

SECTION XIV.

WATER CONSERVATION AND IRRIGATION.

§ 1. Artesian Water.

1. **General.**—In every country in which droughts are recurrent, there are few problems the solution of which is of greater importance than that of an adequate system of water conservation. Much has been done in the Commonwealth so far as the supply of water to centres of population is concerned, and a description of several of the metropolitan water works will be found herein, viz., in the section dealing with "Local Government." In May 1912 an Interstate Conference on artesian water was held in Sydney, at which it was agreed that combined Governmental action should be taken with reference to delimitation of the artesian basin, hydrographic survey, analyses and utilisation of artesian water, etc. (See map on page 529.)

(i.) *The Great Australian Artesian Basin.* In speaking of the "Great Australian Artesian Basin," the area is understood which includes (a) considerably more than one-half of Queensland, taking in practically all that State lying west of the Great Dividing Range, with the exception of an area in the north-west contiguous to the Northern Territory; (b) a considerable strip of New South Wales along its northern boundary and west of the Great Dividing Range; and (c) the north-eastern part of South Australia proper, together with the extreme south-eastern corner of the Northern Territory. This basin (shewn approximately by the map on page 529) is said to be the largest yet discovered, and measures about 569,000 square miles, of which 376,000 square miles are in Queensland, 90,000 square miles in South Australia, 83,000 square miles in New South Wales, and 20,000 square miles in the Northern Territory. The area of the intake beds is estimated at 60,010 square miles, viz., 50,000 square miles in Queensland and 10,010 square miles in New South Wales. A description of the basin and its geological formation will be found in previous issues of the Year Book (see No. 6, p. 569).

(ii.) *The Western Australian Basins.* The Western Australian Basins fall naturally within five distinct groups, viz., the Eucla Basin, in the extreme south-east of the State, and extending well into South Australia along the shores of the Great Australian Bight; the Coastal Plain Basin, west of the Darling Range; the North-West Basin, between the Murchison and Ashburton Rivers; the Gulf Basin, between Cambridge Gulf and Queen's Channel; and the Desert Basin, between the De Grey and Fitzroy Rivers. The boring operations in these basins are referred to hereafter (see page 518).

The Recent and Tertiary strata which enter Western Australia at its eastern border, and which have a prevailing dip towards the Great Australian Bight, form the Eucla artesian water area. But where boring operations have been undertaken, the water has been found to be salt or brackish, and there are other conditions affecting the supply, such as local variations in the thickness of the beds, their relative porosity, and the unevenness of the floor upon which they rest, which, so far, have not been examined with sufficient thoroughness to enable many particulars to be given in regard to this basin.

In the Coastal Plain Basin to the west of the Darling Ranges artesian boring has, on the other hand, been carried on successfully for many years.

(iii.) *The Murray River Basin.* In August 1910 a report was issued by the Government Geologist of South Australia on the geology of the country south and east of the Murray River, with special reference to subterranean water supply in wells and bores along the Pinnaroo and Bordertown railways. The tertiary formation in the district under consideration occupies the western portion of a vast basin or depression, of which the greater part extends eastward into Victoria and northward into New South Wales. This basin is bounded on the west by the azoic and palæozoic rocks of the Mount Lofty and other ranges, extending northwards from near the mouth of the Murray to the Barrier Ranges, and on the east and north-east by the ranges of Victoria and New South Wales. This tertiary water-basin is occupied by a succession of sedimentary formations, both porous and impervious. It is of interest to note that the waters of the Murray River are partly supplied by influx from the water-bearing beds of this basin; this is proved by the fact that, at low water, springs are observed at certain places flowing into it from beneath the limestone cliffs from Pyap Bend downwards. Similar springs must exist along the courses of other branches of the River Murray system, where they cut through the tertiary formation.

(iv.) *Plutonic or Meteoric Waters.* In previous Year Books will be found the theory of Professor Gregory¹ as to the origin of the water in the Australian artesian basin, together with the objections held thereto by the Government Geologist of New South Wales.² (See Year Book No. 6, p. 570.)

(v.) *Particulars of Artesian and Sub-artesian Bores, 1916.* The following table gives particulars of artesian and sub-artesian bores in each State and in the Northern Territory up to the end of the year 1916:—

**COMMONWEALTH AND STATES.*—PARTICULARS OF ARTESIAN AND
SUB-ARTESIAN BORES, 1916.**

Particulars.	N.S.W.	Vict. ‡	Q'land. ‡	S. Aust.	W. Aust.	N. Ter. ‡	Total.
Bores existing ... No.	489	237	2,816	137	114	128	3,921
Total depth bored ... feet	871,080	69,783	2,791,471	96,380	119,804	52,294	4,000,812
Daily flow ... ,000 gals.	135,782	†	433,371	†	30,991	†	†
Depth at which artesian water was struck—							
Maximum ... feet	4,338	1,400	5,045	4,850	4,016	502	5,045
Minimum ... feet	89	150	10	233	175	110	10
Temperature of flow—							
Maximum ... ° Fahr.	148	†	210	208	140	†	211
Minimum ... ° Fahr.	70	†	81	82	60	†	60

* There are no artesian bores in Tasmania. † Not available. ‡ To 31st Dec., 1914.
§ To 31st Dec., 1915.

2. *New South Wales.*—(i.) *Artesian Water Supply.* The New South Wales portion of the great Australian basin, comprising approximately 70,000 square miles, is situated in the north-western portion of the State. Artesian boring in New South Wales dates from 1879, when a private bore was put down on the Kallara pastoral holding, between Bourke and Wilcannia. The first Government bore was that at Goonery, on the Bourke-Wanaaring road, completed in 1884.

1. See *J. W. Gregory, F.R.S., D.Sc.*: "The Dead Heart of Australia," London, John Murray, 1906; "The Flowing Wells of Central Australia," *Geogr. Journ.*, July and August, 1911.

2. *E. F. Pittman, A.R.S.M., formerly Government Geologist of New South Wales*: "Problems of the Artesian Water Supply of Australia, with special reference to Professor Gregory's Theory," (Clarke Memorial Lecture, delivered before the Royal Society of New South Wales, 31st October, 1907); "The Great Australian Artesian Basin," Sydney, 1914; "The Composition and Porosity of the Intake Beds of the Great Australian Artesian Basin," Sydney, 1915.

The following statement shows the extent of the work which has been successfully effected by the Government and by private owners up to 30th June, 1916 :—

Bores.	Flowing.	Pumping.	Total.	Total Depth.
For Public Watering-places, Artesian Wells, etc. ... / ...	124	31	155	318,261
For Country Towns Water Supply ...	3	—	3	4,354
For Improvement Leases ...	39	3	42	66,287
Total Government Bores ...	166	34	200	388,902
Private Bores ...	221	68	289	420,024

The average depth is 1,945 feet in the case of Government bores, and of private bores 1453 feet, and they range from 89 to 4338 feet. The two deepest wells in New South Wales are those at Boronga, in the County of Stapylton, with a depth of 4338 feet and a present outflow of 992,943 gallons; and at Dolgelly, in the Parish of Carcenga, in County Stapylton, with a depth of 4086 feet, and a present discharge of 577,930 gallons per day. The largest flow at the present time is that at the New Yarrawa bore, in the County of Benarba, which yields 1,062,133 gallons a day, and has a depth of 3590 feet.

Of the 539 bores which have been sunk, 387 are flowing, and give an aggregate discharge of 97,657,272 gallons per day; 102 bores give a pumping supply, the balance of 50 being failures; the total depth bored represents 871,080 feet.

The flow from seventy-two bores is utilised for supplying water for stock on holdings served in connection with Bore Water Trusts or Artesian Districts under the Water Act of 1912. The total flow from these bores amounts to 38,124,836 gallons per day, watering an area of 4,421,461 acres by means of 2702 miles of distributing drains. The average rating by the Bore Trusts to repay the capital cost, with four per cent. interest, in twenty-eight years, is 1.627d. per acre, including the cost of maintenance and administration.

In the majority of cases the remaining bores are used by pastoralists for stock watering purposes only, but in a few instances the supply is utilised in connection with country towns.

The watering of the north-western country by means of bore water has largely increased the carrying capacity of the land; and, what is of perhaps greater importance, it has made comparatively small pastoral settlement practicable in country previously confined almost entirely to the operations of companies holding immense areas.

It having been determined that multiplicity of bores is the chief factor governing the annual decrease in bore flows, and also that limiting the discharge from a bore will prolong its flowing life, action has been taken to prevent any waste by controlling the bore flow to actual requirements. It is confidently anticipated that this action will materially reduce the rate of decrease in the future.

(ii.) *Shallow Boring.* The scheme described fully in last year's report for assisting settlers by sinking shallow bores has met with considerable success.

Operations commenced with one plant only. The number has been increased gradually until twelve plants were at work, and steps have been taken to purchase additional plants.

A large number of applications from settlers wishing to take advantage of the liberal conditions offered under the regulations has been received, and further applications are coming to hand daily, so that even when the whole of the plants referred to are at work, they will probably be insufficient to cope with the demand. Out of sixty bores put in hand up to 30th June, 1916, one was abandoned owing to it being found impossible to recover lost tools, and seven others have proved failures. Of the remaining fifty-two bores completed, the cost to the settler has averaged about half the cost charged by private contractors, while in all the latter bores a small profit has been made after charging the settler the minimum cost.

There can be no question that the added value of the holdings represented by the bores already put down is considerably in excess of their cost, and as fairly conclusive evidence of this, it might be stated that in several instances the Government Savings Bank has, on completion of a bore, made the settler a sufficient advance to enable him to pay the total cost in cash.

In addition to the work carried out under the Shallow Boring Regulations outlined above, three plants are at present engaged in sinking bores on Crown lands in the Pilliga scrub for the Lands and Forestry Departments. The primary object of these bores is to supply water for sleeper-getters, but later on, when the required timber has been taken out of the scrub, it is proposed to throw open lands for settlement, when the bores referred to will be taken over by the incoming settlers. Under this scheme twelve bores have been completed, and three are in progress, making in all seventy-two sunk by the Commission, of which eight were failures.

The fact that of the bores put down in the Pilliga scrub, twelve are giving a flowing supply, adds much to their value, and is of special interest as indicating the possibility of tapping a small and hitherto unknown artesian basin.

Experiments at the State farms at Moree and Pera bores, in the use of artesian water for cultivation, have proved that the bore water can produce satisfactory crops for a considerable number of years. With a view to further demonstrating this in respect of large areas, a bore lined with wood-casing to resist corrosion, which is prevalent in this district, has been sunk at the Coonamble Experimental Farm, on a site where there is available a considerable quantity of soil typical of that occurring in the districts within the artesian area.

3. Victoria.—Victoria lies altogether outside the Great Australian Artesian Basin, and as water is generally available from surface or shallow underground supplies, there has not been much occasion for artesian boring. As early as 1880, however, an artesian well was bored at Sale, which gave a large supply of water of fair quality before it failed through corrosion of the casing. In 1905 a new bore was put down, which at a depth of 277 feet yielded sufficient water to fill Lake Guthridge, a local depression. But as the water was impure, and contained too much sulphuretted hydrogen, boring operations were continued to 520 feet, when the lowering of the casing shut off the supply of water. A further bore was then put down at some distance from the first, and this, at a depth of 238 feet, yielded a fresh and clear water supply of about 145,000 gallons per day. Corrosion troubles occurred here also, and at the end of 1912 a third bore was put down to a depth of 235 feet, artesian flows being struck at 187 feet and 235 feet. Towards the end of 1915 a flow of 200,000 gallons per day was struck at a depth of 125 feet on the Powerscourt Estate, near Maffra. Other bores are being put down in the locality.

Largely due to the failure of surface supplies in the drought of 1878 to 1886, not less than 499 bores were, before the end of 1888, put down by shire councils aided by the Government. The total depth bored was 40,000 feet; fresh water was struck in 78 instances; 47 yielded brackish but usable water; 229 were salt, while the balance were dry. The bores covered practically the whole of the settled portions of Northern and North-western Victoria and parts of Gippsland.

In the late eighties a number of bores were put down in the north-western part of the State, varying from 200 to over 2000 feet in depth, but without any notable success. In 1897 a Board reported on boring for artesian water supply in the Mallee country, but this report was adverse, except as regards the extreme northern portion thereof. In 1906 eight bores were put down on the Overnewton Estate, Maribyrnong, to depths varying from 147 to 272 feet; small supplies of good and medium water for stock purposes were obtained, but only one of the wells yielded water fit for domestic purposes. In 1908 boring was commenced in the Mallee country near the Border east of Pinnaroo in South Australia, and a line of bores from the Border to Kow Plains has proved the existence of a large sheet of underground water. Altogether, 87 bores have been successful in striking fresh water, and their depths vary from 155 to 752 feet, the water rising to within from 207 to 6 feet of the surface. In three instances the bores flow, the water rising from four to seventeen feet above the surface. The fresh water extends nearly as far east as the 142nd meridian, and its northern limit is approximately the 35th parallel. Information as to the geological formation of this district is given on page 513 preceding.

At the end of 1915 the number of existing Government bores in use in Victoria was 83, from which supplies are obtained by pumping. The total depth bored amounted to 39,783 feet, while the maximum and minimum depths at which water was struck were 1400 and 150 feet respectively. There are also about 140 existing private bores, with a total depth of about 30,000 feet.

4. **Queensland.**—A return relating to the 30th June, 1916, classifies the Queensland artesian bores under the following headings:—

QUEENSLAND ARTESIAN BORES, 30th JUNE, 1916.

Sunk by—	Artesian Flows.	Sub-Artesian or Pumped Supplies.	In Progress, Abandoned, or Uncertain.	Total.
Government	51	78	100	229
Local governing authorities	14	16	14	44
Private owners	1,047	808	688	2,543
Total	1,112	902	802	2,816

Of the 1112 flowing bores, 111 were of less than 10,000 gallons per day; 235 from 10,001 to 100,000 gallons; 459 from 100,001 to 500,000 gallons; 282 from 500,001 to 1,500,000 gallons; 20 from 1,500,001 to 2,000,000 gallons; and 5 from 2,000,001 gallons upwards. The deepest well was one known as Bimerah Run No. 3, White-wood, lying between the Barcoo and Thomson Rivers; this had a depth of 5045 feet, and was stated to yield 70,000 gallons daily. This flow is, of course, a comparatively small one, many wells yielding, when uncontrolled, from one to three million gallons a day. The waters of many of the wells have been analysed, and some found suitable for wool-scouring only, others are suitable for watering stock but not for irrigation, owing to the presence of alkali; others again serve for both stock and irrigation, while some, such as those containing sulphuretted hydrogen, are not of any use. Water fit for stock may generally be said to be "safe" for domestic purposes in spite of its slightly mineral taste. The wells yielding the mineral waters known as "Helidon Spa," "Boonah Spa," and "Junot Spa," which are much in use in Queensland and New South Wales, are shallow wells from 60 to 200 feet in depth.

The following table shews particulars as to Queensland bores at the end of June, 1916:—

QUEENSLAND ARTESIAN AND SUB-ARTESIAN BORES, 30th JUNE, 1916.

Particulars.	State and Local Authorities.	Private.	Total.
Bores existing No.	273	2,543	2,816
Total depth bored feet	224,520	2,566,951	2,791,471
Daily flow gallons	29,436,270	404,435,190	433,871,460
Depth at which artesian water was struck—			
Maximum feet	4,256	5,045	...
Minimum "	354	10	...
Temperature of flow—			
Maximum °Fahr.	198	210	...
Minimum °Fahr.	85	81	...

5. **South Australia.**—There were in South Australia 137 bores existing at 31st December, 1916, of which 33 were artesian and 104 sub-artesian. There are 107 under 1000 feet in depth, 19 from 1000 to 2000 feet; five from 2000 to 3000 feet; four from 3000 to 4000 feet, and two over 4000 feet. The deepest flowing bore was at Goyder's Lagoon, on the Hergott to Birdsville route, measuring 4850 feet, and yielding 600,000 gallons per day. A bore at Patchawarra, 35 miles north of Innamincka, has been sunk to a depth of 5458 feet, where operations have been stopped for the present. Water was struck in this bore at various depths down to 4000 feet. At that depth the water rose and ran over the surface at the rate of 400 gallons daily. Further sinking was carried on in the hope of getting a better supply, but, so far, without success. The maximum flow, viz., 1,250,000 gallons, is obtained at Coonie Creek, east of Lake Frome.

The following table shews particulars as to South Australian bores at the end of December 1916:—

SOUTH AUSTRALIAN BORES, 1916.

Particulars.	Artesian and Sub-artesian.
Bores existing	137
Total depth bored feet	96,380
Daily flow gals.	*
Depth at which water was struck—	
Maximum feet	4,850
Minimum feet	233
Temperature of flow—	
Maximum °Fahr.	208
Minimum °Fahr.	82
Total cost of construction of bores up to end of year ...	£250,065
Expenditure during year on boring operations ...	£18,704

* Not available.

(i.) *Bores between the Murray and the Eastern boundary of the State.* The sinking of bores across the Ninety-mile Desert between the Murray and the Victorian boundary was commenced in 1886 at Coonalpyn; with the exception, however, of salt water at 55 ft., none was reported to have been struck. Ki Ki bore was sunk in 1887, and at 361 ft. a good supply of water fit for stock was struck. Tintinarra bore was sunk in 1887; it was artesian when first tapped. The water was found to be fit for locomotive engines and is still used for that purpose. The bore at Emu Flat was also sunk in 1887. In 1904 a bore was sunk at Cotton, and numerous successful bores have since been put down by the Public Works Department, and subsequently by residents of the district.

The water rises to a distance from the surface of from 15 to 320 feet, and the maximum quantity obtained per diem is 48,000 gallons at the Gosden bore. Several wells, ranging in depth from 55 to 221 feet, have also been sunk in this district. The latest Government bores are Kumara in the Hundred of Kingsford, and Perponda in the Hundred of Vincent. The former has a depth of 240 feet, and the water, which is in large supply, rises to within about 96 feet of the surface. The latter is 300 feet in depth, and the water rises to within 56 feet of the surface. The water is fresh, containing about $\frac{3}{4}$ oz. salts and other solid matter per gallon.

(ii.) *Bores West of Oodnadatta.* A series of bores has been sunk, beginning with Breaden bore, 20 miles west of Oodnadatta, which was put down in 1911. The others since put down in this district are Gypsum, Imbitcha, Mirackina, Raspberry Creek, Appreetinna and Wintinna. Of these the only artesian supply is Raspberry Creek, where 1,000,000 gallons per day of good water is obtained. The depths of these bores range from 280 feet at Mirackina to 1122 feet at Breaden, and the water from all of them is good.

(iii.) *Other New Bores.* A new bore was sunk at Cannuwankaninna in the Hergott to Birdsville route. A large supply of good water was obtained, flowing over the surface at the rate of 570,000 gallons per day. Another bore was sunk east of Lake Frome, which has been named Dewdney. A supply was struck at 972 feet. The water, which is of good quality, is rather poor in supply.

(iv.) *Eyre Peninsula.* From time to time bores have been sunk on Eyre Peninsula, but with little success. In some instances, stock water ($1\frac{1}{2}$ ozs. salts to the gallon) was obtained, but this only occurred on the Nullabor plains. In all other cases the water struck was far too salt to be used. Consequently the supply of water is now principally from catchments. A number of reservoirs have been constructed to hold from 1,000,000 to 9,000,000 gallons each. Many underground tanks have been built to contain from 40,000 up to 500,000 gallons each.

6. *Western Australia.*—The work by which the Government of Western Australia provides a permanent supply of water to Kalgoorlie, Boulder and adjacent districts on the eastern goldfields comes properly under the heading of "Water Supply Works." A description of the undertaking is fully given in previous issues of the Year Book. (See No. 6, p. 576.)

In August 1912 the administration of the Goldfields Water Supply and of the Mines Water Supply was transferred to a newly established Water Supply, Sewerage and Drainage Department. The statistics in connection with this department will be found in the section of this book dealing with *Local Government*.

The following table shews particulars as to Western Australian artesian bores at 30th June, 1916:—

WESTERN AUSTRALIAN ARTESIAN BORES, 30th JUNE, 1916.

Particulars.	State.	Private.	Total.
Bores existing	65	49	114
Total depth feet	79,860	39,944	119,804
Daily flow gals.	22,784,700	8,206,700	30,991,400
Depth at which artesian water was struck—			
Maximum feet	4,016	*	...
Minimum feet	175	*	...
Temperature of flow—			
Maximum °Fahr.	140	*	...
Minimum °Fahr.	60	*	...

* Not available.

To 30th June, 1915, the total number of Government bores was 65, and there were approximately 49 private bores recorded in addition. The total cost of construction of State bores to 30th June, 1916, was about £137,874, of which amount £146 was expended during the twelve months ended 30th June, 1916. The maximum outflow, 4,000,000 gallons per day, was obtained at Leederville in connection with the Metropolitan Water Supply at 2097 feet.

The boring operations which have been carried out in the artesian basins along the West Australian Coast, are as follows:—

(i.) *The Coastal Plain Basin or Perth Area*, which, generally speaking, extends from Cape Leeuwin to Dongarra, and from which the Metropolitan Water Supply is largely drawn, yields a supply of water mostly fresh and suitable for domestic purposes, though towards the north it becomes brackish and is only suitable for stock.

There are fifty-seven bores in the Metropolitan District, several of which have been put down to augment the hills supply, and the domestic supply of the suburbs and of Fremantle is largely dependent upon this source.

(ii.) *The North-west Basin or Carnarvon Area* may be said to extend from Gantheaume Bay in the south to Onslow in the north, and embraces a very large tract of ideal sheep country.

Many private bores have been put down on sites which permit of the gravitation of the water for miles, and, by this means, a very considerable area has been put under stock. Some remarkable flows have been obtained and, in one case, at a depth of 300 feet a flow reputed to be 3,000,000 gallons per day was struck, the water being suitable for stock.

In all, some 27 bores have been put down.

(iii.) *The Gulf Basin or Broome Area*. So far very little development work has been done. Artesian bores have been put down in the town site, and the domestic requirements of the town are entirely supplied from this source.

The area extends from Condon in the south-west to the Meda River beyond Derby in the north, and for a considerable distance inland.

So far only five bores have been sunk, two being at Broome and two at Derby, and the other on the telegraph line on the road between Derby and Hall's Creek, about 67 miles inland.

(iv.) *Eucla Area*. This area extends from Eucla on the South Australian border, west of Israelite Bay. So far, beyond the bores put down on the survey line of the Trans-Australian Railway, very little has been done in proving the resources of this area.

In 1902 the first bore was sunk, about 35 miles north of Madura, and sub-artesian water struck at 430 feet, at an elevation of 400 feet above sea level.

Following upon this, a deep bore was put down at Madura, below the cliffs and nearer the coast, when an artesian supply of stock water was obtained at a depth of 2101 feet, yielding 31,000 gallons per day.

This was followed later with about 20 bores along the survey line of the proposed railway, which runs east and west about 90 miles inland. These bores were put in at intervals between the 205 mile peg and the South Australian border, and ranged in depth between 323 and 1344 feet. In most instances only stock water was struck in these bores, at depths varying between 300 and 1300 feet, and the largest estimated supply was about 10,000 gallons per day.

7. Northern Territory.—In the Northern Territory, bores to the number of 128 have been put down, 25 belonging to the Commonwealth Government. The cost of construction of the Government bores to 31st December, 1914, was £6254.

The following table gives further particulars of the Northern Territory bores at 31st December, 1914, the latest date for which information is available:—

NORTHERN TERRITORY BORES, 1914.

Particulars.	State.	Private.	Total.
Bores existing	25	103	128
Total depth bored feet	17,600	34,694	52,294
Daily flow	*	*	*
Depth at which water was struck—			
Maximum feet	213	502	...
Minimum feet	110	128	...
Temperature of flow—			
Maximum	*	*	...
Minimum	*	*	...

* Not available.

§ 2. Irrigation Plants.

1. **General.**—Australia's first experiments in irrigation were made with the object of bringing under cultivation areas in which an inadequate rainfall rendered agricultural and even pastoral occupations precarious and intermittent, and, although these original settlements have for the most part proved fairly successful, most of the States, instead of promoting new settlements in unoccupied regions, are adopting the policy of making existing settlement closer, by repurchasing big estates and large farms, subdividing them into holdings of suitable sizes for cultivation, and selling the land upon easy terms of payment. It is in connection with this Closer Settlement policy that the special value of irrigation is recognised.

2. **New South Wales.**—(i.) *Water Conservation and Irrigation.* The provision of an adequate water supply for other than domestic purposes is essential to the well-being of all primary industries, and particularly in a country which is liable to dry seasons which affect extensive areas. Much of the area of the State receives an adequate and regular rainfall, but there is a considerable extent of country where all the factors exist which are requisite to success in agricultural pursuits except a constant water supply. The recognition of the fact that the area suitable for cultivation might be extended largely by a comprehensive system of water conservation and irrigation has led the State to undertake various detached works and schemes, which will constitute portion of the ultimate irrigation system necessary to serve the whole State.

Water conservation and irrigation works within the State of New South Wales are under the control of the Water Conservation and Irrigation Commission, which consists of the Minister for Agriculture for the time being as Chairman, and two other Commissioners. The works controlled by the Commission include the great Murrumbidgee Irrigation Scheme, small irrigation settlements at Hay and Wentworth, natural works of water conservation, shallow boring for settlers, water trusts and artesian bore trusts operating under the Water Act, and also the control of storages and diversions of water by private persons for the purposes of water conservation and irrigation.

(ii.) *Murrumbidgee Irrigation Scheme.* The main features of the scheme include a storage dam across the Murrumbidgee to retain the floodwaters, which will be released for use lower down the river during the dry summer months; a movable diversion weir, about 240 miles below the dam, to turn the required amount of water from the river into

the main canal; a main canal, leaving the river near the weir; two main branch canals; and a series of subsidiary canals and distributing channels through the area to be irrigated; bridges, checks, regulators and other structures throughout the entire system, and meters for measuring the volume allowed to each farm; townships and roadways to serve each farm, and a general surface drainage system are also included in this scheme.

The site of the storage dam is at Burrinjuck, three miles below the confluence of the Murrumbidgee and Goodradigbee Rivers. The dam wall is being constructed of cyclopean masonry and concrete, and when completed will have a maximum height of 240 feet, and will impound the waters in a lake covering 12,740 acres. Ample water is being stored to meet the requirements of the farms already occupied, and to allow of water being drained off during the summer months to augment the natural flow of the river for the benefit of riparian holders down stream. The reservoir will have a capacity of 33,612 million cubic feet, or 771,641 acre feet, the catchment area being about 5000 square miles, drained by three principal streams—the Murrumbidgee, Goodradigbee, and Yass Rivers—up which the water will be backed, when the dam is full, to distances of 41 miles, 15 miles, and 22 miles respectively. Direct communication between Burrinjuck and the Main Southern railway has been provided by the construction of a 2-foot gauge line from Goondah, a distance of 26 miles.

The diversion weir is situated at Berembé, about 40 miles by river and 19 miles in a direct line above the town of Narrandera. It is founded on a solid granite bar extending across the river, and has a length over all of 270 feet between abutments, divided into a sluiceway 40 feet wide in the clear; a lock chamber, 40 feet wide, capable of taking barges up to 100 feet in length; and 55 channeine wickets, manipulated from a punt moored up-stream. During the winter freshets the wickets are lowered, thus affording a clear water-way in the river channel.

The main canal branches from the river just above the weir, and, after passing through Narrandera, continues in a north-westerly direction, skirting the hills abutting on the plains. A scheme for enlarging the main canal to double its present capacity (1000 cubic feet per second) has been recommended by the Public Works Committee. There are two main branch canals, viz., the Gogeldrie canal, which offtakes at 47 miles from Berembé, and runs approximately parallel to the Narrandera-Hay railway through the Yanco area, and the Mirrool branch canal, which offtakes at 78 miles from Berembé and supplies portion of the Mirrool area.

The scheme, as described above, applies only to the land on the northern side of the Murrumbidgee River. It was originally intended to provide a canal to supply the land on the southern side, but subsequently it was decided to apply all the water available from the Burrinjuck Dam to the northern areas, sufficient land suitable for irrigation being there available, which, it is anticipated, will be worked profitably in small blocks devoted to mixed farming, dairying, and stock raising, or fruit and vegetable growing, etc. When the areas are fully settled it is estimated that there will be nearly 6000 farms and 100,000 people. With the aid of irrigation the soil and climate of these areas are suitable for the production of apricots, peaches, nectarines, prunes, pears, plums, almonds, melons, cantaloups, and citrus fruits, also wine and table grapes, raisins, sultanas, figs, olives, and most varieties of vegetables and fodder crops. Dairying, and pig-raising are already being successfully undertaken by settlers in the areas.

The first area made available for settlement was in the vicinity of Yanco Siding on the Hay railway line. The second, which is situated on the northern side of the Mirrool Creek, is served by an extension of the railway from Barellan to Griffith.

Further areas are being thrown open for settlement as the construction works are completed. Farms varying in size from 2 acres to 200 acres have been made available. The "water right" or number of "acre feet" of water allotted to each holding is specified when the holding is notified as available for application. An "acre foot" of water means such a quantity, 12 inches deep, as would cover an area of one acre. The cost of water is five shillings per acre foot. The charge for water is reduced during the early years. For the first year the charge is 2s. 6d. per acre foot, thereafter increased annually by sixpence per acre foot until in the sixth and following years the full rate of five shillings becomes payable. The 50 acre farm is the largest "all-irrigable" unit, but to suit the requirements of dairymen and other stock farmers, blocks of larger areas are being made available. These comprise non-irrigable or "dry" areas, in addition to the irrigable portion. Some of these mixed farms are 200 acres or upwards in extent, but the maximum water right allowed in respect of any of these larger farms is 80 acre feet.

The conditions for the disposal of irrigation blocks are contained in the Crown Lands Consolidation Act of 1913, and Amending Acts. Any person of or over the age of 16 years, if a male, or 18 years if a female (other than a married woman not living apart from her husband under decree of judicial separation), or two or more such persons jointly, may apply for a farm or block. A married woman, not judicially separated from her husband, may, however, if she be not subject to any other statutory disqualification: (a) acquire by way of transfer, with the consent of the Minister, out of her own moneys, a lease within an irrigation area; (b) continue to hold a lease which she held before her marriage; (c) hold a lease which may devolve on her by will or intestacy of a deceased person. The tenure is perpetual leasehold.

The improvement conditions attached to the farm holdings include fencing, planting of trees for windbreaks, construction of dwellings, destruction of noxious plants, and the cultivation of a specified area in each year.

The special reservation of a number of farms for application by returned soldiers is in contemplation. As a preliminary measure a camp has been established on the Mirrool Subdivision, at which it is proposed to employ returned soldiers in the first instance, and thus afford the men an opportunity of gaining an insight into the climatic and other conditions connected with irrigation farming. It is proposed that accepted applicants for this camp shall receive a weekly payment exclusive of their keep, and while in camp they will clear, fence and grade the land, which will ultimately be made available to them for application as irrigation farms. Barracks have been provided, and a Camp Manager will have direct control thereof.

Subject to such conditions as to security and terms of repayment as the Commission may think fit to impose, settlers may obtain an advance, or have payment of rent or water rate suspended. Such advances are limited to the total amount of funds made available by Parliament for this purpose.

The Government Savings Bank Commissioners have statutory power to make loans upon mortgage of irrigation farm leases, and many settlers have already obtained help from the Bank. Concessions in railway fares and freights are made on New South Wales railways to *bona fide* applicants for land. The annual charge for water (5s. per acre foot), is reduced to one-half for the first year, and is then increased yearly by sixpence per acre foot, so that a settler is not required to pay the full charge until he is in the sixth year of occupation.

Towns and villages have been established at centres of the Yanco and Mirrool irrigation areas; the Commissioner is empowered to construct streets, and to provide water supply, sanitary and other services.

A thoroughly up-to-date butter factory is in operation at Leeton; the output at the end of 1916 reached $3\frac{1}{2}$ tons per week. The factory also supplies ice to town residents and settlers. A vegetable and fruit canning factory has also been provided, at which vegetables and fruits grown by the settlers are purchased from them. The output is increasing rapidly. A bacon factory and abattoirs have also been erected, at which pigs from the settlement and a considerable number from districts in the Riverina outside the irrigation areas are treated, and where all stock for butchers is slaughtered for local consumption.

To assist settlers on the Mirrool area, which is situated over 30 miles from Leeton, a small cheese factory has been opened at Griffith. A good marketable cheese is being produced. As an adjunct to the canning factory, a pulping plant has also been installed at Griffith.

One of the most important departmental undertakings on the irrigation areas is undoubtedly the State Nursery. For some years past the Leeton Nursery has been supplying trees to settlers, and this year a second nursery is being established at Griffith. Every effort is made to supply only the very best trees, free from disease, and to ensure this, as much use as possible is being made of budding wood from proven trees in the Leeton Nursery, and at the Yanco Experiment Farm.

The Department of Agriculture which controls the Yanco Experiment Farm has also established at Griffith (Mirrool irrigation area), a Viticultural Nursery for the propagation of vines on phylloxera resistant stocks. These stocks are intended not only for the supply of settlers on the areas, but for vigneron in all parts of the State.

An electric power station has been erected near Yanco Siding; electric light and power are supplied to the various factories, business people, and residents of Leeton and Yanco, and the supply is also available for settlers when the number of applicants in any centre warrants the connections being made.

On the 31st December, 1916, 890 farms were held, representing a total area of 40,174 acres.

In addition, 113 township and village blocks are held under lease. In the matter of cultivation, the following particulars indicate the extent of the work performed by the settlers:—1883 acres under stone fruits, 564 under vines, 694 under citrus fruits, and 16,347 under other fodder crops. The estimated population of the irrigation area is about 5000 persons.

(iii.) *Other Irrigation Settlements.* Irrigation settlements have been established at Hay and at Curlwaa near Wentworth, and these were in 1913 placed under the control of the Water Conservation and Irrigation Commission.

(a) *Curlwaa Irrigation Area.* The Curlwaa irrigation area embraces 10,600 acres, of which 1364 acres have been subdivided into irrigable blocks, 1356 acres being held under lease by 67 settlers. The total number of non-irrigated blocks is seventy-four, comprising 6879 acres. Of these, thirty-three blocks, representing 3846 acres, were in occupation on the 30th June, 1916. An area of 1290 acres has been reserved as a common. During 1915-16 approximately 1200 acres were under cultivation, the greater part being devoted to fruit, including oranges, peaches, nectarines, pears, grapes, sultanas and currants. It has been proved beyond doubt that the Curlwaa soil is eminently suited to the growth of citrus fruit, and some of the finest oranges grown in New South Wales are produced on this area.

The estimated weight of dried fruits produced on the Curlwaa Area is as follows:—

Dried Fruits.	1912-13.	1913-14.	1914-15.	1915-16.
	cwt.	cwt.	cwt.	cwt.
Apricots	127½	260	130	188½
Nectarines	11½	16	3½	8½
Pears	8	43	138½	72½
Peaches	517½	768	653½	505
Lexias	520	568½	313	620½
Currants	1,454	1,539½	532½	1,455½
Sultanas	1,462½	1,772½	1,406½	2,323
Elemes	146	150	...	780½
Total	4,247	5,117½	3,178	5,954½

The value of the dried fruit production for the twelve months ending 30th June, 1916, is estimated at not less than £18,000.

The pumping machinery consists of a suction-gas plant, supplying two engines of about 55 brake horse-power each, working two centrifugal pumps, with an average combined capacity of about 4600 gallons per minute. With eight pumpings during the 1915-16 season, 122,140,500 cubic feet of water were supplied. The length of the main channels is about 4 miles 24 chains, and of subsidiary channels 4 miles 31 chains; total length, 8 miles 55 chains. The land may be leased for periods not exceeding thirty years, the annual rent at present varying from 1s. to 10s. per acre. The rate for water is fixed from time to time by the Commission, and is at present, except in a few special cases, 20s. per acre per annum. Each lessee is entitled to receive a quantity of water equivalent to a depth of 30 inches per annum, limited to 4 inches in any one month.

(b) *Hay Irrigation Area.* The Hay irrigation area consists of about 3842 acres, and previous to 1913 was controlled by a Trust appointed in 1897. The area held and used for irrigation purposes is 989 acres by 81 holders. The lands may be leased for periods not exceeding ninety-nine years, at rentals varying from 5s. to 10s. per acre; the water rate is fixed from time to time, and at present it is £1 per acre per annum. The pumping machinery is similar to that at Wentworth, the capacity of the pumps being 4000 gallons per minute. During 1915-16 season 121,830,992 cubic feet of water were supplied. Dairying is the principal industry; the cultivation of fruit is very limited.

(iv.) *Water Rights.* The Water Act 1912 consolidates the Acts relating to Water Rights, Water and Drainage, Drainage Promotion and Artesian Wells. Part II. of the Act vests in the Crown the right to the use, flow and control of the water in all rivers and lakes which flow through or past, or are situate within the land of two or more occupiers. It abolishes "riparian rights," and establishes a system of licenses for works of water conservation, irrigation, and drainage. Prior to the passing of the Act relating to Water Rights, such works on creeks and rivers, constructed by private individuals, were liable to destruction by any person who considered their existence opposed to his interests. It is now illegal to interfere with any work for which a license has been granted. The security provided is stimulating the construction of irrigation works of a better class throughout the State, and during the year ended 31st December, 1916, 219 applications were made for new licenses, and 93 for the renewal of existing licenses. At the date mentioned, 1090 licenses were in force.

(v.) *Water Trusts and Bore Trusts.* Part III. of the Water Act 1912 provides for the supply of water either for irrigation, stock, or domestic purposes, and for drainage, the liabilities on which are repaid to the Crown, with interest spread over a period of years, and the works are administered by trustees appointed from among the beneficiaries under the Act. For the supply of water, trusts have been constituted in connection with (a) seventy-six artesian wells; (b) seven schemes for the improvement of natural off-takes of effluent channels, for the purpose of diverting supplies from the main rivers; (c) in four instances for the construction of weirs across stream channels; and (d) two pumping schemes, one from natural watercourses, and one from a well. The total area included within these trusts amounts to 5,812,216 acres.

(vi.) *Projected Irrigation Schemes.* The Water Conservation and Irrigation Commission are investigating schemes for storing water for the purpose of irrigation on the Darling, Lachlan, Macquarie, Hunter, Namoi, Peel and Warragamba Rivers, and descriptions of these proposed schemes have been furnished in the last issue of this book (Year Book No. 9, p. 532).

3. *Victoria.*—(i.) *Classification of Works.* The Water Conservation Works in Victoria divide themselves into irrigation works proper, and those providing mainly a domestic supply, such as the works for the supply of Melbourne, controlled by the Melbourne and Metropolitan Board of Works; the Coliban, Wonthaggi, Broken River, Kerang Lakes, and Mallee Supply Works, administered by the State Rivers and Water Supply Commission, and other works for domestic supply controlled by Water Works Trusts or Municipal Corporations. With the exception of the works administered by the Commission, particulars as to these works will be found in the section on "Local Government" of this book.

(ii.) *Works Controlled by the Commission.* With the exception of the First Mildura Irrigation and Water Supply Trust, all the irrigation schemes and the more important domestic and stock water-supply works in rural districts are vested in and controlled by the State Rivers and Water Supply Commission, a body composed of three members, which was created by the Water Act 1905, now incorporated in the Water Act 1915.

(a) *Irrigation Schemes.* This division comprises the schemes constructed and under construction for the supply of water to some seventeen irrigation districts. Up to 1906 these schemes were controlled by local Trusts, which had obtained the moneys for their construction on loans from the State. By the Water Act 1905 all local control was abolished except in the case of Mildura, and the districts were transferred to the State Rivers and Water Supply Commission. Since that date the Government has adopted a vigorous irrigation policy, and the capital expenditure at 30th June, 1915, on water supply in the irrigation and water supply districts under the control of the Commission, and at Mildura, was £3,800,000. The irrigation works draw their supplies mainly from headworks constructed on the Murray, Goulburn, and Loddon rivers. The cost of these headworks, which now stands at £1,122,000, is not debited to any particular districts, but is borne by the State. The extent of land under irrigated culture, for all kinds of crop, is 288,000 acres, an increase of 33,000 acres over the average area irrigated in the previous five years. Within the last seven years the State has adopted the policy of purchasing large areas of land commanded by these schemes and subdividing them for intensive culture. Settlement of this kind largely increases the population of the State. The management and supervision of these areas were formerly vested in two bodies—the Closer Settlement Board and the Water Supply Commission, but in order to do away with this dual control, the Amending Closer Settlement Act of 1912 (now incorporated in the Closer Settlement Act 1915) was passed, transferring to the Water Supply Commission the entire management, leasing, and general supervision of all such areas within irrigation districts.

(b) *Domestic and Stock Schemes.* The second division takes into account the schemes constructed and under construction for the supply of water for domestic and stock purposes, the capital expenditure on which at 30th June, 1916, was £4,822,000. The area of country lands artificially supplied with water for these purposes is nearly 21,000 square miles. The number of towns supplied, exclusive of the City of Melbourne and its suburbs, is 154, serving an estimated population of 292,000. The principal works of this division are situated in the Wimmera and Mallee districts, and cover an area of over 12,000 square miles. In addition to the Commission's districts, some large areas are still administered by local authorities.

Mildura. The creation of an irrigation Colony at Mildura was the outcome of a visit by Mr. Deakin to California in 1885, when Messrs. Chaffey Bros. were invited to visit Victoria, with the object of founding a similar settlement to those which they had been largely instrumental in establishing in California.

Active operations were commenced in 1887, since which date marvellous progress has been made, instanced in the fact that, originally used as a sheep run and carrying one sheep to every three acres, the dried fruit harvested from 12,000 acres in 1916 was valued at £683,000 gross.

Water is pumped and supplied under Act of Parliament by the first Mildura Irrigation Trust from the river Murray by two pumping stations, viz. :—(1) into a billabong, and thence to pumps lifting to various levels, and (2) to a comparatively small area adjacent to the town.

The length of the Trust's main and subsidiary channels is 280 miles. For the year ending 30th June, 1916, the Trust's receipts aggregated £32,944, and its expenditure £30,648. For the same period the number of water acres supplied was 41,405.

Loans (balance) advanced to the Trust by the Government for the purpose of improving the plants and channels, etc., amounted at 30th June, 1916, to £71,738, exclusive of the sum of £11,382 (balance) arrears of interest.

The area of the settlement is 45,000 acres, of which 12,000 acres are under intense culture, vines predominating.

4. *Queensland.*—The main irrigation works in Queensland are as follow :—(a) those at Ayr, which utilise the waters of the Burdekin River, and shallow wells on its banks; (b) those at Bingera, near Bundaberg, which utilise water pumped from the Burnett River just above the point of meeting of the salt and fresh waters, and (c) those at Fairymead, which utilise water pumped from a number of shallow spear wells sunk on the alluvial flats on the north side of the Burnett River and about six miles from Bundaberg. There were 741 irrigators in the State in 1916, chiefly farmers and graziers, and the area irrigated was 10,886 acres.

5. *South Australia.*—(i.) *The Renmark Irrigation Trust.* The Renmark Irrigation Trust was established in 1893 on similar lines to Mildura, but on a smaller scale. The area of settlement is 21,000 acres, and the area under irrigation 5270 acres. The dried fruit pack for 1916 was 2650 tons, green fruit 1300 tons, and the gross value of the production for that year was £153,000. The population of the town and settlement is 3000. The chief products are sultanas, currants, raisins, oranges, apricots, peaches, pears and olive oil.

(ii.) *Other Waterworks.* A number of country water works are under the control of the Public Works Department. As, however, they are not irrigation works properly so called, but are used for supplying water for domestic purposes, etc., to several towns, no further reference will be made to them in this chapter. (See Section XXVI., *Local Government.*)

(iii.) *Area under Irrigation.* Until 1910, irrigation in South Australia, with the exception of the schemes already mentioned, made little, if any, progress; but in that year an Irrigation and Reclamation Works Department was created, since when the preparation of land for irrigation settlements has been vigorously pursued.

The functions of the Department cover (a) the reclamation of the swamp lands along the lower reaches of the Murray, which are watered by gravitation, and (b) the preparation of the sandy loam highlands for intense culture, the water, after being pumped from the river, being distributed by concrete channels. A number of the small settlements along the river originally established as Village settlements, were taken over by the Department, and the areas available for reticulation extended and offered for occupation. These include Waikerie, with an irrigable area of 2515 acres, in addition to 4372 acres of "dry" land; Kingston with 415 acres of irrigable and 3096 of "dry" land; and Moorook, now in course of extension; 2950 acres are available at this settlement, of which 1200 acres will be irrigated. The new areas commenced by the Department are Berri, where 3043 acres of irrigable land and 2364 acres of "dry" land have been allotted to 160 settlers. Further pumping plants have been installed, which will enable this settlement to be extended to 9000 acres of irrigable land and 11,000 acres of "dry" land. The adjoining area of Cobdogla, the preparatory survey of which has been completed, contains approximately 30,000 acres of first-class land suitable for intense culture, in addition to 11,000 acres of "dry" land. The first section of this area, comprising about 2000 acres, which can be watered from a lift of about 20 feet, will soon be available for allotment. When completed, this settlement will be supplied from four distinct pumping plants, two on the River Murray at different points, and two on Lake Bonney at the north and south ends respectively. This lake is fed from the river by means of Chambers' Creek, and comprised an area of 4000 acres. At Cadell an area 2700 acres has been acquired, 1200 acres of which is first-class irrigable land; this will be prepared and offered for settlement by the Department. The reclaimed swamps, which have already been completed and allotted, comprise 1930 acres, while other swamp lands of about 1200 acres are in course of reclamation.

A recent innovation has been the preparation of joint schemes of reclaimed and irrigable land, the swamps being reclaimed and the adjoining sandy loam highlands channelled, thus enabling the adoption of dairying, fodder growing, and stock raising in conjunction with horticulture. The areas comprise, Mypolonga, 1700 acres of reclaimed land, 1254 acres of irrigable, and 1481 acres of "dry" land; Wall, 619 acres of reclaimed land, 160 acres of irrigable and 208 acres of "dry" land; Pompoota, 560 acres reclaimed land, 250 acres irrigable land, and 3277 acres of "dry" land; Jervois, 990 acres of reclaimed land, 290 acres of irrigable land, and 260 acres of "dry" land; Swanport, 116 acres of reclaimed and a similar area of irrigable land; Neeta, 560 acres reclaimed, 1320 acres irrigable, and 2348 acres of "dry" land. Mypolonga and Wall have been allotted, the latter to returned soldiers, and Pompoota is being utilised as a training farm for returned soldiers. The other areas have yet to be allotted for settlement. The reclaimed lands consist of peaty soils composed of rich river silt, and are eminently suited for the growth of lucerne and other fodders, onions, potatoes, etc. The soils of the irrigable lands have already proved their suitability for the production of peaches, apricots, nectarines, oranges, lemons, figs, and grapes.

All lands are allotted under perpetual lease, and blocks are surveyed into areas varying up to 50 acres of irrigable or reclaimed land. No lessee is permitted to hold more than 50 acres of irrigable or reclaimed land or of both irrigable and reclaimed;

except that in the case of a partnership 50 acres may be allotted for each member of the partnership up to a maximum of 150 acres. In addition, areas of non-irrigable land are allotted to lessees of irrigation and reclaimed blocks for dry farming. The rentals of the blocks are fixed by the Land Board immediately prior to the land being offered for application. For the reclaimed land an amount is charged sufficient to cover interest on cost of land and reclamation, while for the irrigable land the rent is based on the unimproved value of Crown lands, or to cover interest on cost of repurchased lands.

On the irrigable land, the water rate has been fixed at 30s. per acre per annum for the first four years, after which an amount will be charged sufficient to cover actual cost of supplying water, and interest on pumping plant, channels, etc. On the reclaimed lands an amount is charged to meet annual management, drainage, and maintenance expenses. A sliding scale covers the rent on all land, and water rates on the irrigable land for the first four years, *i.e.*—first year, one quarter of the rent and water rate; second year, one-half; third, three-quarters; fourth and afterwards, full amount per acre. On the irrigable lands, each lessee is entitled for the water rate to 24 acre-inches per annum, supplied in six irrigations; special irrigations and domestic supplies are supplied at times other than during the general irrigations, at a nominal cost. On the reclaimed lands, water is supplied regularly by reticulation from the river.

The Department assists settlers by fencing, clearing, grading and constructing irrigation channels and tanks. Such improvements are undertaken up to a value not exceeding £15 per acre of the irrigable area in each lessee's block, but before the work is commenced a deposit must be paid equal to 15% of the Department's estimated value of such improvements. The total cost of the work, less deposit, is treated as a loan to the lessee, and is repayable in twenty equal annual instalments after the expiration of five years, or at any shorter period if desired by the lessee; current rate of interest being charged. Any lessee is permitted to accept the contract for carrying out his own improvements according to the specifications and estimates of the Department, up to the maximum amount per acre, as mentioned above. Advances can be obtained from the Advances to Settlers Board for the purchase of stock, discharging mortgages, erecting permanent buildings, and other improvements, the first £400 being advanced on the fair estimated aggregate value of the settler's lease, and any improvements already made on the holding, and those in course of being made thereon. Any loan beyond £400 would not exceed 15s. in the £ of the fair estimated value of the improvements already made.

In the section dealing with Closer Settlement (page 265) the subject of irrigation areas in South Australia has already been referred to.

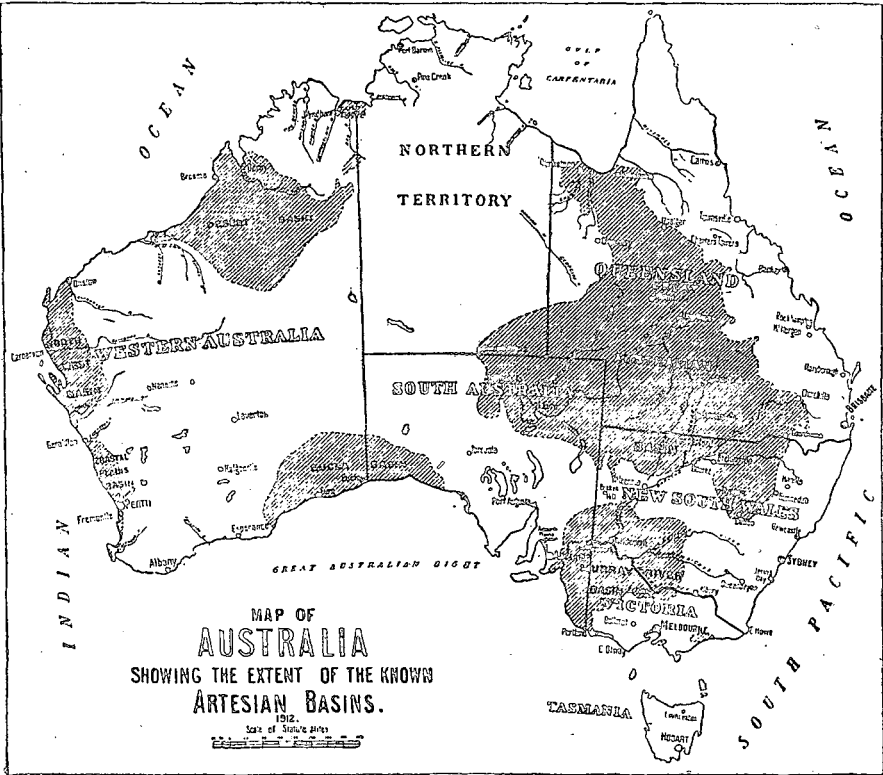
6. Western Australia.—An Irrigation Act has been brought into force providing for the constitution of irrigation districts. At Harvey the works for irrigating about 4000 acres devoted to fruit growing, principally oranges, were completed, and formally opened on the 21st June, 1916. A scheme is now in preparation for irrigating a further area of about 4600 acres in the same district.

Numerous small private irrigation schemes are in full operation on many of the south-west rivers in connection with fruit, fodder, and potato growing.

7. Murray Waters.—The negotiations which took place prior to the passing of the River Murray Waters Act as to the relative State rights of New South Wales, Victoria and South Australia to the waters, are given in detail in previous issues of this book. (Year Book No. 9, page 537.)

On the 31st January, 1917, the River Murray Waters Act was brought into operation. The principal provisions of this Act are that a storage of one million acre feet is to be created by the construction of a dam on the Upper Murray above Albury. This work is to be constructed by New South Wales and Victoria conjointly. A joint investigation has been in progress by the two States interested for some years past, with a view to determining the most suitable site for the construction of this large work, but although a number of sites have been tested, no determination has yet been arrived at.

MAP SHEWING THE POSITION AND EXTENT OF THE "AUSTRALIAN
ARTESIAN BASINS."



This map was prepared by the Interstate Conference on Artesian Water, held in Sydney during May, 1912. It contains the latest facts relative to the various artesian basins of the Australian continent. Of these basins the most important is the Great Australian Basin, which is about 569,000 square miles in extent, viz.:—About 376,000 square miles in Queensland, 90,000 square miles in South Australia, 85,000 square miles in New South Wales, and 20,000 square miles in the Northern Territory. The Murray River Basin extends over South-Western New South Wales, North-Western Victoria, and South-Eastern South Australia. The Western Australian Basins fall naturally within five groups, viz.:—The Flinders Basin, the Coastal Plains Basin, the North-West Basin, the Desert Basin, and the Gulf Basin. (See also pages 512 to 520.)

From the storage dam to Echuca, the river will not be locked, but from Echuca to Blanchetown in South Australia, 26 weirs and locks will be constructed, affording a navigable depth at all times for vessels drawing 5 feet of water. The weirs and locks above Wentworth will be constructed by Victoria and New South Wales jointly, and below Wentworth by South Australia. The Act also provides for the construction of locks and weirs in the Murrumbidgee River from its junction with the Murray River to Hay, or alternatively, for an equivalent expenditure of £540,000 upon locking the Darling River from its junction with the Murray upwards.

A system of storage is to be provided in Lake Victoria, to be controlled by South Australia.

The total expenditure involved by the construction of the works covered by the Act is estimated at £4,663,000, of which the Commonwealth Government will contribute £1,000,000, and the three States interested the balance, in equal shares.

The effect of constructing the River Murray storage would be to insure at all times sufficient flow below Albury to permit of diversions for irrigation, and stock and domestic supplies, and also to make good the losses in the river due to seepage, evaporation, and lockages. The Act provides that, subject to certain conditions, New South Wales and Victoria shall share the regulated flow of the river at Albury, and shall each have the full use of all the tributaries of the River Murray within its territory below Albury, with the right to divert, store and use the flows thereof. It is estimated that the New South Wales regulated river flow after the construction of the Upper Murray Storage will amount to at least 120,000 acre feet per month at Albury during the irrigation season, except in a period of phenomenal drought, such as 1902 and 1903. An investigation is now being made of the manner in which the New South Wales share of the Murray River waters can most profitably be used, but no conclusion has yet been arrived at.