

a timber structure on the Broken Creek, in the district of the Tungamah Water-works Trust. It is a joint work between this Trust and the

Plate 48.



GOWAN GARDIE WEIR, BROKEN RIVER VICTORIA.

Numurkah Water-works Trust. It serves to store water in the Broken Creek, and to divert into Baala Creek for stock and domestic purposes. Its cost, with offtake works, was about £700. The Dumbulbulane weir is a timber structure situated on the Broken or Nine-Mile Creek, about 5 miles below the Katandra weir. It is in the district of the Tungamah Water-works Trust, and serves to store water in the creek for domestic and stock use. A few of the weirs that have been constructed on Avoca and Wimmera Rivers are illustrated by Plates 50 and 51. The Avoca very rarely contributes to the flow of the Murray, and the Wimmera waters have never been known to reach the Murray. They are situated in the arid parts of Victoria, and are somewhat typical of our Bogan and Macquarie Rivers. The Glenorchy weir (Plate 50), on the Wimmera River, is a timber structure, 292 feet in length between the abutments, with a central notch of about 100 feet. The notch is divided into sixteen bays by wooden standards, which support the gangway and frames for carrying drop-bars. The wings are about 2 feet 8 inches above the sill of the notch. A little above the weir, on the right bank, two channels leave the river, supplying the Dunmunkle and Swede's Creeks respectively. The object of the Swede's Creek scheme is to supply the course of the

Plate 49.



KATANDRA WEIR, BROKEN CREEK, VICTORIA.

Plate 50.



GLENORCHY WEIR WIMMERA RIVER.

Richardson River—a stream which, without this assistance, would only run at intervals. The water so diverted supplies portion of the district of the Wimmera United Water-works Trust.

Dooen Weir. The Dooen weir (Plate 51) has been built on the Wimmera River, near Dooen. It is a timber structure, 200 feet in

Plate 51.



DOOEN WEIR, WIMMERA RIVER.

length between the abutments, divided by wooden standards into forty bays. The purpose served by this weir is the diversion of water into a gravitation channel 2 miles in length, from which it is raised by a steam-pumping plant through a rising main, $1\frac{1}{4}$ miles in length, into a summit reservoir of a commanding elevation. From this reservoir are supplied 155 miles of channel reticulation for the service of the country lying to the north.

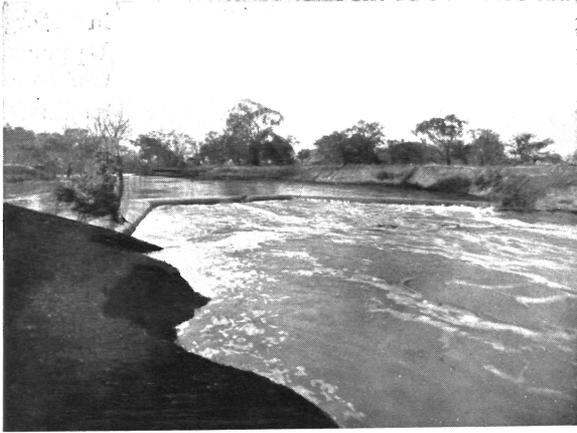
The Serpentine weir is a timber structure on the Loddon River, below the effluence of the Serpentine Creek. In conjunction with a regulator, it controls the diversions into the Serpentine Creek for the service of the Tragowel Plains Irrigation Trust, and for the domestic and stock supply of portion of the Loddon United Water-works Trust's district.

The weir was constructed by the Tragowel Plains Trust.

NAVIGATION.

The pioneer navigator of the Australian inland rivers was Captain Francis Cadell. In 1853 he brought the "Lady Augusta," a steamer

Plate 52.



SERPENTINE WEIR, LODDON RIVER, VIC.

of 72 tons burthen, through the Murray mouth. In the following year he succeeded in reaching Albury in that vessel, and in subsequent years did much towards making the Murray and its tributaries navigable.

In connection with the early history of navigation on the Murray River, the following reprint of a paragraph which appeared in the *South Australian Register* of November 8th, 1853, may be of interest:—"The Legislative Council addressed the Governor in reply to his announcement of the opening of the River Murray by Captain Cadell, requesting three gold medals to be struck commemorative of the event—one for the Governor, one for Captain Cadell, and one to be deposited among the records of the Council. The Council recommended that a sum of £4,000 be placed on the estimates, to be paid to Captain Cadell, conditionally on his employing two additional steamers, not inferior in capability to the 'Lady Augusta,' to ply on the Upper Murray, Murrumbidgee, and Darling, for the space of three years. Some time back a premium of £4,000 was voted by the Council for the first two iron steamers passing through the Murray. Captain Cadell has now accomplished this." The *Register* (S.A.) stated that the expenses incurred by Captain Cadell in carrying out this project were not less than £8,000.

As the river-borne traffic of the Murray and its tributaries is almost entirely controlled by South Australia, the question is one of importance to that State. The trade consists of carrying stores to the towns, stations, and the settlers located on the banks of the rivers, and bringing back wool, hides, tallow, and small quantities of farm produce; the trade of the Lower Murray and the river-borne traffic of the Darling centres in Morgan. The

Controlled by
South
Australia.

Plate 53.



"PRINCESS ROYAL" RIVER-BOUND IN DARLING.

Upper Murray trade, which includes the river-borne traffic of the Murrumbidgee, Edwards, and Wakool rivers, centres in Echuca, where excellent accommodation exists for the discharge and shipment of cargo. With a high river the Murray is practically navigable as far as Albury, but there is very little traffic beyond Echuca, which is

666 miles from the South Australian boundary. On the Darling, steamers trade as far as Walgett, a distance of 1,180 miles from Wentworth. The Murrumbidgee is navigable to Narrandera, but it is only on rare occasions that steamers go beyond Hay. The distance from the junction of the Murray and Murrumbidgee Rivers to Hay is 240 miles. The gaugings at Morgan show that the Murray is, on an average, navigable for about seven months in the year. The Darling, however, only provides for very intermittent navigation, and it is not an uncommon sight to see boats stranded in the river channel for months at a time. Since the beginning of 1902 the Darling has only been navigable for about five months. Plate 53 shows a typical steamer (the "Princess Royal") river-bound in the Darling.

Murray
navigable for
seven months
in the year.

Of late years there has been a marked diminution in the volume of trade entering South Australia. This is due to the fact that owing to the drought the rivers have remained unnavigable for long periods, and also to the extension of railways. The Murray is now tapped by railways at Murray Bridge

River Trade
Diminishing.

and Morgan in South Australia, and in New South Wales and Victoria the railways reach the river at Mildura, Swan Hill, Koondrook, Echuca, Cobram, Yarrawonga, Corowa, and Albury. The Darling is also tapped at Bourke, Brewarrina, Walgett, and Collarenebri, and railways are proposed to connect Wentworth and Wilcannia. With regard to the Murrumbidgee, the South-Western Railway Line which runs parallel to, and at a short distance from the river, fulfils all the requirements of the trade of the Riverina country.

The following returns, furnished by the Collector of Customs at Adelaide, will show the great decrease in the South Australian river trade with regard to the inward and outward shipping, and the value of the imports and exports:—

Year.	Inward Shipping.		Outward Shipping.		Value of Imports.	Value of Exports.
	No. of Steamers and Barges.	Registered Tonnage.	No. of Steamers and Barges.	Registered Tonnage.		
1883	193	28,556	195	29,733	£ 664,167	£ 355,035
1892	144	23,504	145	23,345	425,706	131,293
1901	69	11,215	70	11,731	137,304	45,327

Plate 54.



WHARF AT ECHUCA, MURRAY RIVER.

The differential railway rates of New South Wales, Victoria, and even South Australia itself have had an influence on the river-borne traffic. At the present time the three States compete by great reductions in the freight of river-grown products. For example, wool grown in Bourke is conveyed to Sydney at less average cost per mile than wool grown at Orange, and the difference is even more accentuated in the desire of Victoria to attract the river products to Melbourne. It might be pointed out that wool grown on the Darling and conveyed by steamer to Echuca is then carried to Melbourne by rail for 2s. 3d. per bale, whereas the charge to the settlers in the neighbourhood of Echuca is 6d. 6d. per bale. The Victorian railways also make a very great reduction in the carriage of goods from Melbourne if consigned to the Darling

Differential
Railway
Rates.

Plate 55.



ROYAL MAIL STEAMER "RUBY."

country. The charge for carrying sugar for instance from Melbourne to Echuca, if for the Darling, is only 11s. per ton, whereas the storekeeper in Echuca has to pay freight at the rate of 50s. per ton for the same class of goods. The same thing applies to the South Australian railways, and upper river goods sent from Morgan and Murray Bridge are conveyed at a great reduction compared with local grown products.

Plate 55 shows the Royal mail steamer "Ruby." She has been engaged in the Murray River traffic for a number of years. Accommodation is provided for about twenty passengers.

If it be admitted that South Australia has a claim for a fair share of the waters of the Murray for navigation, and I do not think there

are many who will say that she has not certain rights in this respect, then it must also be admitted that New South Wales and Victoria have certain claims for the economic use of the river waters. In South Australia the settlers along the banks of the river and on the margin of the lakes are entitled to certain volumes of fresh water, and provision is also necessary for the Renmark Irrigation Colony and the village settlements. At certain periods of the year immense volumes of water flow to the sea, and it is necessary that these should be stored for distribution on the land. In New South Wales and Victoria there are large areas of irrigable land thirsting for water to make them fertile and capable of carrying a large population. It seems to be folly to allow this wealth of water to be wholly utilised in maintaining a

**Economic
use of
River Waters.**

Plate 56.



WHARF AT MILDURA: LOW RIVER, 1902.

navigable river without first ensuring that the land be made capable of producing something for the boats to carry.

In connection with the maintenance of navigation, a sum of £368,479 has been spent in removal of overhanging and dangerous trees, reducing dangerous bars, and snagging of the Murray, Murrumbidgee, and Darling. Of this sum, £156,410 has been expended on the Murray, £87,772 on the Murrumbidgee, and £124,297 on the Darling.

Of the total sum expended, the contribution by the various States is as follows:—New South Wales, £248,614; Victoria, £98,865; South Australia, £21,000. The figures show that the policy adopted by New South Wales cannot be regarded from a selfish standpoint, as it receives

**Amount
expended by
States in
maintaining
Navigation.**

very little benefit from navigation, and has expended about a quarter of a million in its maintenance, or nearly twelve times the amount expended by South Australia, which derives practically all the benefits that accrue from the trade of the rivers.

PROPOSED STORAGES.

The Waranga reservoir, which is part of the Goulburn National works, is being formed by the construction of an embankment $4\frac{1}{4}$ miles long, across the mouth of the broad flat depression known as the Waranga Swamp.

**Waranga
Reservoir.**

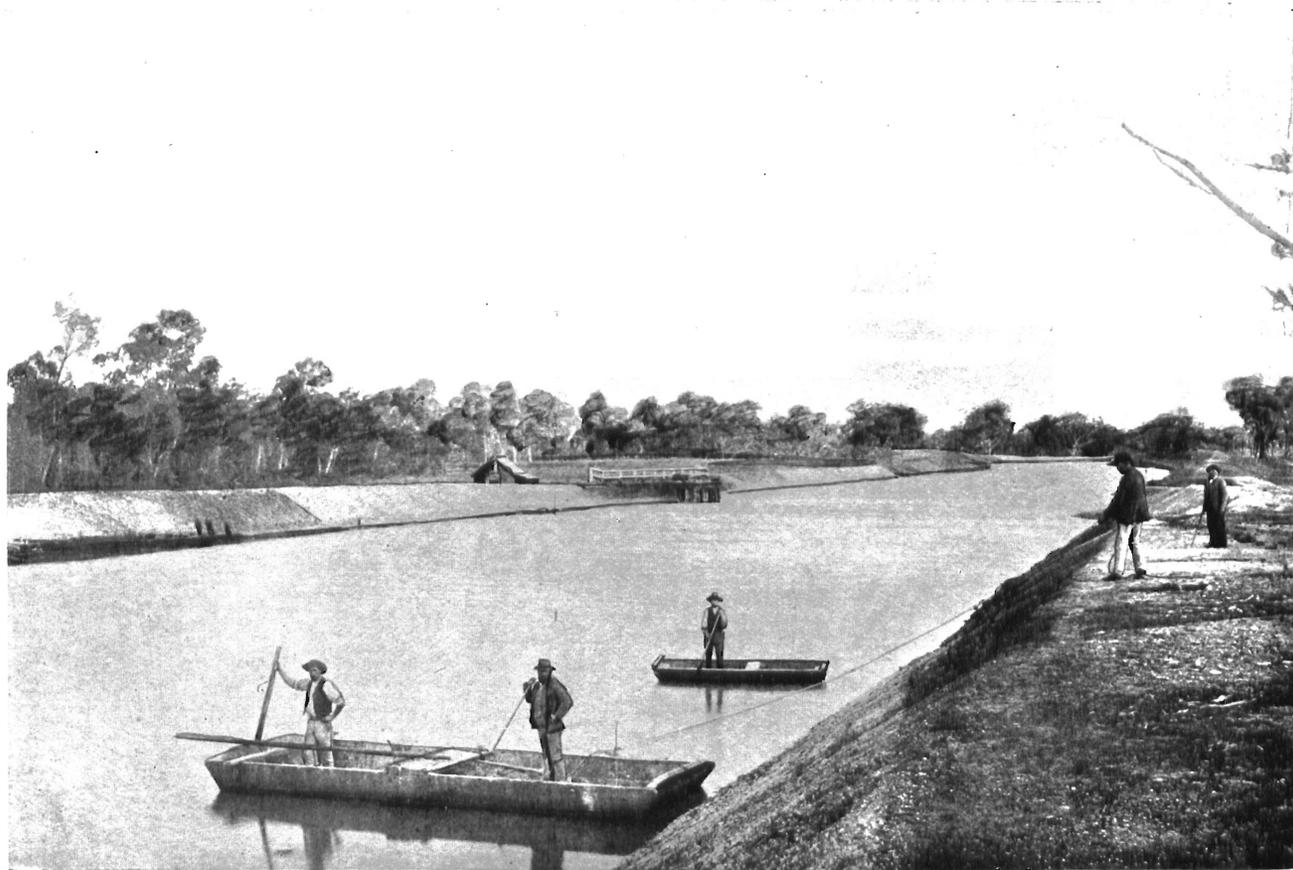
Its purpose is to store water diverted from the Goulburn to supply the dry districts to the west and north. The main western channel, from the Goulburn weir to Waranga, has a carrying capacity of 103,000 cubic feet per minute, and will be, when completed, about 24 miles in length.

The total capacity of the reservoir will be 9,000 millions of cubic feet, whereof 8,600 will be available. The depth of water over the greater part of the submerged area of $18\frac{1}{4}$ square miles will be about 20 feet, of which about 18 will be above the sills of the outlets. The main outlet channel will run north-westerly to the Campaspe; a minor outlet will serve the country to the north.

Contracts amounting to £144,000 are in progress for the embankments, the outlets, and the completion (4 miles) of the main channel, from the Goulburn weir to Waranga.

On the Murray the irrigable areas of suitable land are large, not only in New South Wales, but in our sister State, Victoria. It is proposed to divert the Upper Murray water at Bungowannah, which is situated about 7 miles below the town of Albury, and a large tract of country could be commanded by the canals on both sides of the river. In order to carry out any diversion scheme to serve this portion of the country, the water must be stored. On the Mitta and Kiewa, in Victoria, possible storage sites may be discovered, but so far no investigations have been made. On the Upper Murray the country has been thoroughly examined, and reservoirs could be constructed at Murray Gate and at Cumberoona. On the latter site detail surveys have been made, and a dam constructed at this point 70 feet high, would be 8,000 feet long from the Victorian to the New South Wales side of the valley, and would impound 25,367,000,000 cubic feet. The great dam recently built on the Nile at Assuan is 6,400 feet long, and the storage capacity 37,612,000,000 cubic feet, or about 50 per cent. more than the proposed Cumberoona reservoir. The dam on the Murray could, however, be easily increased

**Cumberoona
Reservoir.**



GOULBURN RIVER NATIONAL WORKS: WESTERN CHANNEL.

beyond 70 feet, and a much larger volume of water impounded. In view of the abnormally dry year of 1902 and the early part of 1903,

Plate 58.



THE UPPER MURRAY, NEAR CUMBEROONA, N.S.W.

the question of storing a larger quantity of water than was at first anticipated will require to be seriously considered, in order to provide an adequate supply for the irrigable areas adjacent to the Murray in the States of New South Wales and Victoria, and at the same time to allow a sufficient volume of water to pass down the river to satisfy the lower riparian holders.

As far as the Murrumbidgee is concerned, there are many sites suitable for the construction of dams for impounding the surplus waters. Perhaps the best of the sites is that known as **Barren Jack Reservoir**, situated a short distance below the confluence of the Goodradigbee and Murrumbidgee rivers. The river at this spot passes between two granite hills, many hundreds of feet in height, and an immense volume of water could be impounded. The percentage of rainfall that finds its way into the streams from the upper reaches of the river is large, and both the Murrumbidgee and

