the tracks established by the mail carriers were reasonably defined and by 1882 the mail route extended from Warren through Nyngan, Hermitage Plains (Hermidale) and Cobar to a road which linked Ivanhoe with Milparinka.

It is easier going now for this 1918 *truck, which was the first to carry mail from Wilcannia to Ivanhoe as well as being first over the completed Maccullochs Range deviation.*

This mail route continued west, crossed the Darling River at Wilcannia, then on to Mt Gipps (about 16 miles north of Broken Hill) and the South Australian border.

By 1884 a road had been surveyed between Nyngan and Wilcannia, along the tracks established by the mailmen, and by 1889 a road existed between Wilcannia and Silverton via Mount Gipps. The final link in the route of the Barrier Highway, the section between Silverton and Cockburn, was in use by 1897. Later this route was altered to pass through Broken Hill and Thackaringa to the South Australian border.

By the turn of the century the route of the Barrier Highway was well established and already serving a similar role to that of today's Highway.

DEPARTMENT'S RESPONSIBILITY

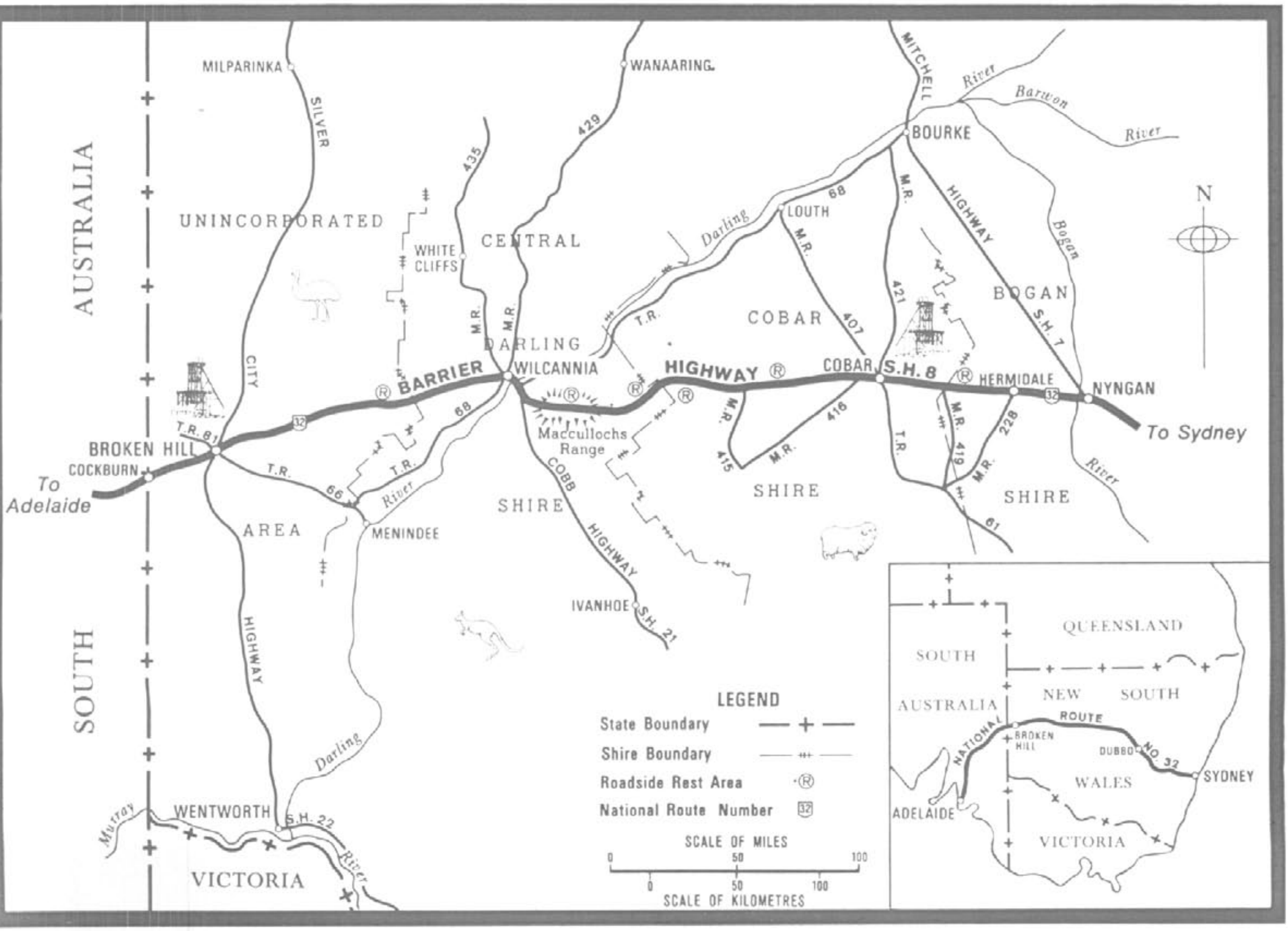
On 2nd September, 1935 the Department assumed control of all public roads in the Western Division of New South Wales as well as of Main Roads in the six municipalities of Broken Hill, Bourke, Brewarrina, Cobar, Wentworth and Wilcannia. Roadworks in the unincorporated area outside the municipalities were previously under the control of the Department of Public Works and for administration purposes, the Western Division was divided into four districts, viz., Broken Hill, Bourke, Cobar and Hay (although Hay was outside the Division's boundaries).

Following the transfer of control (which was formally authorised when the Main Roads (Amendment) Act came into force on 27th July, 1936), the District Engineers of the Department of Public Works continued to supervise work on behalf of the Department of Main Roads in the Broken Hill, Bourke and Hay districts. Supervision of work within the Cobar district was undertaken directly by this Department's Central Western Division at Parkes.

As from 1st August, 1955 the districts centred on Broken Hill and Cobar were incorporated into the newly created Murray-Darling Division, with its headquarters at Broken Hill. On 1st January, 1956 the Central-Western Division (Parkes) assumed direct control, from officers of the Department of Public Works, of roadworks, bridges and ferries in the Bourke district. When the Central Northern Division was established at Bourke on 1st March, 1962, the responsibility for reconstruction of those portions of the Barrier Highway within the Shires of Cobar and Bogan was transferred to it.

The Central Northern Division has reconstructed approximately 142 miles of the Highway, the Murray-Darling Division 203 miles and the balance of the work has been performed by Bogan Shire Council on behalf of the Department.

The construction of the Barrier Highway from 30 miles east of Cobar to 30 miles west of Broken Hill has been undertaken by construction teams working from camps at various locations



controlled by Works Offices at Broken Hill, Cobar and Wilcannia, the last named having been established in 1967 to complete the work both east and west of that town.

RECONSTRUCTION AND BITUMINOUS SURFACING

Forty years ago the Barrier Highway was a defined earth track with occasional minor improvements. Today it is a smooth bitumen highway designed over most of its length to a 60 mph standard.

The programme of reconstruction on the Barrier Highway commenced in 1953. At this time the only sealed sections were in the towns of Broken Hill and Cobar. Outside these urban areas, the road pavement consisted largely of the natural material through which the road formation passed and only very clayey or sandy sections were stabilised with gravel or sand clay. Bridges and culverts were few and most of the larger watercourses merely had gravelled causeways.

By 1955, the Department had completed sealing on the 30.6 mile section from Broken Hill to the South Australian border.

Bituminous surfacing on another major section, connecting the towns of Cobar and Nyngan, was completed in December, 1969. On this section, the Department's forces progressively extended the bituminous surface in an easterly direction from Cobar, while Bogan Shire Council undertook construction, on behalf of the Department, westwards from Nyngan.

During the period when reconstruction was underway between Cobar and Nyngan it was also in progress easterly from Broken Hill and westerly from Cobar. The sealing of the pavement between Broken Hill and Wilcannia was completed and in use by November 1970, and by this date work was well advanced on the remaining stretch between Wilcannia and Cobar. The last section of roadworks undertaken was the construction of a deviation over Maccullochs Range (see more details on page 39).

Design

Initially, the design for reconstruction of the Highway provided for a flush sealed pavement 18 feet wide on a 26 feet wide formation. However, the dimensions were increased later to a 20 feet wide pavement on a 28 feet wide formation and since 1962 all construction has been to a standard of a 22 feet wide pavement on a 34 feet wide formation.

Earthworks

More than 4 million cubic yards of earthworks were carried out in preparation for the construction of the pavement.

The Barrier Highway traverses flat to undulating country throughout. Along the route the soil is generally fine red loam but the road also crosses some gravel ridges, rocky outcrops and sand dunes. In the sand and clay areas, earthworks were carried out using tractor/scoop combinations, elevating graders or elevating scrapers in association with various types of rollers, graders and watering equipment. On the range areas, additional equipment in the form of explosives, jack hammers and heavy tractor-dozers were required for excavation of rock.

Drainage

The Barrier Highway crosses one of the driest areas of the State but ironically drainage facilities have formed a major part in overall construction. A feature of the harsh climate is occasional heavy downpours which cause the sudden flooding of the many undisciplined watercourses across the plains.

Since commencing reconstruction, the Department has constructed over 100 bridges and almost 47,000 linear feet of culverts across the numerous watercourses along the Barrier Highway. In addition, it has also been necessary to provide approximately 80 causeways and floodways to cater for maximum waterway needs at a number of locations.

Pavement Construction

A total of 1,363,000 cubic yards of gravel was used to construct the base and surface courses of the road pavement. These materials were generally obtained from pits excavated along the route and were handled by a combination of front end loaders and trucks.

Almost 2 million gallons of bitumen has been used in the sealing of the road pavement and approximately 83,000 cubic yards of coverage aggregate were incorporated into the bitumen seal on the pavement. Half of this material was screened slag from Cobar, while the balance consisted of local ridge gravel and material from Broken Hill quarries.

THE DISRUPTIVE ELEMENTS

Too little . . .

In an area where the average rainfall is under 10 inches the provision of water for construction purposes was a major difficulty. During the summer months this became an even more pressing problem with evaporation at its highest and constant watering was necessary to maintain the correct moisture content for compaction.

Bituminous surfacing means the end of gravel, sand and mud on the Barrier Highway and brings a new era of east-west travel.

Top: Forty miles east of Cobar.

Centre: This last unsealed length, approximately 50 miles east of Wilcannia, has been replaced by the new deviation over Maccullochs Range.

Bottom: Approximately 29 miles west of Nyngan.

Water was obtained by the Department from public watering places when possible, but this practice often necessitated haulage over long distances. Consequently, tanks to collect and store rainfall were constructed along the route of the roadworks and water was also purchased from privately owned bores within shorter hauling distances.

To obtain sufficient quantities of water the Department also found it necessary on a number of occasions to resort to the more expensive alternative of sinking its own bores to tap artesian supplies. Water was pumped up from approximately 300 feet below ground level and earth-banked storage dams (tanks) of up to 800,000 gallons were constructed.

Water was conveyed from these dams to the roadworks in Departmental water tankers with a maximum capacity of 3,000 gallons and as many as 13 of these tankers were in use simultaneously.

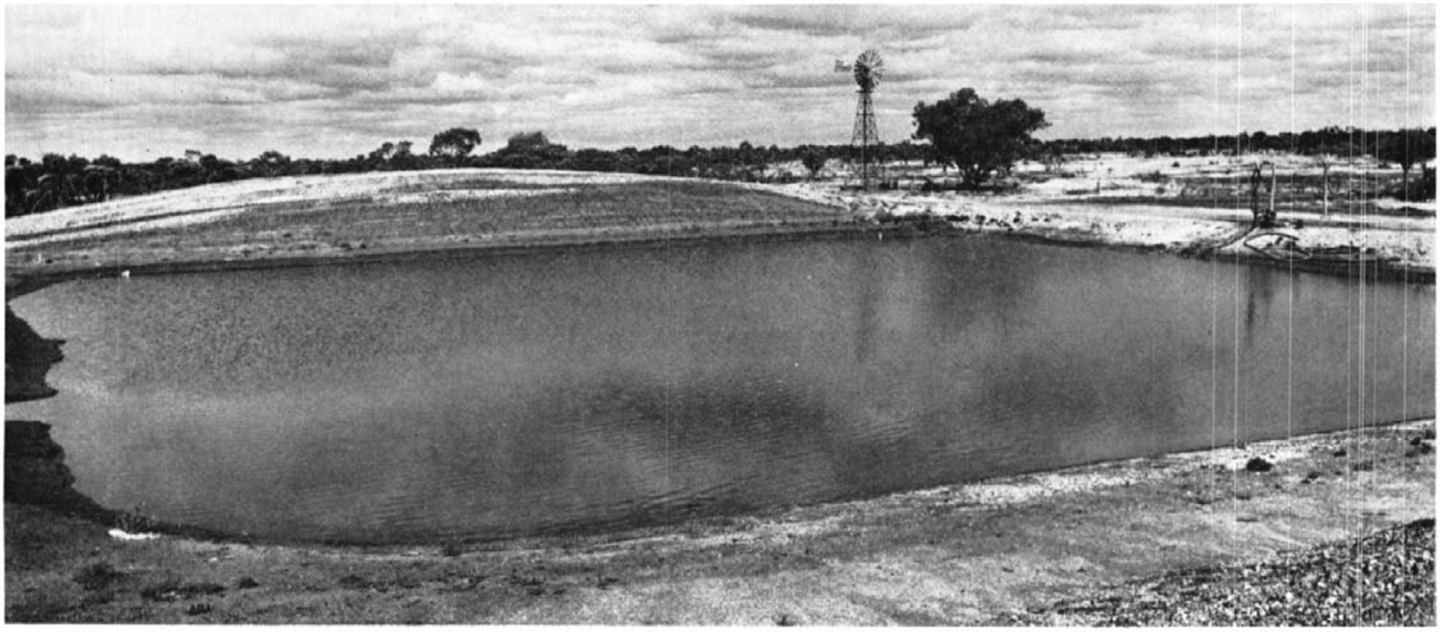
It is estimated that during the construction of the 39-mile long deviation along Maccullochs Range the Department used over 26,000,000 gallons of water in compaction operations.

. . . and too much

Fluctuations from one weather extreme to another are a feature of the west, and the threat of damage to the road pavement by scouring during heavy showers of rain, was an additional problem faced by the Department's engineers and workmen.

Dust was another constant hindrance to construction. The hot dry climate combined with the constant use of sidetracks and haul roads by trucks and road plant, caused disintegration of the fine red soil into layers of dust. Roadworks were frequently interrupted and delayed by the need to rescue heavily-


BARRIER HWY
COBAR
NYMAGEE



laden gravel trucks and other equipment bogged in dense, deep pockets of unstable dust.

THE FINAL LINK—MACCULLOCHS RANGE DEVIATION

"a range of Sandstone hills, lying in the vast flat desert between the Bogan and Darling Rivers. Some of these hills are peaked and others flat-topped and stand like lonely mountains, rocky, barren and cheerless."

This quotation from Bailliere's 1870 Gazetteer of New South Wales aptly sets the mood of the Maccullochs Range where work on the final stage in the programme to seal the Barrier Highway has just been completed.

Although rising to a height of only 300 feet above the surrounding area, Maccullochs Range earns its name by virtue of being the only vertical feature over hundreds of miles of central western plains. Approaching from Cobar it commences 40 miles east of Wilcannia, and extends in an east-west direction for 12.5 miles.

Major Thomas Mitchell, leader of an expedition sent to explore the course of the Darling River, came upon the Range on 24th June, 1835 and named it after his friend John Macculloch, a Scottish doctor and geologist. Macculloch, who gave up his medical career in 1811 to pursue his interests in geology and mineralogy, died only a few months after his name was given to this Range.

The New Deviation

The work on the Maccullochs Range section of the Barrier Highway is a deviation from the original route in use for many years. This route passed to the north of the Range across a number of low-lying areas which form shallow lakes after rain.

To eliminate the problem of flooding on the Highway, a new route running along the Range was chosen and this is about three miles shorter in length than the previous route.

Construction of the deviation was carried out over a three year period and in very difficult conditions. All work was performed by the Department's own forces attached to Wilcannia Works Office with an average of between 20 and 25 men employed at all times on the project.

The 39-mile deviation cost approximately $2.5 million or $64,000 per mile. The road pavement throughout is 22 feet wide with 6 feet wide shoulders and has been flush sealed with two coats of bitumen. Of the aggregate incorporated in the surface of the deviation, 91% was obtained from Cobar, where stockpiles of slag from the copper mines were screened to yield suitably sized materials.

Fifty-three different items of plant were employed during construction of the deviation. On the Range, elevating self-loading scrapers were used to perform the required earthworks and also assisted in winning and placing some of the basecourse loams. To achieve adequate breakdown of the pavement gravels, which were laid over the fine-grained sandy loams of the basecourses, rock-busters, as well as rollers, were used. A "rockbuster" is a mobile hammer mill which is towed over a windrow of rocks and through the action of revolving hammers, reduces oversize rocks to useable size in one operation (see photographs on front cover and at left).

Principal quantities involved in construction of the section over Maccullochs Range were:

Earthworks ..	808,400 cubic yards
Pipe and Box Culverts	8,350 linear feet
Base and Surface Course Area ..	625,091 square yards
Sealed Area ..	499,950 square yards
Water	26,000,000 gallons

Driving up maximum grades of only 4.4% for 1,730 feet present-day motorists might be excused for failing to notice the Range at all, and, in view of the sense of security and unity engendered by an all-bitumen highway, it is unlikely that any future description will refer to them as "lonely mountains, rocky, barren and cheerless."

Expenditure

The total cost of the reconstruction and bituminous surfacing of the Barrier Highway since 1953 (including the Maccullochs Range deviation) has been almost $16 million.

ROADSIDE REST AREAS

Motorists using the Barrier Highway today will not experience the rough conditions encountered by travellers at the turn of the century or more recently by construction teams. However, the flat, fairly monotonous nature of the country, the climate (particularly summer heat) and long distances between settlements can create conditions which are unfamiliar and uncomfortable to many drivers and their passengers.

To assist travellers to overcome these problems and to enjoy the journey more by taking out some of the strain of covering massive mileages without a break, a series of roadside rest areas has been established along the Highway. These areas are provided with shelters, tables and seats, fireplaces, firewood, drinking water and litter bins.

The Department has constructed six rest areas along the route, the last of these being on the southern side of the Highway, 34 miles east of Wilcannia, near the site of the ceremony to mark the sealing of the final section (see details on page 40). The other rest areas are located at:

* 52 miles west of Nyngan.
* 42 miles west of Cobar.
* 73.9 miles west of Cobar.
* 57 miles east of Wilcannia.
* 76 miles east of Broken Hill.

A FINE THREAD AGAINST ISOLATION

Stories of the hardships and isolation faced by Australia's early settlers have become a major part of our folklore.

Many of these stories relate back to the experiences of pioneers in the region of New South Wales now served by the Barrier Highway. This inhospitable, dry country had little to endear it to early settlers, many of whom had been reared in the lush greenery of the English countryside. But settle it they did, learning to survive the heat, the droughts, the dust and the occasionally devastating floods. Perhaps the greatest hardship of all was isolation. For many out west

Top: Compaction by vibrating rollers on the Maccullochs Range deviation.

Centre: Old and new methods. At right: Handplacing stones east of Broken Hill in June, 1941 when work was supervised for this Department by officers of the Department of Public Works (Hay District). See text on page 35. At left: Tractor-drawn "rockbusters" make more noise and dust but they are much faster, more efficient and less effort than older manual methods.

Bottom: One of the "tanks" constructed by this Department to provide bore water for compaction during construction over Maccullochs Range. The disused wind pump adds a familiar shape to the skyline, whereas a diesel motor pump did all the work.

isolation remains, but is gradually being diminished by modern communications.

To combat isolation good road links are essential. To the inhabitants of this sparsely settled region who derive their livelihood for the main part from widely scattered pastoral and mining activities, the Barrier Highway is the principal road which connects them with their neighbours, with the towns through which their essential goods and services are distributed and with the east coast. As part of a network of roads which includes the Great Western Highway from Sydney to Bathurst and the Mitchell Highway from Bathurst to Nyngan, the Barrier Highway now provides a fully sealed route between Sydney and the far western boundary of New South Wales, a distance of almost 760 miles.

These important western highways carry an increasing volume of traffic. In 1970, the average daily count on the Barrier Highway ranged from 120 vehicles a day on the least trafficked sections to 450 on the heaviest. Although these daily traffic volumes do not even equal the hourly volumes on some city roads, the social and economic significance of good roads in this area of New South Wales has long been recognised by the Department.

The high standard of travelling surface achieved by the reconstruction of the Barrier Highway guarantees the motorist a safe, fast and comfortable journey. These benefits are now available not only to the local population but also to the large number of intrastate and interstate travellers (including businessmen, tourists and long distance hauliers) who pass along the Barrier Highway.

The Commissioner for Main Roads (Mr R. J. S. Thomas) watches as the Minister for Highways (Hon. C. B. Cutler, E.D., M.L.A.) makes the symbolic "final fling" to mark the completion of this work.

* * *

FINAL SEALING AND OFFICIAL CEREMONY

On 31st October, 1972 a "blacktop" was placed on the last unsealed section of the Barrier Highway, approximately 34 miles east of Wilcannia. At this point, the remaining few hundred feet of work was undertaken before a large audience of visitors who watched as the bitumen and precoated aggregate were laid down. The Deputy Premier and Minister for Highways the Honourable C. B. Cutler, E.D., M.L.A., then spread the final few shovelfuls of aggregate onto the roadway to signify the official completion of this important project.

At a brief ceremony held in the nearby roadside rest area, guests were addressed by Mr Cutler who was welcomed by the Commissioner for Main Roads (Mr R. J. S. Thomas) and the President of the Central Darling Shire (Councillor A. P. Connell) and thanked by the Member for the State Electorate of Broken Hill (Mr L. A. Johnstone, M.L.A.). A commemorative plaque affixed to a large tablet of natural rock was unveiled by Mr Cutler and a barbeque lunch served to guests.

To further commemorate this occasion, the Department had struck a medallion—a little larger in size than a 50 cent coin and made of a metal alloy of copper and zinc. When related to the copper mining at Cobar and the zinc mining at Broken Hill, the components of the medallion take on special significance. The face of the medallion also features appropriate local symbols—a minehead and Sturt's desert pea—as well as the old obelisk in Macquarie Place, Sydney from which road mileages are still measured. The designs on both sides of the medallion have been reproduced on the plaque mentioned above and appear in the illustration on page 34.

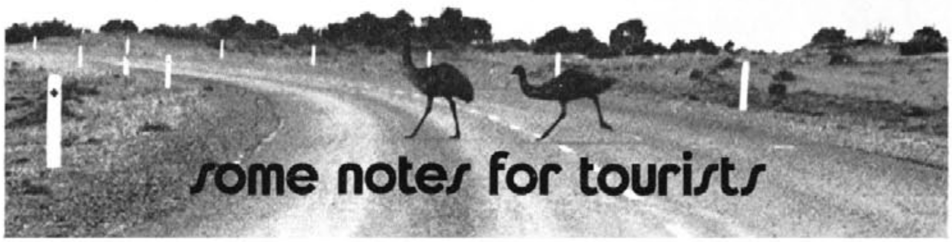
The medallions were handed out at the official ceremony and arrangements were also made to distribute them at schools along the Highway between Nyngan and Broken Hill. School students living near the Highway now have two tangible reminders of the importance of the completion of this work—a medallion on one hand and on the other, the actual bitumen sealed Highway itself. It is hoped that both will prove valuable assets to them in the years ahead.

All the medallions have been distributed and no further request for them can be fulfilled. However, for those who wish to obtain a "souvenir" of the occasion, supplies of the Department's 12-page brochure are still available. This brochure contains similar information to that incorporated in this article and features 11 colour illustrations. In addition, the Department now holds stocks of a reprint of the article on the development of the route of the Barrier Highway, which originally appeared in the March, 1959 issue of "Main Roads" (Volume 24, No. 3, pp 82-88) as part of a series on historical roads of New South Wales●

The following articles on the Barrier Highway and the Western Division have appeared in earlier issues of "Main Roads".

- *Roads in the Western Division. February, 1937, Vol. 8, No. 2 pp 41-44.*
- *The Western Division and its Road System. Pt. I. General description of physical features, population and industries. September, 1947, Vol. 13, No. 1, pp 17-25. Pt. II The Road System and its Problems. December, 1947, Vol. 13, No. 2, pp 38-46.*
- *Western Division Roads. March, 1950, Vol. 15, No. 3, pp 95-98.*
- *Bitumen Surfacing near Broken Hill. Work completed on Barrier Highway, west of City. June, 1956, Vol. 21, No. 4, pp 122-123.*
- *Barrier Highway. December, 1965, Vol. 31, No. 2, pp 56-59.*

BARRIER HIGHWAY JOURNEY



some notes for tourists

Motorists heading west away from the hectic east will now find a great deal of pleasure and relaxation in travelling the all-bitumen Barrier Highway. Where once such a trip could turn into an ordeal—especially in wet weather—and required more than a touch of tenacity, tourists and "locals" need no longer curse the condition of the road.

For present-day "explorers" using the newly-sealed highway, it is a *far cry* from the hardships experienced by Charles Sturt and his party when, in the mid-1840's, they passed through the Broken Hill region. Frustrated by their slow progress across the rocky landscape (and obviously aware of the "Macadam" method of roadmaking which was introduced into New South Wales in the early 1820's) Sturt wrote ". . . it appeared as if McAdam had emptied every stone he ever broke to be strewed over this metalled region!" He would be pleased to know that such stoney impediments—at least for east-west travellers—have at last been buried under bitumen.

Observant travellers along the Barrier Highway may see many emus, frequent kangaroos, occasional echidnas, a few foxes, most likely a large lone eagle and probably huge flocks of chattering cockatoos and galahs.

Approaching Broken Hill, the Western Plains present an immense "horizon-hitting" red-brown landscape while elsewhere along the Highway there is a comforting abundance of trees and small shrubs. The vegetation itself brings a reward to those who look closely, as many species of wildflowers and unusual plant life grow within view of the road and are particularly attractive after seasons of heavy rainfall.

An appreciation of the beauty of these plains often depends on the season of travel or the weather encountered, as well as the degree of interest and anticipation in the "eyes of the beholder". It is not an area that openly reveals itself to sideways glances at sixty miles per hour!

TAKE A LONGER LOOK

En route to the Silver City, the towns of Cobar and Wilcannia deserve more than a brief stop or a quick dash down the main street. Only a longer stay allows visitors to get the feel of the "far" country. In addition, some brief research may also save those who are *passing through* from inadvertently missing otherwise unrecognized reminders of the past. Such reading will certainly help them to grasp the drama and history of those hectic hey-days when as mining boom town and busy river port these were prosperous places—thronging with people and throbbing with activity.

☆ ☆ ☆ ☆ ☆ ☆ ☆

COBAR

Concentrated in and around Cobar—"the Copper City"—is an interesting contrast between old and new mining methods. Head frames of the Fort Bourke, Chesney and New Occidental (Gold) Mines are still standing as tangible evidence of a mining history that dates back to the discovery of copper here in 1869. Mining developed quickly and continued until 1919, when lower grade ore, low prices, rising costs and a water shortage caused the closure of most mines. The last of the large producers, C.S.A. Mines, was closed in 1920 following a fire. It is said that C.S.A. Co. was named after the original (1871) discoverers at that site—who were a Cornishman, a Scotsman and an Australian. At first, wagon loads of ore were dragged north by bullock teams to Bourke, for shipment down the Darling River to Adelaide, but later a more direct route (now Main Road No. 407) was established across to Louth, while some was carried west to Wilcannia, where shipping was more certain.

Prior to 1900, Cobar had a population of about 10,000 (compared with 3,740 to-day) and, as well as the mining companies, it boasted 14 copper smelters and even its own Stock Exchange. Teams of men constantly scoured the countryside cutting timber for the wood-burning smelters. Nothing remains of these smelters except the large slag dump at the eastern entrance to the town. This accumulation of "waste" is now being crushed and used in some roadmaking and concreting.

Between 1935 and 1953 New Occidental Gold Mines N.L. operated in Cobar and in 1957 Cobar Mines Pty Ltd purchased its mining leases and other assets. Following the location of ore-bodies at greater depths than previously worked, shaft sinking was started at the old C.S.A. mine in February, 1962, and production commenced in June, 1965.

Today, the new C.S.A. Mine produces over 700,000 tons of ore per year and employs over 500 people. Situated 7 miles out on the Louth Road, this modern mine uses diesel powered trackless, rubber-tyred load-haul-dump units (of 6-ton capacity) at levels 1,200 and 1,800 feet below the surface. To satisfy town needs as well as the mines thirst for over 130 million gallons each year, water is piped from the Macquarie River near Warren, more than 120 miles to the east.

Despite severe droughts, a rich wool industry has played an important economic role in Cobar's history and has been largely responsible for the continued existence of the town during periods of low mining activity. It began back in 1862, when sheep were introduced primarily as a source of food.

☐ On Fort Bourke Hill (east of Cobar) there still stands the hand-placed stone walls of a group of buildings, now known as Towser's Huts—after the man who built them in the late 1800's. The huts were rented to miners and charcoal burners working in the area and their layout has earned for them the claim of being "Australia's first motel".

☐ Situated alongside the Barrier Highway at the eastern end of Cobar is the impressive Pastoral, Mining, and Technological Museum. The 2-storey building was erected in 1910 and used for 10 years as the general office of the Great Cobar Ltd mining company. In addition to a "walk-in" section representing an old mine, the museum contains exhibits on geology, botany, entomology, aspects of pastoral life, aboriginal artifacts, and the general history of the district.

☐ Visitors to Cobar may also inspect the Commonwealth Meteorological Station (on the Louth Road) and watch the release of a weather balloon (twice daily).

Aboriginal Paintings at Mt Grenfell

☐ About 25 miles west of Cobar, the Pulla Pulla Road runs north for 18 miles to Mt Grenfell homestead, where visitors (with permission) may inspect a remarkable series of aboriginal paintings on numerous rock ledges,

COBAR

Cobar Court House (at left) in Barton Street was built in 1882 and is an elegant link with the past. It is a contrast in style to Towser's Huts (see text) and to the modern high school (1966), with its double roof, breezeways and spacious landscaped setting. Changing shapes and sizes can also be seen (at right) in this trio of shops (circa 1889, 1895, and 1910) fronting Marshall Street on the route of the Barrier Highway through the town.

BROKEN HILL

Left: This unpretentious Moslem mosque was built of corrugated iron in 1891 and still stands at the corner of William Street and Racecourse Road, North Broken Hill. It was *"restored by the Broken Hill Historical Society to commemorate the role played by the Indian and Afghan camel drivers in the development of transport in the West Darling District"*.

Right: Probably the best-known building in the city is the unusual Post Office in Argent Street. Next to it stands a Town Hall of victorian vintage and with a foundation stone laid by Sir Henry Parkes ("The Father of Federation") on 3rd April, 1890.

COBAR . . . *continued*

all within 400 yards of the car park. Also in the area are a number of fish fossils and fossilized footprints.

It is interesting to note that the name "Cobar" is probably derived from "copar" (or "coburra") an aboriginal term for the ochre with which they daubed themselves on ceremonial occasions.

COBAR

Below: This monument—known familiarly as "the Stele"—was sculptured by Pat Brooks (a former Cobar resident), erected beside the Barrier Highway, near the Museum, by the Cobar Chamber of Commerce and unveiled on 29th August, 1969, by Hon. W. C. Fife, Minister for Mines.
The design features the mythical bird, the phoenix, rising up with the scientific symbol for copper held in its beak. This represents Cobar's rebirth through the re-commencement of copper mining in the 1960's after a lapse of 40 years.
The inscription *"Campbell, Hartman, Gibb and the Balgal"* refers to the 3 well-sinkers who in 1869 found green-coloured rock at an aboriginal water-hole. It was later identified as copper-bearing ore by Mrs Kruse, who had been a "balgal"—that is a woman who, in the mines of Cornwall (England), hand-picked the ore on the conveyor belts before it was milled. The land near the water-hole was purchased in October, 1870, and subsequently became the site of the Great Cobar Mine, once reputed to be the biggest copper mine in the world.

WILCANNIA

With fewer than 1,000 residents, Wilcannia is now much quieter than a century ago when steamer traffic on the Darling River made it a major inland port (probably the third largest in Australia—even though 1,300 miles from the sea!). It was surveyed and proclaimed a town in 1864 and in 1880 the gold rush to Mt Browne (200 miles northwest near the Queensland border) brought a burst of prosperity. Another boom came following the discovery of opals at White Cliffs (60 miles north) in 1889—with Wilcannia merchants selling supplies to the diggers. However, the extension of the railway to Bourke in 1885 and to Cobar in 1892 meant that river trade declined and business eventually dwindled.

Nevertheless, Wilcannia's surfeit of superb sandstone buildings still surprises many travellers, who expect something less substantial. Some worth seeing are:

In Reid Street

- ☐ Court House and Police Station (1878)—and prison.
- ☐ Museum (1878), previously belonging to Rich and Co., merchants.
- ☐ Post Office and Customs House next door (now a private residence).
- ☐ Bank of New South Wales.

In Ross Street

- ☐ Golf Club, originally Resch and Co.'s Lion Brewery (1885), one of the first in the State.
- ☐ Hospital (1879), now with additions and on call to Royal Flying Doctor Service.

In Myers Street

- ☐ St James Church of England (1883).

While speaking of churches it is worth adding that the Illustrated Sydney News of 4th September, 1880, reported: *"The marriage is announced at Wilcannia, recently, of Mr Edward Bulwer Lytton Dickens, a son of Mr Charles Dickens, the celebrated writer, and Miss Desailly, daughter of Alfred Desailly, Esq., of Netallic station"*. After managing Mt Murchison station, Dickens set up business in Wilcannia in 1882. He was M.L.A. for Wilcannia from 1889 to 1894 and died at Moree in 1902.

☐ Those looking for other unusual and intriguing links with the past might drive out to the cemetery to see the gravestone of Sergeant Major Parr. Parr was one of the "Glorious Six Hundred" who rode in the famous, ill-fated Charge of the Light Brigade (1854) during the Crimean War . . . and survived to add his name to the early pioneers of the Wilcannia district.

☐ The bridge over the Darling River was opened to traffic on 11th January, 1896, and is a classic example of the vertical lift-span structures built over western rivers about that time. On the southwest bank is a cottage once used as the "bridge keeper's" residence, while at the corner of Reid and Cleaton Streets is the Court House Hotel, formerly the Punt Hotel and presumably situated adjacent to the site of an earlier river crossing. In 1874 Charles Smith operated a punt and a pontoon bridge—said to carry sheep across at the rate of 4,000 per hour!

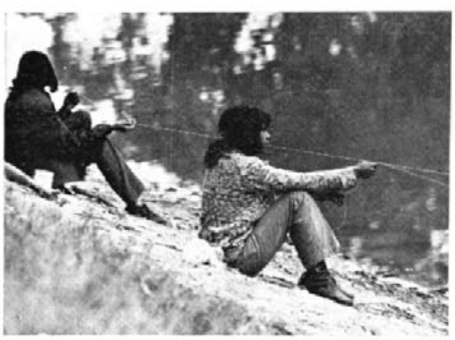
BROKEN HILL

There are a number of informative books and descriptive tourist brochures about the Silver City which tell the story of its remarkable development. This article will therefore simply spotlight some of the subjects and sights which may attract visitors who are "browsing around" Broken Hill.

☐ A mine inspection is a "must". Today four large companies are operating—North Broken Hill Ltd, Minerals, Mining and Metalling Ltd, Zinc Corporation Ltd, and New Broken Hill Consolidated Ltd. Formed by the first syndicate in 1885, the Broken Hill Proprietary Co. Ltd grew to be

WILCANNIA

Below: Aboriginal girls fishing from bank of Darling River at Wilcannia.



WILCANNIA

Below: On the same river almost 90 years ago (in 1884) oarsmen of the Wilcannia Rowing Club paused to pose for posterity.
(By courtesy of Water Conservation and Irrigation Commission.)

BROKEN HILL

Left: Further along Argent Street is a vast verandah of ironwork framing the Palace Hotel—and the Visitors' Information Centre.

Right: In contrast, this contemporary Civic Centre in Chloride Street features modern facilities for a wide range of public functions and cultural activities.

Australia's largest company but when the "Big Mine" closed down in 1939, B.H.P. left the city to move into the iron and steel industries (including shipbuilding) with centres at Newcastle, Port Kembla, Whyalla, etc.

The mining companies, together with the City Council, have established regeneration areas around the city—transforming semi-arid areas into a perimeter of greenery. Early work in the 1930's was based on recommendations of the late Albert Morris.

☐ At the corner of Chloride and Crystal Streets (in the grounds of the R.S.L. Club) is a small monument topped by a piece of "*ore from the line of load*". Inscriptions on it read "*This monument commemorates the discovery of the Broken Hill ore body by Charles Rasp* (1846–1907) *September*, 1888. *The monument faces Block* 12, *Rasp's first mining base which is* 660 *yards from this spot. Unveiled by His Excellency Lt. Gen. Sir Eric Woodward, K.C.M.G., C.B., C.B.E., D.S.O.,* 19 *September*, 1958". Since this discovery, well over 100 million tons of ore have been extracted.

☐ Across the road, at the entrance to the railway station is a plaque featuring a map of Australia and showing the transcontinental rail route. It was "*unveiled by the Right Hon. J. G. Gorton, M.P., Prime Minister of Australia on November* 29, 1969, *to commemorate the joining at Broken Hill of the standard gauge railway line linking the east and west coasts of Australia*".

☐ Nearby, there is a bed of the strikingly beautiful Sturt's desert pea—floral emblem of Broken Hill. This low-growing wildflower blossoms about September each year and is protected.

☐ By appointment, visitors can observe broadcasts of the unique "School of the Air" from the studio at North School in Lane Street. Instituted by the Department of Education in 1956, it goes "on the air" through the Royal Flying Doctor Service Network of transmitters and receivers to children scattered over 500,000 square miles of the outback.

☐ Situated 5 miles east of the city on the Barrier Highway, the radio control station of the Royal Flying Doctor Service is open for inspection daily. In front of the entrance is a "distance and direction disc" in memory of Professor James MacDonald Holmes, foundation member of the N.S.W. Council and friend of Dr John Flynn. Flynn began the service in Queensland in 1928, and this base was established in 1939. It is now connected to more than 400 "outposts" and each month about 5,000 radio messages are exchanged concerning medical matters.

☐ Further afield, within a radius of less than 100 miles, tourists can inspect:

* a number of sheep stations, including Corona (52 miles north) which was once owned by Sir Sidney Kidman, the "Cattle King". The West Darling District of 45,000 square miles carries over 2 million sheep and produces an annual wool clip worth more than $8 million.

* Silverton (16 miles northwest), a "ghost" town of the 1880's, and nearby Penrose Park, with historic relics such as an early steam engine.

* Menindee Lakes (70 miles southeast) for yachting and swimming, and nearby Copi Hollow for power-boating and water-skiing.

* and Mootwingee (82 miles northeast), an aboriginal tribal ground with many rock carvings and paintings●

*

Interested readers are referred to (1) "*West of the Darling*" *by Bobbie Hardy* (*Jacaranda Press*, 1969) *and its detailed bibliography.* (2) *Those with access to journals of the Royal Australian Historical Society will find valuable information in two articles by James Jervis.*

* *The Exploration and Development of the West Darling Country* (*Vol.* 34, *Parts* 2, 3, *and* 4, 1948).
* *The Exploration and Settlement of the Western Plains* (*Vol.* 42, *Parts* 1 *and* 2, 1956).

Also (3) "*The Dreadnought of the Darling*" *by C. E. W. Bean* (*Angus & Robertson*, 1956).

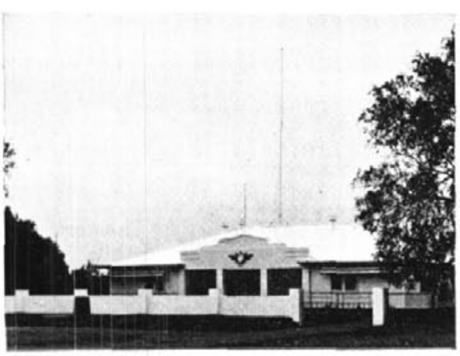
BROKEN HILL

Below: Seldom is a monument as far from its subject as this broken column which was unveiled in Sturt Park by the Mayor, Alderman T. F. Hynes, on 21st December, 1913, to honour eight bandsmen (each listed by name) of the "Titanic" which 20 months earlier had struck an iceberg and sunk in the Atlantic Ocean with the loss of 1,635 lives. The inscription reflects the feelings evoked in those days by such tragedy and courage—even though so distant. "*Erected by the citizens of Broken Hill as a memorial to the heroic bandsmen of the steamship 'Titanic', who playing to the end—'Nearer my God to Thee, Nearer to Thee'—calmly faced certain death, whilst women, children, and their fellow-men were being rescued from the wreck of that ill-fated vessel off the coast of Newfoundland on April 15th,* 1912".

BROKEN HILL

Below: Broken Hill base of Royal Flying Doctor Service (see details in text above).

Below right: Many motorists are unaware of a small stone monument on the south side of the Barrier Highway about 20 miles west of Broken Hill. It declares "*The pioneers of the discovery of silver-lead at Thackaringa in* 1876 *were Julius Charles Nickel, John Stokie, Patrick Green. The first ore was raised from the pioneer mine approximately* 1,000 *ft. south of this site*". The inevitable "rush" followed, but all that remains on these now lonely and silent slopes are numerous heaps and holes, and a rusting boiler.



Getting the "Feel" of Roads

SCALE MODELS HELP BLIND CHILDREN

As you read this page, your resulting thoughts continually build up visual images in your brain. These images are the products of years of conscious and unconscious education, principally made possible by sight.

A blind child, deprived of sight since birth, must be deliberately educated in the perspective and geography of the world around him before his education can hope for expansion towards the standard of the average sighted person.

Maps and models help blind children to make sense of information gained from other faculties and external aids, and assist them to widen their knowledge of the unseen world around them.

In July this year, the Department donated seven scale models of completed works to the Royal New South Wales Institution for Deaf and Blind Children at North Rocks. These models are now being used by students at the School for Blind Children as aids in learning spatial relationships, geographical concepts, as well as road and bridge technology.

Such scale models have always been associated with learning about and *seeing* things which, otherwise, would not always be easy to visualise. They were previously displayed by the Department to let interested persons *look* into the future and understand how certain new road and bridge proposals would appear when completed. The models made available to the School included:

* Tarban Creek Bridge—which forms part of the North Western Expressway.
* Captain Cook Bridge, over George's River—which forms part of the Southern Expressway.
* Warringah Expressway—first section from Sydney Harbour Bridge to Cammeray.
* Bridge over Clarence River at Harwood—and associated deviation of Pacific Highway around Maclean.
* Bridge over Macquarie River at Dubbo.

The Principal of the School recently forwarded the following report which explains the fields and the manner in which the models are used by the students.

"ORIENTATION AND MOBILITY

Congenitally blind children often have distorted concepts of spatial relationships and verbalisms which can hide a lack of direct experiences. Blindness necessarily restricts these experiences.

Blind children, for example, often believe streets go on indefinitely; they do not have a useful concept of a city block;

they think all intersections are the same; they have no realisation of the heights of buildings or the position of buildings.

The child who has no vision must be taught how spatial phenomena are related to one another by tactile means such as maps and models.

Models, such as those given to the School by the Department, enable the child by touch to condense into one perceptual closure the meaning of a whole scene. By touching a model of an area he can encompass widely separated spots in one perception. For example, on a mobility excursion or a class outing a child may have travelled by bus across the Bradfield Highway to the City. On another occasion he may have travelled by train via Milson's Point to the City. He has had two experiences and built up some concepts from information his teacher has given him and from his remaining senses. Perhaps his teacher has told him that from the train window, while the train is stopped at Milson's Point station, it is possible to see cars and buses on the Bradfield Highway, which is lower than the trainline. From such comments, the child builds up a mental picture of his surroundings but it is probably inaccurate.

However, if it is possible to provide the child with a model of the area (such as the Warringah Expressway model) then his concepts can become a real percept of that particular location. On the scale model he can feel the cars and buses on the varied road levels, the underpasses and bridges, the train on the elevated railway line and another standing at the station. He can compare the high and low rise buildings and feel their proximity to roads, trees and park areas. He now has a far more accurate picture of that particular part of his environment. Next time he is in a similar situation it will be a far more realistic experience for him, as he will not be relying entirely on the verbal pictures of a sighted companion. He will have had a tactual experience of a similar situation, which is meaningful to him and which is transferrable to the new situation.

SOCIAL SCIENCE

The models donated by the Department are used in the classroom in conjunction with foam rubber maps, which are one of the basic aids used by blind children in learning geographical concepts. When a lesson is being given on New South Wales the children learn to find coastal areas, plains, mountains, rivers, cities and towns, on their foam maps.

A specific example could be Dubbo on the Macquarie River. The child feels for the recess in the foam which represents the river and which is labelled with the name in braille. The child then locates a marker denoting the town, which is also labelled in braille. The location of Dubbo can be related to other markers representing, for example, Orange and Cobar. From the map the child also learns that Dubbo on the Central Western Plains is quite a long way from Sydney on the coast and consequently has a different climate to that of Sydney.

There is a certain amount of information like this that text books and the teacher can give, which is meaningful to a blind child, especially if one of the remaining senses is involved (e.g. temperature—climate). However, quite often the information is merely a visual concept and this is where the models become so valuable. For example, on the Dubbo Bridge model the children can feel the two bridges spanning the Macquarie River—one is low and narrow, the other much higher and wider. They ask why and learn that because the small old bridge was too close to the river flats, which flooded in heavy rain and cut the approach roads to the bridge, the new one was built higher and longer so this would not happen. The bridge also needed to be larger to cope with the increased population and the increased number of vehicles that would cross the bridge.

In one tactual closure, the child can feel the two bridges, the river flats, the water courses down to the river, the willow trees along its banks and the river itself. Because the model is correctly scaled he can conceive the comparative sizes of these things. Without a tactile model it is not possible for a blind child to do this realistically. Further more, by treating the whole model in sections the children are able to build up a wealth of information on the town of Dubbo, which can be regarded as representative of other country towns in the area.

INDUSTRIAL ARTS

Industrial Arts for the visually handicapped is not only concerned with practical workshop techniques, but also with the technology of everyday life. Road and bridge construction together with traffic flow and control are a part of this technology.

For the visual handicapped a word description has little meaning. However, the model of the bridge over Tarban Creek provides a tangible illustration of traffic movement on an expressway.

A blind person may not be able to make practical use of the knowledge gained, but he will be able to understand the world around him in a better way. His conversation with his sighted peers will thus be on equal terms●"

WESTERN DISTRIBUTOR

Completion of Stage 1 of the first section of the Western Distributor from Sydney Harbour Bridge to Day Street was marked by the opening to traffic of the southbound roadway on 2nd September, 1972. Stage 2 was completed soon after and the northbound carriageway was brought into use on 30th September, 1972.

This section of the Western Distributor was brought into full operation on 20th December, 1972 when Stage 3 was finished and the connecting ramp from Pyrmont Bridge to the Distributor's northbound carriageway (via Day Street) was opened.

As can be seen from the aerial photograph above, the Distributor is already an attractive, integral part of the city scene. It should ease traffic conditions in Sydney's crowded streets by providing separate, more direct access between Sydney Harbour Bridge and the southern end of the City. By this means, north-south traffic is being directed away from the busy shopping and commercial thoroughfares such as Pitt, George and York Streets. The western business area of the City is also bypassed as the Distributor crosses above Clarence, Kent, Napoleon, Sussex and Erskine Streets.

At a later date, the Distributor will be continued southwards to an interchange at Ultimo, from which the Southern and Western Expressways will commence. Further adjustments to its links with the city street system (e.g. at Margaret Street) will then be made.

An article giving construction details about the Distributor appeared in the September 1970 issue of "Main Roads" (Vol. 36 No. 1, pp 2-6) and is available on request as a separate reprint.

☆ ☆ ☆ ☆ ☆ ☆ ☆

With the completion of each stage of the Western Distributor and its opening to traffic, there has been a re-arrangement of the traffic flow in some nearby city streets. Consequently, the Department published a 4-page colour leaflet as a guide to motorists and distributed copies to drivers of city-bound vehicles at the Sydney Harbour Bridge toll gates over a 12-hour period on 31st August, 1972, just prior to the opening of Stage 1.

To ensure that the maximum number of motorists were provided with the necessary knowledge about direction changes, copies of the publication were supplied to the press for reproduction and were also made available to Motor Registry offices and N.R.M.A. offices at a number of city and suburban locations.

The leaflet includes a map of the city area from George to Day Streets and from the toll plaza to Druitt Street. It clearly shows the direction of traffic flow in streets adjacent to the Distributor and indicates any restricted turning movements. The leaflet describes a novel "colour code sign system" which has been introduced to assist southbound motorists on Sydney Harbour Bridge to select the most appropriate lane and thereby pass through the correct toll booth. To do this, drivers simply follow one of three colours according to their destination. Thus, motorists wishing to travel east via Grosvenor Street follow the blue signs displayed on the Bridge and above the toll booths. For Day Street and York Street the colours to follow are green and orange respectively.

These arrangements are still in operation and any person wishing to obtain a copy of this helpful leaflet needs simply to contact the Public Relations Section, Head Office, by telephone, and a copy will be posted out●

Right: New bridge over the expressway to link Gladstone Avenue and Mt St Thomas Boulevarde, Fig Tree.

Below: Looking past the present route of Gladstone Avenue (at the temporary southern "end" of the expressway) to the new bridge which will carry Masters Road, Fig Tree, over the next section of the expressway.

UNDER & OVER

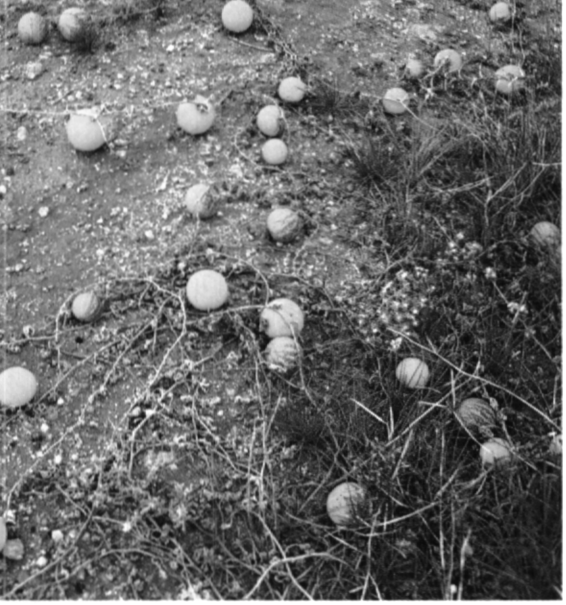
To be free of any at-grade intersections, the Southern Expressway must cross under or over a number of important roads and railway lines when it is extended between Gladstone Avenue, Fig Tree and Northcliffe Drive, Berkeley. Illustrated here are some of the thirteen major bridge works required on this three mile section.

The different, attractive designs add a touch of distinction to the basic functional value of these structures. Although the bridge sites may now seem strangely isolated and lacking in any unifying link, on the completion of this section of the expressway, they will become an integral part of it and will provide for the smooth flow of the large volumes of cross traffic in this area.

Left: Berkeley Road, Unanderra, will cross the expressway on this slim structure.

Above centre: Construction of the bridge to carry the expressway over the Main South Coast Railway line at Fig Tree.

Right: These new bridges will carry the expressway over the Australian Iron and Steel Company's railway line and access road — near the proposed interchange at Five Islands Road, Unanderra.



Roadside paddy melons

Barrier Highway horizon and Barrier Hi

Black Crow

Barrier Highw

Vibrating rollers compact Maccullochs Range deviation during construction

Signs warn motorists of marsupials. Safe driving protects both

A Better Way West

For millions of people who live in the crowded coastal corridor of our State, there is a different world waiting for them out West. Visitors now have in the Barrier Highway a fast, comfortable, *distance-defeating* driveway to discovery.

Gone are the drawbacks and delays of yesterday's dusty, corrugated conditions. Today there is a bitumen road from the beginning (at Nyngan) to the border (at Cockburn) – and on to Adelaide, too.

The *sights* are not as obvious nor as frequent as in the east but, for those who succumb to the lure of the outback, there is always plenty to see, (as outlined in the article on page 41). The dangers of western travel have now been diminished, if not entirely eliminated, but a sense of adventure is still a vital part of every first visit. A journey west can be a wonderful way to observe wildlife in its natural surroundings, to savour the vastness of our State's varied landscape and to fossick for history in sunburnt townships at the *opposite end* of New South Wales.

Trains may "take the tension out of travel" but, for most of us, there is no substitute for the feeling of freedom engendered by sitting behind the wheel of our own car and heading away from city congestion. And, as there is no substitute for seeing things first hand, there is no better way to see the West than by road. That means *the Barrier Highway* – now reconstructed and sealed all the way.

Watch for emus, too

...itumen — 30 miles east of Broken Hill

...ay Highlights

Bright Galah

Sturt's Desert Pea

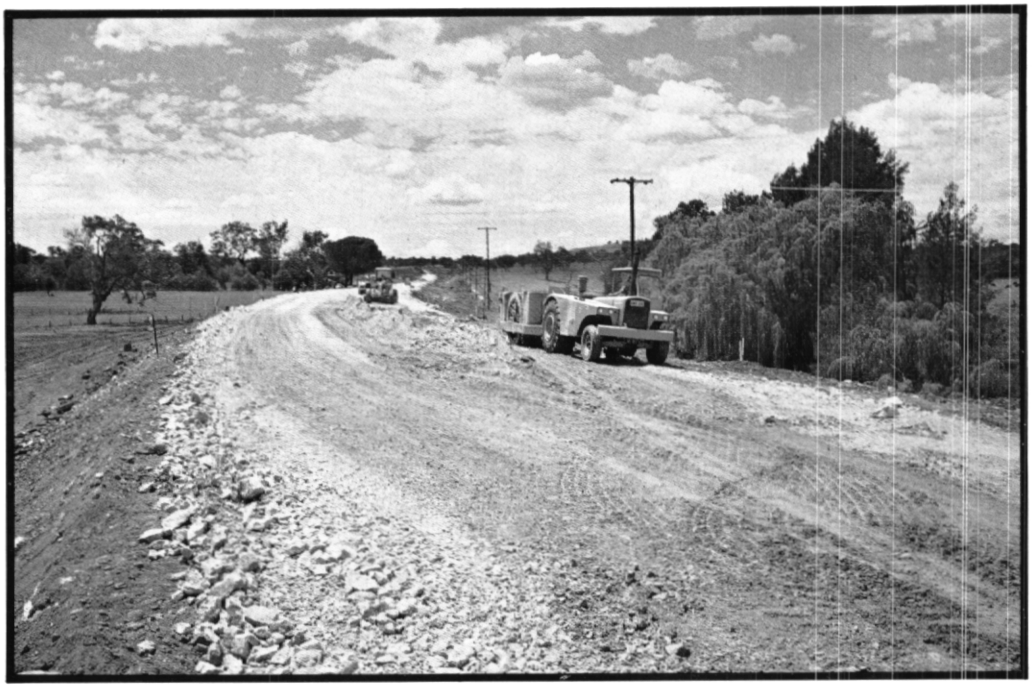
Minehead at Broken Hill

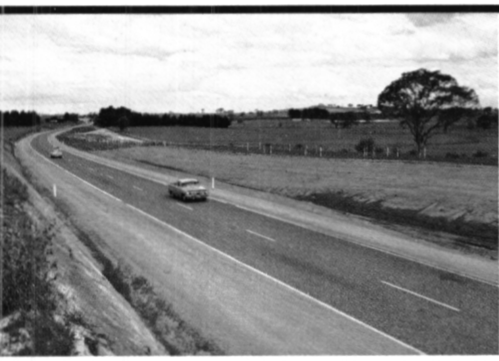
Old steam engine at Cobar

Bridge over Darling River at Wilcannia

Afternoon haze on the Highway — 39 miles east of Cobar

Improvements to the Mitchell Highway between Bathurst and Wellington





smoothing out the twists

Reconstruction of the Mitchell Highway at 8 miles north of Molong includes widening the pavement and improving the alignment (above). It also involves building a bigger bridge over the Bell River at Claremont (at far left—bottom), of which more details are given on page 51.

Recently completed sections, such as at 25 miles west of Bathurst near Shadforth (at left and far left—top), mean that Mitchell Highway motorists are getting easier curves and more miles of pleasant driving.

FAR AND NEAR

A REPORT ON ROAD AND BRIDGE WORKS AROUND THE STATE

The new bridge under construction at Three Rivers will soon eliminate this "loop" on the Mitchell Highway north of Molong.

MITCHELL HIGHWAY

Completion of Sealing

On 6th November, 1972 another milestone in the history of road construction in New South Wales was passed—with the completion of the bituminous surfacing of the Mitchell Highway. The 85-mile section from Bourke to the border with Queensland is now sealed throughout, following the completion of the last 5-mile section approximately 2.5 to 7.5 miles south of Engonnia (i.e. 25 to 30 miles south of the border).

☆ ☆ ☆

In mid-1958 the only bitumen surfaced pavement on the whole length of the Mitchell Highway from Nyngan to the Queensland border at Barringun was a 13-mile section at Bourke (from 3 miles south to 10 miles north), together with short lengths in the towns of Nyngan, Coolabah, Byrock, Engonnia and Barringun. The length of the road without bituminous surfacing then totalled almost 200 miles.

Between 1958 and 1961 the Department's works organisation at Bourke extended the bitumen sealing of the Highway 16 miles by increasing the lengths to 14 miles south and 15 miles north of Bourke.

In 1961 the Department established a Works Office at Nyngan and efforts were concentrated on the completion of pavement sealing between Nyngan and Bourke. This target had been achieved by 1966, the rate of progress averaging 20.5 miles of road reconstruction and bituminous surfacing per year.

North of Bourke the sealed pavement was extended a further 5 miles during 1961-62. In 1965 reconstruction work was commenced on the black soil areas between Engonnia and Barringun and this 21-mile section of the Highway was completed in 1968.

Reconstruction and bituminous surfacing was then commenced on the section from 20 miles north of Bourke to Engonnia, a distance of approximately 42 miles.

Since 1965 a length of approximately 67 miles of reconstruction and bituminous surfacing has been completed north of Bourke at an average rate of almost 9.5 miles per year and at a total cost of approximately $3.75 million.

If it was easy to translate into monetary terms the savings due to shorter travelling times, less "wear and tear" on vehicles and less strain on drivers, the cost of these roadworks would just as easily be recognised as a good investment for the people of New South Wales and a bonus for the interstate travellers using this route.

Earlier "Main Roads" articles on the northern section of the Mitchell Highway include:

* *"Borewater and bitumen on road to Barringun" in September,* 1965 *issue* (*Vol.* 31, *No.* 1, *pages* 14-15).
* *"Nyngan to Barringun—Bitumen surfacing on Mitchell Highway" in September,* 1964 *issue* (*Vol.* 30, *No.* 1, *pages* 26-27).
* *"The Mitchell Highway"—in the series on "Historical Roads of New South Wales"—in June,* 1956 *issue* (*Vol.* 21, *No.* 4, *pages* 101-111).

* * *

Bridges north of Molong

A 6-mile section of the Mitchell Highway north of Molong is currently the centre of a concentrated burst of bridge-building. No record breakers, these four bridges are nevertheless typical of the hundreds completed each year by the Department—to improve the short crossings over the multitude of waterways which dissect the State's Main Roads System.

* At 7 miles north of Molong, Emoh Ruo Court Pty Ltd of Narrabri are building a 3-span prestressed and reinforced concrete bridge, 170 feet long, over Molong Creek at Larras Lee. The contract price is $78,703.80 and the bridge should be completed by mid-1973.

* Less than a mile to the north at Bell River, Claremont a 3-span, 172 feet long, steel girder and reinforced concrete deck bridge has been built for the Department by Ermani Constructions Pty Ltd at a contract price of $116,347.

* About five miles further on, the Bell River again crosses the Highway and here, at Three Rivers, A. Cipolla and Co. Pty Ltd are undertaking the construction of another new bridge. The 6-span prestressed and reinforced concrete structure, will be 362 feet in length. It will be located on a short deviation of the Highway and will be situated about 600 yards downstream from the existing narrow timber bridge. Completion is expected in June, 1973 at a cost of $157,743.

* In January, 1973 a fourth contract is expected to be let for the construction of a new bridge over Molong Creek, 1·5 miles south of Larras Lee, to replace the old Angus Bridge. The new structure will be a 3-span composite steel girder and reinforced concrete bridge, 135 feet long.

All four bridges provide a width of 28 feet between kerbs.

In conjunction with the construction of these four bridges, the Department is continuing with the reconstruction and widening of the Mitchell Highway to provide a 24 feet wide pavement and 44 feet wide formation on the 10-mile section from Copper Hill to Three Rivers (between 3.9 and 13.9 miles north of Molong).

FAR AND NEAR

SNOWY MOUNTAINS HIGHWAY

Final sealing almost finished

Reconstruction and bituminous surfacing on the last unsealed section of the Snowy Mountains Highway should be completed by mid-1973.

Over half of the section between Kiandra and Rules Point (13.6 miles west of Kiandra) has been sealed and the remaining 6.6 miles should be finished by about April 1973.

Between Rules Point and Inspiration Point (29.4 miles west of Kiandra) 4 miles at the western end have been prime sealed and work on the remaining 12 miles should be completed by next June.

Workers in this area have to contend with snowfalls and intensely cold conditions, and roadworks have to cease completely during the mid-winter months.

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NEWELL HIGHWAY

Full length sealing nears completion

On the Coonabarabran-Narrabri Section of the Newell Highway, bitumen sealing was completed to the primed stage in January, 1972. The final seal should be put down by March, 1973.

The only section of the Highway which now remains unsealed is from 43.5 miles north of Moree to Boggabilla (72 miles north of Moree), near the Queensland border.

Reconstruction work on this 28.5 mile long section is well advanced and should be finished late in 1973. At that time the Newell Highway will join the Barrier, Mitchell and Snowy Mountains Highways (see pages 34, 51 and 53 respectively) and will become the fourth State Highway on which bituminous surfacing will have been completed in a 12-month period.

It is worth noting that all of these highways form part of important interstate routes. The Barrier Highway is a section of National Route No. 32 which runs from Sydney to Adelaide, and the Mitchell Highway forms the major part of National Route No. 71 which connects Nyngan (on National Route No. 32) with Cullamulla in Queensland. The Snowy Mountains Highway has been numbered National Route No. 18 and lies at the eastern end of a route which extends from the south coast near Bega (on the Prince's Highway) to Adelaide (also on the Prince's Highway) via Cooma, Wagga Wagga, Hay, Mildura (Victoria) and Renmark (South Australia). The 600-mile long Newell Highway covers about two-thirds of the inland inter-capital link between Melbourne and Brisbane, which is formally known as National Route No. 39 from near Seymour (Victoria) to Goondiwindi (Queensland).

This aspect highlights the fact that increased traffic, including many interstate tourists, will "follow the bitumen" along these routes and will bring better business prospects and aid the development of many country areas of the State.

An article entitled "Newell Highway—Reconstruction Tocumwal to Ardlethan and Narrabri to Moree" appeared in the March, 1966 issue of "Main Roads" (Vol. 31, No. 3, pp 87-93).

New Bridge at Narrabri

At Narrabri, construction is under way for the Department on a new bridge over the Namoi River.

The bridge, a 5-span prestressed concrete structure 325 feet in length, will replace a narrow timber beam bridge which was built in 1914. Designed by the Department, the new bridge will be located on a deviation of the Highway on an improved alignment. It will measure 28 feet between kerbs and will carry two eight-feet wide footways. Provision has been made for duplication of the bridge when traffic conditions warrant it.

The bridge has been designed with single column piers similar to those in the approach spans of the bridge over the Macquarie River at Dubbo. In June, 1972 a contract for construction of the bridge was let to Firth Civil Constructions Pty Ltd of Tamworth and the time for completion is 60 weeks. The contract price of $195,195.00 includes the demolition of the existing timber structure on completion of the new bridge.

The approaches to the bridge will be constructed by the Department's own forces.

New Bridge south of Moree

On 9th November, 1972, a contract was let for the construction of a new bridge over Courallie Creek on the Newell Highway, 16 miles south of Moree.

The new bridge will be an 8-span reinforced concrete structure, 280 feet in length, and will be situated on a new deviation of the Highway. It will replace a narrow timber structure known as Gurley Bridge which is on a poor alignment. Designed by the Department, the new bridge will measure 29 feet between kerbs.

The successful tenderer was A. Cipolla and Co. Pty Ltd of Sydney. The contract price is $114,780.00 and the time for completion of the bridge is 70 weeks.

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PRINCE'S HIGHWAY

Boydtown—Kiah

The Prince's Highway has been shortened by almost two miles with the opening of a $1.25 million bridge and deviation south of Eden. The deviation, from 4.9 to 8.1 miles south of Eden, was opened to traffic on 28th September, 1972.

The new road replaced a narrow, winding section of the Highway with poor sight distance and provides much safer travelling conditions between Boydtown and Kiah. It includes a 482 feet long bridge over Whelan's Swamp and 2.5 miles of climbing lanes to accommodate slow-moving traffic—especially heavy trucks associated with the local timber trade.

Earlier references to this work appeared in the March, 1972 issue (Vol. 37 No. 3, p 94) and the June, 1972 issue (Vol. 37, No. 4, pp 114-115) of "Main Roads".

Big Bridge for Bega

Construction on the first stage of a bypass at Bega is under way and this flood-free route will include the provision of a new bridge over the Bega River and its overflow channel.

The 23-span bridge, a prestressed and reinforced concrete structure 2,046 feet in

FAR AND NEAR

length, will be the sixth longest bridge in the State, behind such giants as:

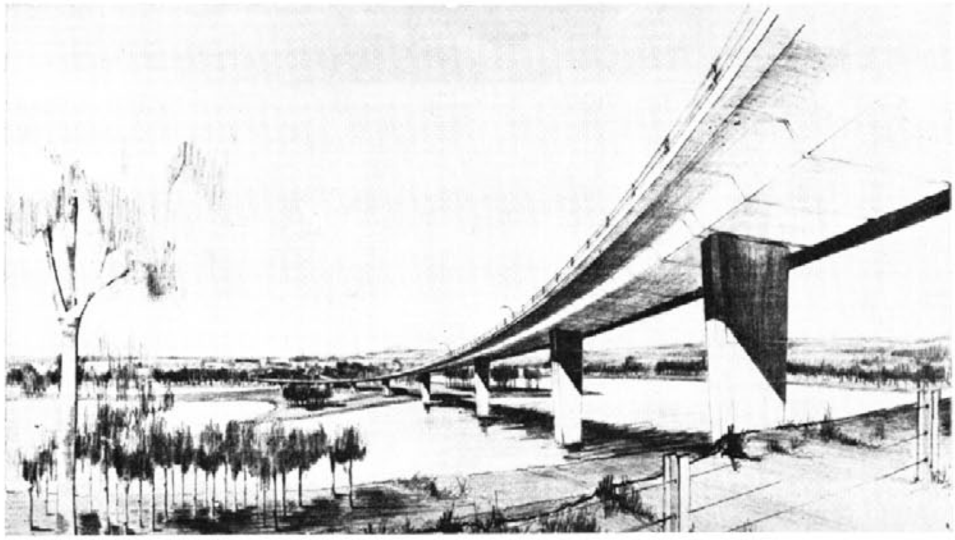
* Sydney Harbour Bridge (3,770 feet).—see details in March and June, 1972 issues of "Main Roads" (Vol. 37, No. 3, pp 82-87 and No. 4, pp 122-126).
* the bridge under construction at Gundagai (3,750 feet)—see details on next page,
* the bridge under construction at Camden (3,380 feet)—see details on page 58,
* Stockton Bridge, north of Newcastle (3,358 feet)—see details in March, 1972 issue of "Main Roads" (Vol. 37, No. 3, pp 66-69),
* the bridge over the Clarence River at Harwood—see details in September, 1966 issue of "Main Roads" (Vol. 32, No. 1, pp 2-9).

The new bridge will be located 600 feet upstream from the existing bridge, and as the Bega River is subject to severe flooding, it has been designed by the Department to provide a clearance of four feet above the highest recorded flood—which occurred during February, 1971. The northern approaches will include an improved access to Carp Street, Bega while pedestrian access from North Bega has been catered for by the provision of a footway on the downstream side. A stairway leading from the footway will give access to the western end of Carp Street. A low concrete parapet capped with two steel rails will separate the pedestrian footway from the road carriageway.

On 23rd August, 1972 a tender of $1,173,581 for the construction of the bridge was accepted by the Department from Peter Verheul Pty Ltd. To reduce the construction time, the Department has supplied the materials for the steel piles on which the bridge will be founded.

The bridge should be available to traffic in December, 1974, and the total cost, including approaches, will be in the order of $2·5 million.

Interested persons in the Sydney Metropolitan Area are invited to view a scale model of the proposed new Bega bridge and deviation, which is on display at the Department's Head Office (third floor).



Artist's impression of new bridge to carry Pacific Highway over Wilson River at Telegraph Point.

OXLEY HIGHWAY

New Bridge at Ellenborough

Travelling conditions on the Oxley Highway will be considerably improved by the provision of a new bridge over the Ellenborough River on the Oxley Highway, west of Wauchope. In October, 1972 the Department accepted a tender of $234,654 from Transbridge Pty Ltd for the construction of a 5-span, prestressed concrete structure, 330 ft in length and 28 feet between kerbs.

The existing old timber bridge at this site was damaged by a timber jinker and has had to be supported by "Bailey" bridging which restricts the passage of traffic.

Designed by the Department, the new bridge will be located on an improved alignment about 700 feet upstream from the present bridge. It will have a two feet wide safety kerb on each side and will be very similar in design to the recently completed bridge over Stony Creek on the same Highway (see photograph in article on Oxley Highway reconstruction—in "Main Roads," June, 1971, Vol. 36, No. 4, p. 117).

PACIFIC HIGHWAY

New Bridge at Telegraph Point

Work is underway on a new bridge over the Wilson River at Telegraph Point (11.5 miles north of Port Macquarie) to replace a narrow wooden bridge on poor alignment and to eliminate a railway level crossing. Located in a deviation of the Pacific Highway north of Port Macquarie, this new bridge will be a flood-free, 15-span prestressed and reinforced concrete structure, 1,836 feet long (see artist's impression above).

Construction is being undertaken for the Department by Pearson Bridge (N.S.W.) Pty Ltd at a contract price of $1,432,000 and work should be finished by about mid-1974.

Construction of the bridge is part of a multi-million dollar programme to be undertaken in the area over the next few years, which, when completed, will considerably improve travelling conditions on this major interstate artery.

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FAR AND NEAR

HUME HIGHWAY

New Bridge at Gundagai

The Department has commenced construction of the foundations for a new bridge over the Murrumbidgee River at Gundagai (see illustration at right).

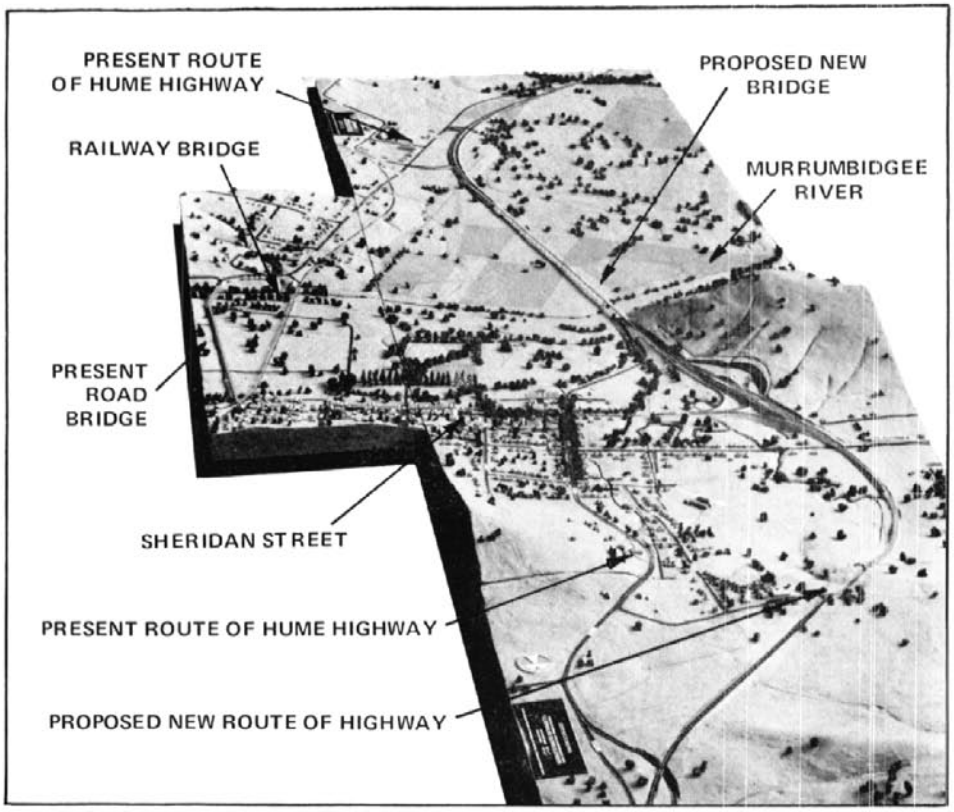
Measuring 3,750 feet in length, the bridge will be a 27-span composite steel and concrete twin girder structure with 3 spans over the main river channel and 24 spans over the flood plain. In view of the high velocity floods which cross the plain provision has been made in the design for single column "T" shaped piers.

Designed by the Department, the new structure will be very similar to the bridge now under construction over the Nepean River at Camden. On completion it will displace the bridge at Camden as the second longest road bridge in New South Wales and the longest ever built by the Department.

The new bridge will be located on a deviation of the Hume Highway west of the town. This 4.4 mile long deviation will provide motorway conditions and will involve the construction of 15 lane miles of roadway and nine other bridges. Although the new highway route will pass around Gundagai, access to the town will be available both from the northern end of the deviation, at Sheridan Street (where there will be an interchange) and from South Gundagai. The narrow wrought iron Prince Alfred Bridge built in 1866 will remain for use by local traffic.

Estimated cost of the new bridge and deviation is approximately $5 million, and they are expected to be completed about the end of 1975.

The foundation piles for the main bridge are at present being constructed by the Department's own forces and the remainder of the main bridge and the associated bridges will be constructed by contract. Construction of the roadworks will also be undertaken by the Department's own forces and progress on them will be programmed to fit in with the work on the bridges. It is expected that tenders for construction of the piers and superstructure will be invited by mid-1973.



Scale model of proposed deviation of Hume Highway and new bridge at Gundagai looking south. This model is on display at the Department's Head Office, Third Floor.

Twin Bridges near Mittagong

Tenders were called in November, 1972 for the construction of twin bridges over Paddys River on the Hume Highway, 26.5 miles south of Mittagong.

Each bridge will be a 3-span structure, 225 feet long and 28 feet between kerbs. They will be of prestressed concrete and reinforced concrete construction and will replace an old narrow timber structure.

The design for these bridges is in accordance with the Department's plan to provide dual carriageways on the Hume Highway as soon as practicable.

The northbound bridge will be built first and will carry two-way traffic while the existing timber bridge is demolished and the second bridge for southbound traffic is constructed.

A feature of the bridges will be round single column piers designed to blend the new structures with the natural surroundings, which will in turn be enhanced by the establishment of a new Remembrance Driveway plantation nearby.

The approaches to the bridges will be constructed by the Department.

LAKE ILLAWARRA CROSSING WIDENED AT WINDANG

Improvements to traffic facilities on the bridge over the entrance to Lake Illawarra at Windang were completed with the opening of the northbound carriageway on 22nd September, 1972. The southbound carriageway became fully operational on 22nd December, 1971.

The old bridge was a narrow timber structure which frequently caused delays to traffic using the Shellharbour-Port Kembla Road (Main Road No. 522) in periods of peak traffic flow.

To overcome the problem, a new two-lane concrete structure, with one footway, was erected alongside the existing timber bridge. When this was completed, all traffic was diverted to the new structure while replacement of the superstructure of the old bridge was in progress. These bridgeworks were carried out for the Department by Peter Verheul Pty Ltd.

Now combined as a single unit, the composite structure is 983 feet long with a four-lane divided carriageway and two footways each five feet wide.

An aerial photograph taken during construction of the new structure appeared on the front cover of the September, 1971 issue of "Main Roads" (Vol. 37, No. 1).

FAR AND NEAR

CASTLEREAGH HIGHWAY

Still more bitumen

For a number of years, the Department has been actively working on the progressive bituminous sealing of the Castlereagh Highway. On 22nd September, 1972, work was completed on the section from eight miles north of Walgett to the Lightning Ridge turn-off. The cost of this 40·4 miles long section has been approximately $2·5 million. Its completion means that the Castlereagh Highway now has a sealed surface northwards from Gilgandra through Coonamble and Walgett to the junction with Main Road No. 426, which leads to Lightning Ridge. Bituminous surfacing is now being continued towards the Goodooga turn-off and Angledool, near the Queensland border.

This extension of sealed highway will undoubtedly be a boon to the people of Walgett and to the growing number of tourists driving north to try their luck at the opal-mining centre of Lightning Ridge.

Lightning Ridge has a claim to fame as the world's only "black opal" field. To distinguish these opals from lighter types, the term "black" was chosen to emphasise their darker background tones. However, the name is a little misleading as it suggests these stones might not be as bright or attractive as others, whereas they are equally "*ablaze with flashes of liquid flame*".

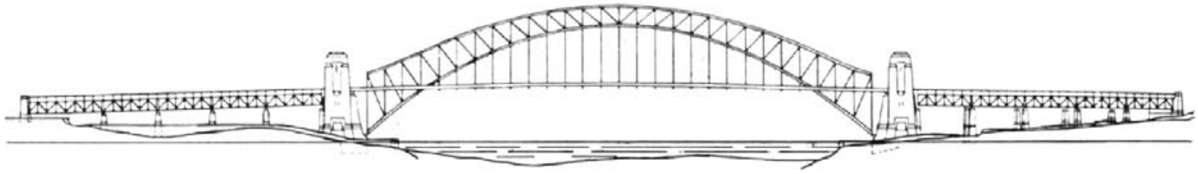
From a road building view point, it is interesting to note two of the stories associated with the finding of the first opals in this area. The suggestion by T. Cosgrove in the February, 1970 newsletter of the Royal Australian Historical Society (p. 8) that "*This field was discovered about* 1912 *when a few road-makers, looking for gravel, picked up handfuls of this beautiful stone*" conflicts with the following claim by the late S. Lloyd in "The Lightning Ridge Book" (1968—p. 89). "*The first evidence of anyone taking a mineral interest in the Lightning Ridge locality is that of Robert Moore, newly appointed manager of Muggarie Run (Angledool) Station. In* 1873-74 *he 'sent a hatful of the pretty stones collected from the Nebea Ridges, to Sydney, to ask what the value was, and whether it was worth going on with as a mining venture.' The reply was 'that it would be worth* 70/- *per ton as road metal in Sydney'* ".

Seldom have roadworks offered such possibilities for profit! For dedicated engineers there has always been a certain inner sense of satisfaction in undertaking road and bridge building, but it is not often that such rich rewards have come within reach of the early "gravel-getters". These pioneers worked in all corners of our State practising the valuable but virtually unacknowledged art of tracing and transporting the best type of road-making materials.

It seems certain that by 1891 opals had been found in the Lightning Ridge locality, but it was not until about 1903 that a small syndicate was set up to systematically mine the area. This was but the beginning and, although the more hectic days have passed, **Lightning Ridge is still a magnet attracting many people eager to see the place where opals were formed and are found. To visitors and miners alike, the sealing of this section of the Castlereagh Highway will make getting there less arduous.●**

An article describing the development of the Castlereagh Highway, and the exploration and settlement of the adjacent country was included in the March, 1961 issue of "Main Roads" (Vol. 26, No. 3, pp. 84-89).

An article entitled "Castlereagh Highway—Reconstruction Coonamble to Walgett" appeared in the March, 1968 issue (Vol. 33, No. 3, pp. 73-74).



SYDNEY HARBOUR BRIDGE ACCOUNT

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 30TH JUNE, 1972

Income	1971–72	1970–71
	$	$
Road tolls	4,707,302	4,518,708
Railway tolls	272,465	299,992
Omnibus tolls	21,723	26,151
Net rents from properties	167,722	170,700
Total Income	**5,169,212**	**5,015,551**

Expenditure	1971–72	1970–71
	$	$
Maintenance, lighting and cleaning of bridge and approaches	803,248	564,345
Provision of traffic facilities	292,276	161,124
Cost of collecting road tolls	507,614	516,030
Improvements and alterations to toll gates and archways	7,031	32,143
Administrative expenses	175,443	81,346
Loan charges—State loans	1,251,890	1,229,660
Loan charges—Borrowings under Section 42A of the Main Roads Act, 1924	909,144	923,576
Total Expenditure	**3,946,646**	**3,508,224**
Excess of income over expenditure transferred to Appropriation Account	1,222,566	1,507,327
	$5,169,212	**$5,015,551**

Statement of Receipts

FOR YEAR ENDED

RECEIPTS	County of Cumberland Fund $	Country Fund $	Commonwealth Fund $	Total $
Motor vehicle taxation	13,831,864	42,118,337	....	55,950,201
Charges on commercial vehicles under the Road Maintenance (Contribution) Act, 1958	3,537,392	14,149,567	....	17,686,959
Levy upon Councils in accordance with Section 11 of the Main Roads Act, 1924	5,890,275	....	....	5,890,275
State Government loans—Repayable	1,000,000	1,000,000	....	2,000,000
Loan borrowings under Section 42A of the Main Roads Act, 1924	6,300,000	500,000	....	6,800,000
Contributions by Councils towards maintenance and construction of Main and Secondary Roads	343,459	301,841	....	645,300
Contributions by other departments and bodies towards maintenance and construction of Main and Secondary Roads	265,089	510,686	....	775,775
Commonwealth/State Government grants—				
Restoration of flood damage	....	....	....	....
Relief of unemployment	....	655,000	....	655,000
Sydney Harbour Bridge Account for expressway approaches	56,883	....	....	56,883
Commonwealth Aid Roads Act, 1969—				
Urban arterial roads—Schedule 2	....	....	39,060,000	....
Rural arterial roads—Schedule 3	....	....	12,410,000	....
Other rural roads—Schedule 4	....	....	3,326,617	....
Planning and research—Schedule 5	....	....	1,120,000	55,916,617
Other	836,413	183,896	....	1,020,309
Total Receipts	**$32,061,375**	**$59,419,327**	**$55,916,617**	**$147,397,319**

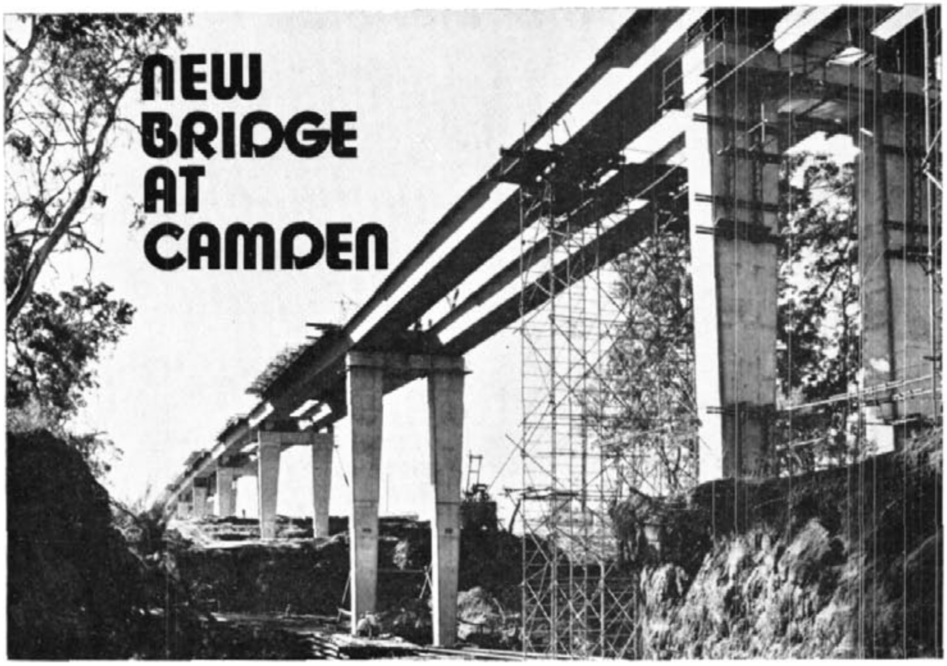
and Payments

30TH JUNE 1972

PAYMENTS	County of Cumberland Fund $	Country Fund $	Commonwealth Fund $	Total $
Construction and reconstruction of roads and bridges	9,259,182	27,094,165	45,913,855	82,267,202
Construction and maintenance of unclassified roads in the unincorporated area of the Western Division	....	....	195,783	195,783
Maintenance and minor improvement of roads and bridges ..	5,430,991	20,933,317	....	26,364,308
Restoration of flood damage	....	475,456	....	475,456
Land acquisition	6,063,013	1,134,874	7,918,528	15,116,415
Purchase of land and buildings for works operations	448,120	436,448	....	884,568
Purchase of land and buildings for administration	176,802	212,450	....	389,252
Administrative expenses	3,775,630	5,637,843	....	9,413,473
Planning and research	....	....	1,741,592	1,741,592
State Treasury loans—				
Sinking Fund payments	15,470	172,730	....	188,200
Interest, exchange, management and flotation expenses	193,710	922,270	....	1,115,980
State Treasury—Repayment of temporary advance	100,000	100,000	....	200,000
Loan borrowings under Section 42A of the Main Roads Act, 1924—				
Repayment of principal	171,118	177,466	....	348,584
Interest	671,819	1,086,255	....	1,758,074
Other	315,030	547,288	....	862,318
	26,620,885	58,930,562	55,769,758	141,321,205
Transfers to reserve for loan repayments	145,425	163,763	....	309,188
Net transactions of operating and suspense accounts	662,736	609,476	....	1,272,212
Total Payments	**$27,429,046**	**$59,703,801**	**$55,769,758**	**$142,902,605**

The new bridge is a 2-lane, 3,380 feet long structure and will form part of a 5-mile deviation of the Hume Highway which will allow through traffic to by-pass the towns of Narellan and Camden. This deviation will be linked with the 9·75 mile section of the South Western Expressway now under construction between Cross Roads (near Liverpool) and Maryfields (near Campbelltown)—by a dual carriageway road from Campbelltown to Narellan.

The new bridge will cross the Nepean River and its flood plain approximately one mile upstream of the existing low level bridge. On completion the bridge will carry the Hume Highway across its last major flood barrier, with a minimum clearance of 3 feet above the level of the highest recorded flood—in February, 1873.



SELECTING THE TYPE OF STRUCTURE

The first part of this article gives brief outlines of the considerations behind two very important choices—one relating to the selection of the type of bridge structure and the other relating to the method by which prestressing of the superstructure would be carried out.

As well as examples of the ways in which thought *precedes* action *in bridge construction, they are an indication of the immense amount of planning and investigation which is undertaken by Departmental officers to ensure that its construction methods are a blend of the most economical and the most efficient.*

* * *

The second part gives details of the fabrication and erection of the steel girders and prestressing of the superstructure by controlled lowering at the supports This information is supplementary to that already published in the June, 1971 *issue of "Main Roads" (Vol.* 36, *No.* 4, *pp.* 98–103) *under the title "Design of New Bridge over Nepean River at Camden".*

* * *

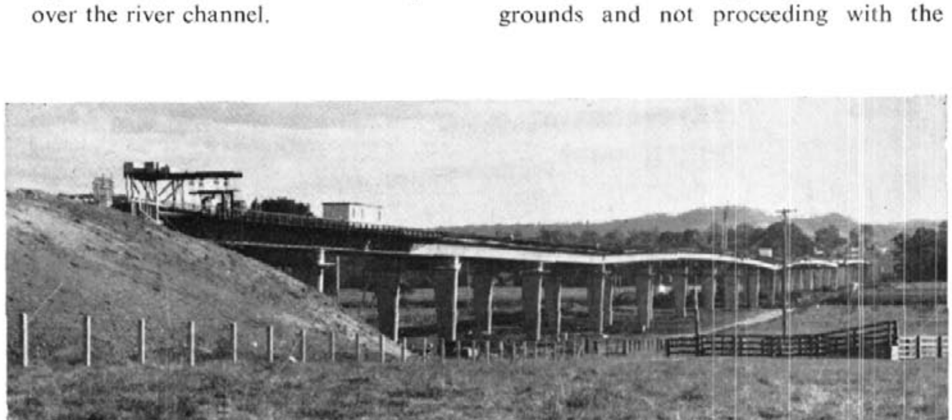
This article has been edited from material prepared by Mr A. R. Smith, Assistant Bridge Engineer (Design), and Mr R. J. L. Wedgwood, Resident Engineer, Camden Bridge. The first section is part of a paper presented by them in 1970 *to the Civil Engineering Branch, Sydney Division, of the Institution of Engineers, Australia.*

In considering various types of structures, the following observations were made:

- The presence of sound rock at an average depth of 65 ft below natural surface pointed to the use of continuous spans with their inherent material economy, better appearance, and improved riding qualities. Cast-in-place concrete piles to the rock were considered to be the most suitable foundation for this type of structure.
- The permanent well-defined river channel required a minimum span of 130 ft length. Therefore the alternatives would have been to use constant span lengths of 130 ft or more for the full length of the bridge or to use shorter approach spans with the 130-ft span over the river channel.
- Whilst the bridge site is only 21 miles from the coast it is considered that the atmosphere is substantially non-corrosive. Therefore there is little difference in the relative merits of steel or concrete bridges in terms of future maintenance.

In order to compare the relative economies of continuous span structures constructed from steel, reinforced concrete or prestressed concrete, and with various span arrangements in each case, a number of structure types were investigated and preliminary estimates prepared.

In all of these preliminary investigations the concept of the design of the whole of the bridge as a single entity was adopted, rather than the approach of first selecting a superstructure type on economic grounds and not proceeding with the



detailed design of the substructure (such as the number of piles, etc.) until later.

As the site was admirably suited to the operation of the Department's Benoto machine in boring for the foundations, the use of 34-in diameter cast-in-place piles became one of the major considerations during the design. The vertical load capacity for this size of pile at this site was assessed at 350 tons. This figure was based on proof load tests on similar piles at Stockton Bridge over the North Channel of the Hunter River, north of Newcastle (see March, 1972 issue of "Main Roads", Vol. 37, No. 3, pp. 66–69) and at the bridge over Tuggerah Lake at The Entrance (see brief details in March, 1969 issue of "Main Roads", Vol. 34, No. 3, p. 87—and front cover of June, 1969 issue, Vol. 34, No. 4).

At least two 34-in diameter piles per pier were required for the span at the main channel. Hence it was decided for *the initial investigations* to adopt two 34-in diameter piles (each with a load capacity of 350 tons) for the piers. Subsequent work showed that two piles per pier gave the most satisfactory solution when *all* factors were considered.

To enable cost comparisons for various types of bridges, preliminary designs were developed to the stage where the section sizes, pier sizes, and pile loads were determined. The scope of these investigations was quickly narrowed down to three types of bridges, as follows:

□ *Steel Plate Open Trough Girder with Composite Concrete Deck.*

A comparison between a single trough, a two-trough, and a three-trough cross section showed that the two-trough cross section was the most economical arrangement for a 38-ft 8-in deck width. This is in line with the findings of Johnston and Mattock (in a paper entitled "Lateral Distribution of Load in Composite Box Girder Bridges" published in Highway Research Record No. 167, 1967) that the most economical number of trough (box) girders for this type of superstructure is equal to the number of design traffic lanes.

Preliminary design calculations were made for continuous superstructures of equal spans, with allowance for moment redistribution between the supports and mid-span, by means of controlled lowering at the supports. The span lengths considered ranged from 70 to 160 ft. However, as mentioned above, the main channel required a minimum span of 130 ft and, consequently, those estimates in which all span lengths were less than 130 ft had to be adjusted to incorporate a 130-ft main channel span.

□ *Reinforced Concrete Box Girder.*

Previous cost studies for the bridge over Tuggerah Lake at The Entrance (a structure of similar type and proportions) had indicated that the economic limit to the span length was 85 ft.

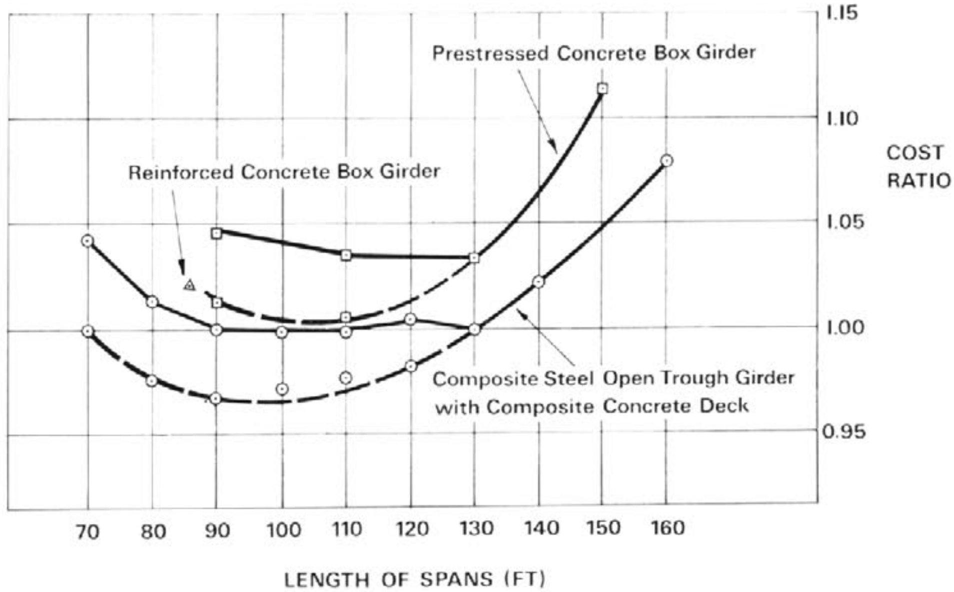
An estimate was prepared for a bridge proposal with spans of 85 ft together with a main channel span of 130 ft.

The pile load under the 85-ft spans was 305 tons.

□ *Prestressed Concrete Box Girder.*

Prestressed concrete box girder bridges of constant span lengths of 90, 110, 130, and 150 ft, were investigated, the 90- and 110-ft span cases also being adjusted for the 130-ft main channel span.

The cost comparisons indicated general optimum span lengths for this site of 90 ft for the steel open trough girder, with a composite concrete deck, and 105 ft for the prestressed concrete box girder. However, when the requirement of the 130-ft main channel span was taken into account, the cost for the steel open trough girder with composite concrete deck remained at a relatively constant minimum over the range of 90 to 130 ft. On the other hand the cost for the prestressed concrete box girder was at a minimum in the range of 110 to 130 ft.



BRIDGE COST COMPARISON
Bridge over Nepean River at Camden

The cost comparisons showed the total cost of the steel open trough girder with a composite concrete deck to be 2 per cent less than that for the reinforced concrete box girder and 3 per cent less than that for the prestressed concrete box girder.

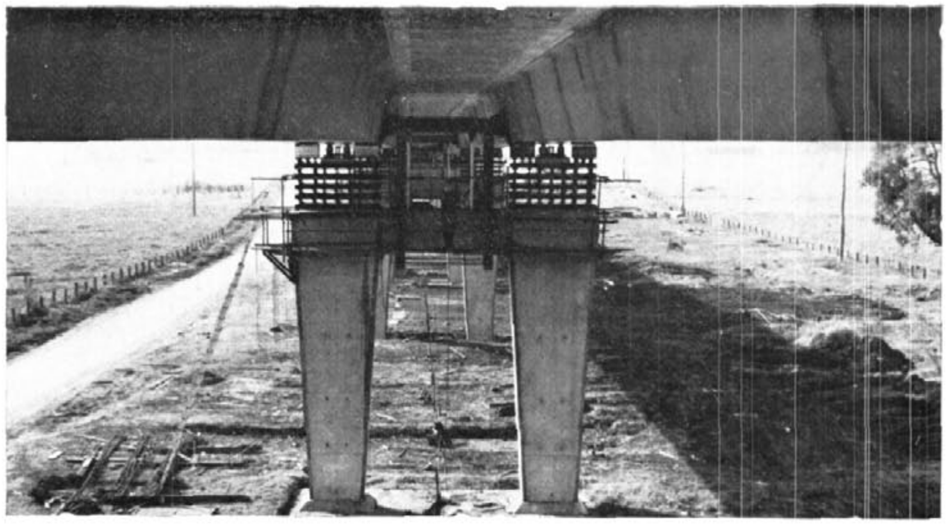
The cost comparisons are illustrated on the above graph.

Bearing in mind that, at best, the estimates could only be expected to be within ±5 per cent, the percentage differences in total cost noted above were not sufficient to favour outright one bridge type over the others.

Further consideration was necessary, therefore, to enable a choice of structure type to be made. One important point was that the use of a constant 130-ft span arrangement had the greatest potential for economy in that it allowed the maximum amount of repetition in design, fabrication, and erection.

For the reinforced concrete box girder type, the limit to the spans was approximately 85 ft and constant 130-ft spans over the whole length of bridge were thus not practicable. For the prestressed concrete box girder type, constant 130-ft spans resulted in a maximum pile load of 400 tons, which was in excess of the 350 tons accepted as a maximum. More than two piles per pier would thus have been required.

On these grounds, therefore, the steel open trough girder with a composite concrete deck at constant 130-ft spans was chosen. The maximum pile load for this structure was 325 tons.



PRESTRESSING BY CONTROLLED LOWERING

Continuity in composite steel girder and concrete deck bridges presents the difficulty that the composite section has a greater resistance to positive bending moment (at mid-span) than to negative bending (over the intermediate piers). As a result, it is customary to increase substantially, the thickness of the steel girder plates in the negative moment region over the piers. This practice, however, does not prevent cracks developing in the concrete deck due to girder bending over the piers or from the effects of the shrinkage of the concrete against the restraint of its attachments to the girders.

In designing the bridge at Camden, alternative procedures were considered for improving the negative moment capacity of the composite girder at the piers. These were:

(a) the provision of additional steel reinforcement in the deck slab over the piers to act compositely with the rest of the composite girder;

(b) the prestressing of the region over the piers by means of high tensile steel tendons embedded in the deck;

(c) the use of prestressed precast deck slabs instead of a cast-in-place deck;

(d) the redistribution of the bending moments by controlled lowering at the supports during construction. This procedure reduces negative moments at the piers and increases mid-span positive moments.

Of the above alternatives, (b) would have required a large amount of prestress to prevent the concrete deck cracking because the steel open trough section would also be prestressed simultaneously. The use of prestressed precast deck slabs as in (c) would have required the provision of a suitable shear connection between the slab and the girders after the prestressing was complete. This shear connection could have been in the form of bolts combined with epoxy adhesives, the extra cost of which would have outweighed the advantages in this case. These two procedures were therefore discarded in favour of a combination of (d) and (a).

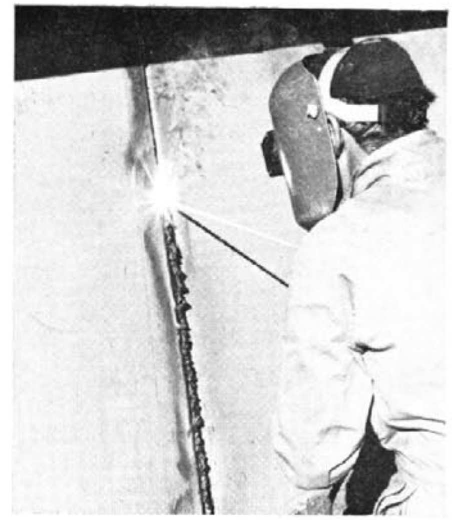
By the use of the moment redistribution technique, major variations in the thickness of steel plate in the steel trough sections have been avoided. This has allowed the use of a relatively constant cross-section throughout the length of the bridge. The width of the top flanges varies from 16 in at mid-span to 30 in over the piers. The total cross-section at the piers was further increased by the use of approximately 40 sq in of reinforcement per girder in the deck slab.

The controlled lowering also produces an initial compression in the concrete deck slab to counteract the effects of shrinkage and tensile stresses over the piers.

A brief description of the controlled lowering of the superstructure at the supports is given on page 62.

Although this method has been used successfully in recent years for continuous steel plate open trough girder structures in Europe and also, with slight variations,





FABRICATING THE GIRDERS

in Japan, this is probably its first large scale use in major bridge building practice in Australia.

The contractor for the construction of the bridge, John Holland (Constructions) Pty Ltd, subcontracted the fabrication of the 114 steel plate open trough girder segments to the firm of Improved Constructions Pty Ltd whose workshops are at Villawood, approximately 23 miles north of Camden.

These girder segments were fabricated in lengths of 30, 60, and 70 ft and the 30-ft segments each weighed 10 tons, while the 60- and 70-ft segments each weighed approximately 20 tons. The steel used for the top and bottom flanges was notch-ductile structural steel Grade N.D. 1, Class B, and that used for the webs, diaphragms, and other plates was ordinary mild structural steel.

Being "open trough" girders they are made up from five separate steel plates—two top flange plates, two web plates, and a bottom flange plate. The girders are 4 ft 4½ in high, 7 ft wide across the bottom, and 9 ft wide at the top between the webs. The two top flanges are 1 in thick and vary in width from 16 to 30 in. The single bottom flange varies in thickness from ¾ to 1 in. The two web plates are $\frac{11}{16}$ of an inch thick and are inclined at 1 in 4 from the vertical.

The five separate plates which make up each girder were initially fabricated separately by welding to length and cutting to width, the web plates being cut to the required camber.

The plates were then assembled in a jig to form an open trough girder, each girder being first made up in an upside down position. The plates were tack welded together to give sufficient strength to make the girder self-supporting. The girder was then held at each end by a clamp arrangement and set on trunnions which allowed it to be rotated to any position for welding.

The weld of the bottom flange plates to the web plates was a full penetration corner butt weld. A single bevel on the inside of the web was the only plate preparation. This weld was made up of a root pass done manually, followed by two passes of automatic submerged arc welding on the inside. The root run was later back-gouged from the outside and filled with a further pass of submerged arc weld. The weld of the top flange plates to the web plates was a full penetration tee butt weld and a single bevel on the outside of the web allowed access for the weld build-up. This weld was made up of four passes of manual electric arc welding on the outside, with a back gouge of the root pass and two manual weld passes on the inside. The completed welding was checked by both radiographic and ultrasonic procedures.

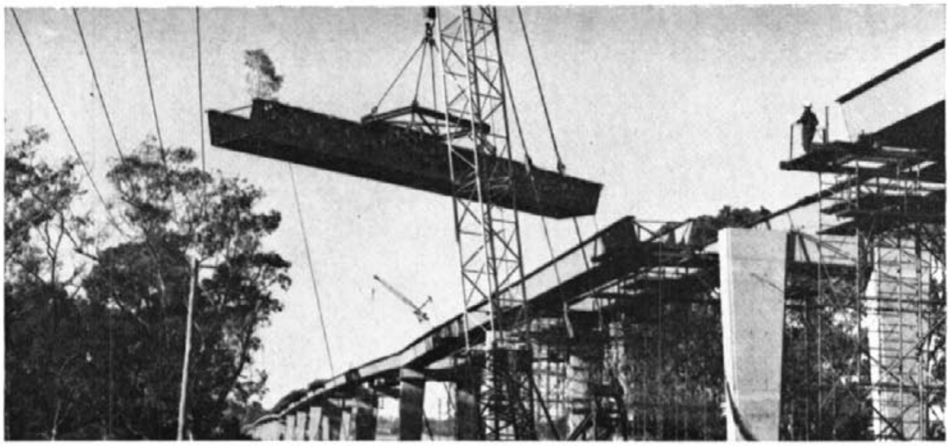
A diaphragm plate was placed in those girder segments which were to be supported on the bearings at the pier. The diaphragm plate and all stiffeners were made up as a sub-assembly, the diaphragm being placed in position when the girder plates were assembled, and later being fillet welded to the bottom flange and web plates. Stiffener beams were welded along the bottom flange plates, and the stud shear connectors, around which the concrete was later to be cast, were placed using a stud welding gun.

Finally, the girders were milled at each end to ensure that the ends were square and would fit together in the field and the bevels for the field welds were cut.

Protective Painting

On arrival at the site, the girders were sand-blasted to a near-white metal finish and given an initial protective coat of an inorganic zinc ethyl-silicate primer to a minimum thickness of three thousandths of an inch on the outside surfaces, and four thousandths of an inch on the inside surfaces. The inside surfaces will receive no further coating, but the outside surfaces have been painted with a vinyl top coat, to a minimum thickness of three thousandths of an inch. An "Elcometer" thickness gauge was used to measure the thickness of these coatings.

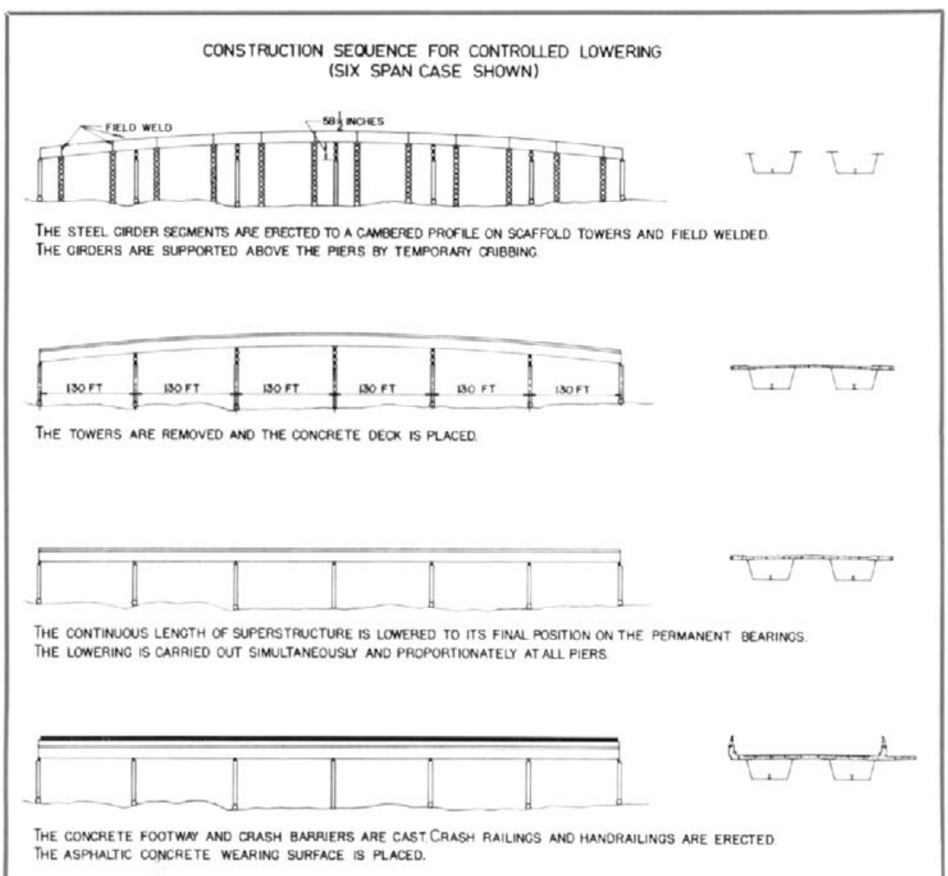
The top paint coat on the bridge at Camden will be blue instead of the commonly used grey of earlier steel bridges. The use of colour is aesthetically pleasing and is expected to be a feature of future bridges. The new Stockton Bridge, north of Newcastle, has bright red handrails, etc., while the new expressway bridge being built across the Hawkesbury River at Mooney Mooney will have a dark green finish.



ERECTING THE GIRDERS

A single crane was used to lift each girder into place by means of a lifting frame with four "grabs" to hold the girder under the top flanges. The girders were erected onto scaffold towers placed at approximately the quarter points of each span.

The initial erection of the girders was to a cambered profile with the ends of each continuous length at the final level but with the centres approximately $26\frac{1}{2}$ inches above the final level for the four-span continuous lengths and $58\frac{1}{2}$ inches above the final level for six-span lengths. Once in place, the girder segments were set to the required levels and aligned correctly—the ends being brought to the required $\frac{1}{16}$-in root face gap, ready for field welding to commence.



Field Welding

To allow easier placement of the weld metal (as well as to provide protection for the welders) a single vee bevel plate preparation was permitted for the field welding. Control tests carried out at the commencement of the job indicated that the distortions arising from the use of the single vee preparation (instead of the more normally used double vee level preparation) would be within acceptable limits.

Manual electric-arc welding using low hydrogen electrodes was used for field welding. The weld vee was filled from the inside with 4 or 5 passes and the surface of the weld ground flush for appearance and radiography purposes. The root pass of the weld was then gouged out from the outside using an arc-air gouging procedure and the gouge so formed was filled with a single pass of weld metal and ground flush.

Testing of Welds

All field welding was checked radiographically and, in the box corners, checks were made with an ultrasonic probe.

For the radiographic checks, a film inside a plastic sheath was attached to one side of the weld. On the other side a stand was set up into which a radioactive isotope was to be positioned. The isotope was stored in a lead-lined container and it was necessary to keep the area clear because of the danger of radiation. The operator moved the isotope to the stand by means of a screw thread device and gamma rays from the isotope passed through the metal to impinge on the film. The length of exposure time (usually 2 to 5 minutes) depended on the strength of the isotope, the thickness of the plate and the distance from the plate.

This non-destructive testing of the welding was carried out for the Department by the firm, Metlabs Pty Ltd, of Guildford.

Weld metal flaws which did not comply with the specification requirements, were removed, replaced, and then re-checked. Following the approval of the welding, the temporary towers were removed and the girders were then supported from the piers on rail cribbing.

The Formwork

At this stage the formwork for the deck was set up. The forms above the trough girders were of plywood pieces supported on light steel beams over cross frames, which were removed and re-used. The forms erected between the girders and the cantilever forms were of steel and were hung from the transverse beams which were supported from the top flanges of the girders. The reinforcement was then positioned and tied, and ready mixed concrete with a minimum strength of 4,000 lb/sq in was placed in the deck.

The surface of the 7½ inch thick deck has been finished with a vibrating screed, and then floated off and broomed.

Prestressing by Controlled Lowering

When all the deck concrete was adequately cured and at least 28 days old, the girders and deck in a continuous set were lowered to the final profile, i.e., to the permanent bearings on the intermediate piers. There are five continuous lengths of girders in the bridge—a four-span set, three six-span sets, and another four-span set.

The lowering was carried out using jacks placed on cribbing set up between the support cribbings for each girder. The jacks took the weight of the girders, some of the support cribbing was removed and the girders lowered by means of the jacks until they rested on the lowered support cribbing. The jacks were reset and the procedure repeated.

As mentioned above, the maximum lowering distance was 58½ inches for the six-span continuous lengths and 26½ inches for the four-span continuous lengths. The lowering procedure prestressed both the steel trough girders and the composite concrete deck, inducing a tensile stress of about 5,000 lb/sq in into the bottom flange of the girder and a compressive stress of about 500 lb/sq in into the concrete deck.

These stresses were related solely to the bending moments induced by the controlled lowering and not by any thrust from restraint at the ends. In fact, the girders were free to extend during the controlled lowering operation and this extension had to be allowed for in the initial setting up of the girders on the piers.

There were two length change effects. One related to the change in plan length between the initial cambered profile and the final profile. This change was ⅛ inch for a four-span case and ⅝ inch for a six-span case. The other change related to the stresses brought about by the lowering which caused the bottom flange to increase in length by 1 inch for a four-span case and by 1⅝ inch for a six-span case, while the concrete deck shortened by ⅞ inch for a four-span case and by 1¼ inch for a six-span case.

When the superstructure was down to its correct profile, the bearings between the girders and piers were grouted and packed. With the completion of the lowering, the follow-up work of placing the footway, crash barriers, and railings, was able to commence ●

TENDERS ACCEPTED BY COUNCILS

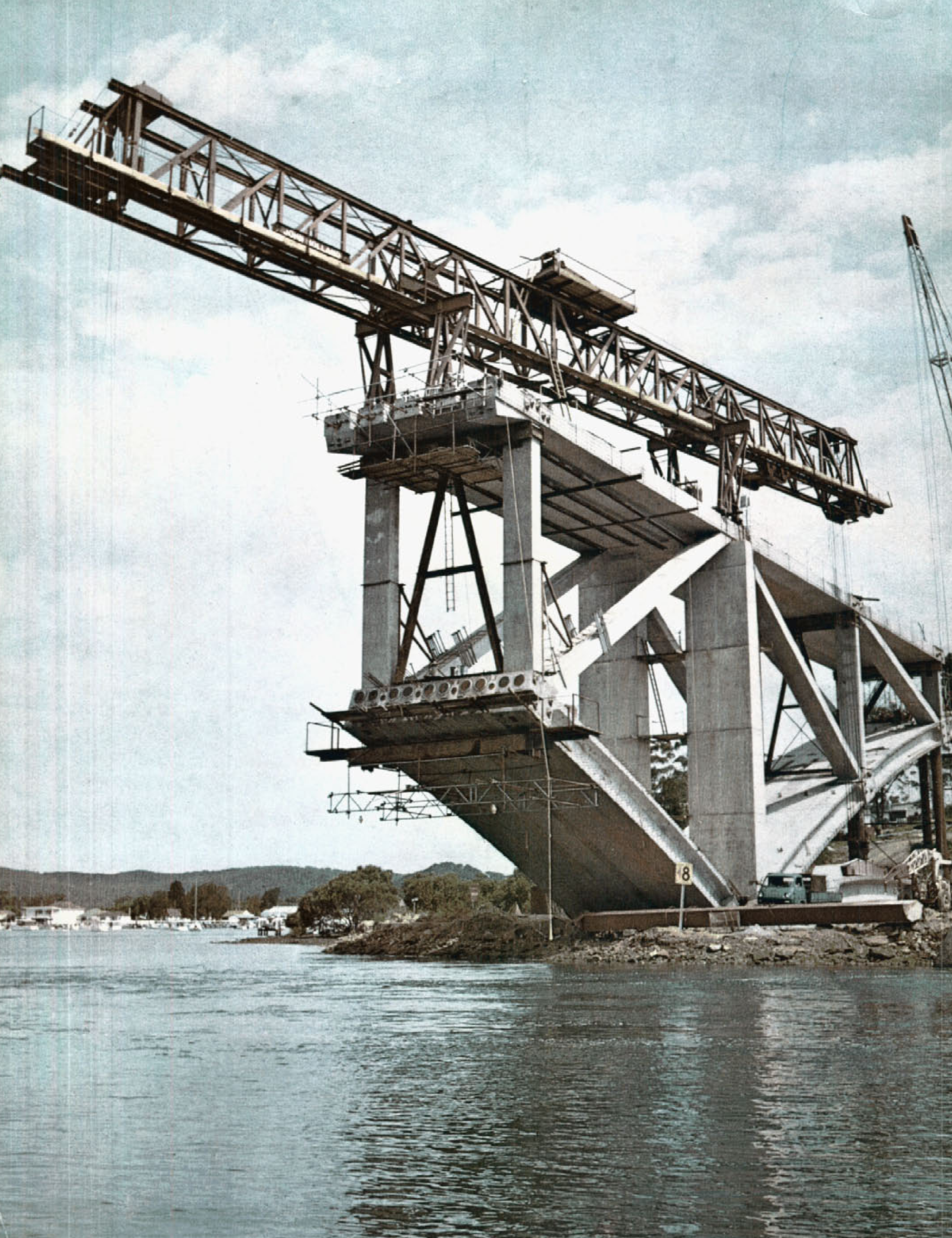
The following tenders (in excess of $10,000) for road and bridge works were accepted by the respective Councils during the three months ended 30th September, 1972.

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Ashford	S.H. 16	Bruxner Highway. Construction of 12-cell 6 ft x 5 ft reinforced concrete box culvert at 5.6 miles west of Yetman.	N. Del Gatto	14,810.74
Ashford	M.R. 137	Bituminous surfacing of various sections from: 28 to 29.3 miles north of Inverell; 9 to 10.6 miles north of Ashford; 12.2 to 14 miles north of Ashford.	Emoleum (Australia) Ltd	17,748.99
Ashford	M.R. 187	Construction of 12-cell 11 ft x 11 ft reinforced concrete box culvert over Smedleys Gully, 43.4 miles north of Inverell.	N. Del Gatto	40,698.45
Bibbenluke	S.H. 19	Monaro Highway. Construction of earthworks, drainage and minor ancillary works, between 18.3 and 21.3 miles south of Bombala.	Monaro Road Construction Pty Ltd	67,404.00
Blacktown	M.R. 537	Extension of reinforced concrete box culvert at Mavis Street, Rooty Hill.	Hill Bros. Construction Pty Ltd	12,211.00
Coolah	M.R. 206	Construction of six-span reinforced and prestressed concrete bridge, 210 ft long, over Sandy Creek 14.2 miles south-west of Dunedoo.	A. Cipolla and Co. Pty Ltd	60,716.80
Cudgegong	Developmental Work 3216	Manufacture, supply and delivery of prestressed and reinforced concrete girders for bridge over Wyaldra Creek, 2.5 miles north of Gulgong.	Dyson-Holland Prestressed Pty Ltd	12,952.00
Goobang	M.R. 233	Construction of 3-cell 12 ft x 12 ft reinforced concrete box culvert over Back Goobang Creek 9.2 miles north of Parkes.	A. Cipolla and Co. Pty Ltd	16,612.40
North Sydney	Various	Replacement of deteriorated or deformed asphaltic concrete on various roads.	Bituminous Pavements Pty Ltd	12,181.50
South Sydney	Various	Replacement of deteriorated or deformed asphaltic concrete on various roads.	Pioneer Asphalts (N.S.W.) Pty Ltd	18,920.00
Wollongong	Southern Expressway	Construction of reinforced concrete box culvert over Byarong Creek at the Avenue.	A.R.C. Engineering Pty Ltd	12,260.06
Wollongong	S.H. 1	Prince's Highway. Construction of a crib block retaining wall opposite Nimbin Street, Corrimal.	Fred Berridge Constructions	19,965.14

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $10,000) for road and bridge works were accepted by the Department during the three months ended 30th September, 1972.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
North Western Expressway	City of Sydney. Supply of 593 precast column segments for construction of viaduct in Darling Harbour Goods Yard.	Peter Verheul Pty Ltd	326,633.00
North Western Expressway	City of Sydney. Supply of high-tensile steel hardware for post-tensioning precast columns in Darling Harbour Goods Yard.	Macalloy (Australia) Pty Ltd	155,233.62
South Western Expressway	City of Campbelltown. Construction of twin 3-span prestressed and reinforced concrete bridges, 187 ft long, over Badgelly Road at Campbelltown.	Allied Constructions Pty Ltd	294,011.35
State Highway No. 1	Prince's Highway. City of Wollongong. Manufacture of reinforced concrete bridge piles for bridge over Fairy Creek.	Frankipile Australia Pty Ltd	32,349.95
State Highway No. 1	Prince's Highway. Municipality of Bega. Construction of 23-span prestressed and reinforced concrete bridge, 2,046 ft long, over the Bega River at Bega.	Peter Verheul Pty Ltd	1,173,581.00
State Highway No. 2	Hume Highway. Municipality of Camden. Manufacture, delivery and erection of 9 precast, pretensioned, concrete girders for bridge over Macarthur Road at Camden.	Peter Verheul Pty Ltd	37,767.00
State Highway No. 7	Mitchell Highway. Shire of Molong. Supply of 7,300 cu yds of lower course gravel and 3,700 cu yds of upper course material for reconstruction between 5 and 7 miles west of Molong.	L. J. Osborne	15,516.00
State Highway No. 7	Mitchell Highway. Shire of Molong. Supply of up to 9,000 cu yds of natural gravel or crushed rock base course material for reconstruction between 7.6 and 8.7 miles west of Molong.	D. C. Kennett	13,500.00
State Highway No. 7	Mitchell Highway. Shire of Wellington. Construction of a 2-cell 12 ft x 12 ft reinforced concrete box culvert at 16.3 miles west of Wellington.	A. Cipolla and Co. Pty Ltd	29,751.30
State Highway No. 9	New England Highway. City of Maitland. Manufacture and delivery of precast, pretensioned concrete units for bridge over Four Mile Creek, 6.5 miles east of Maitland.	Basic Industries Pty Ltd	30,510.00
State Highway No. 9	New England Highway. City of Maitland. Haulage of up to 50,000 tons of slag skulls from B.H.P. stockpile to approaches of bridge over Four Mile Creek, 6.5 miles east of Maitland.	W. D. Smith (Constructions) Pty Ltd	45,500.00
State Highway No. 9	New England Highway. City of Maitland. Supply and delivery of 2,000 tons of ¾ in gauge asphaltic concrete for reconstruction between Maitland and Rutherford.	Bituminous Pavements Pty Ltd	24,780.00
State Highway No. 10	Pacific Highway. Shire of Lake Macquarie. Supply and delivery of 1,300 tons of ¾ in gauge asphaltic concrete for reconstruction at Catherine Hill Bay turnoff.	Boral Road Services Pty Ltd	17,260.00
State Highway No. 14	Sturt Highway. Shire of Hay. Stabilisation of foamed bitumen and compaction of surface course pavement from 14.4 to 16.4 miles west of Hay.	Emoleum (Australia) Ltd	26,057.61
......	Shire of Hay. Supply of 3/16 and ⅜ in aggregate to Hay Works Office.	Graham Stevenson Pty Ltd	22,401.50
......	Supply and delivery of up to 1,200 tons of hot mixed, cold laid bituminous plant mix to various stockpile sites in the South Grafton Works Office area.	Bituminous Pavements Pty Ltd	19,827.00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