

## 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.

(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 505) is said to be the largest yet discovered, and is 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 Desert Basin, between the De Grey and Fitzroy Rivers; and the Gulf Basin, between Cambridge Gulf and Queen's Channel.

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 Gregory<sup>1</sup> 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.<sup>2</sup> (See Year Book No. 6, p. 570.)

(v.) *Particulars of Artesian and Sub-artesian Bores, 1912.* The following table gives particulars of artesian and sub-artesian bores in each State and in the Commonwealth up to the end of the year 1912:—

**COMMONWEALTH AND STATES.—PARTICULARS OF ARTESIAN AND  
SUB-ARTESIAN BORES, 1912.**

Particulars.	N.S.W.	Vict.*	Q'land.	S. Aust.*	W. Aust.†	Tas.	C'wlth.
Bores existing ... No.	488	130	2,065	94	64	...	2,841
Total depth bored ... feet	775,966	184,002	2,204,816	74,674	75,102	...	3,314,560
Daily flow ... ,000 gals.	63,499	†	529,807	†	24,000	...	...
Depth at which artesian water was struck—							
Maximum ... feet	4,338	558	5,045	4,850	4,006	...	5,045
Minimum ... feet	46	131	10	65	175	...	10
Temperature of flow—							
Maximum ... Fahr.	148	†	211	208	140	...	211
Minimum ... Fahr.	73	†	81	82	60	...	60

\* Government bores only. † Exclusive of 36 private bores. ‡ Not available.

2. *New South Wales.*—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. At the end of 1912, out of 483 known artesian bores in New South Wales, 193 were Government bores.

1. See *J. W. Gregory, F.R.S., D.Sc.*: "The Dead Heart of Australia." London, John Murray, 1906.

2. *E. F. Pittman, A.R.S.M., 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 distribution of these bores was as follows:—

NEW SOUTH WALES ARTESIAN BORES ON 31st DECEMBER, 1912.

Particulars.	State.	Private.	Total.
Bores existing ... .. No.	193	295	488*
Total depth bored ... .. feet	379,195	396,771	775,966*
Daily flow ... .. gallons	63,498,969†	‡	‡
Depth at which water was struck—			
Maximum ... .. feet	4,338	3,550	...
Minimum ... .. "	89	46	...
Temperature of flow—			
Maximum ... .. ° Fahr.	139	148	...
Minimum ... .. "	77	73	...

\* Exclusive of 21 Government and 23 private bores which failed; the total depth bored being 27,566 feet and 30,227 feet respectively. † Excluding the flow from seventeen pumping bores, the particulars of which are not available. ‡ Not available.

Of the wells at the end of 1912, the depth is stated in 487 cases, ranging from 46 to 4338 feet. There is a preponderance of wells from 1000 to 2000 feet in depth, but neither the shallow wells under 500 feet, nor the very deep wells over 3000 feet are so numerous in proportion as in Queensland. 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 daily outflow of 1,062,133 gallons; and at Dolgelly, in the Parish of Careunga, in County Stapylton, with a depth of 4086 feet, and an outflow of 622,185 gallons per day. The largest outflow is stated to be that at the Boobora bore, in the County of Stapylton, which yields 1,133,300 gallons a day, and has a depth of 3225 feet.

The Zetz Spa, much used as a mineral water in New South Wales, comes from Ballimore, near Dubbo.

It may be said that the cost of artesian wells works out at an average of about 20s. per lineal foot; it depends, of course, upon the depth to which boring operations have to be extended, and on the accessibility of the bore to a railway station. The practice is to line the bore with three strings of casing, ten, eight and six inches in diameter respectively. The ten and eight inch strings are inserted as far as may be considered necessary, and the six-inch string generally taken to the bottom of the bore. Recent contract prices per lineal foot for a bore complete are as follows:—To 1000 feet, 27s. per foot; 1000 to 1500 feet, 17s. 9d.; 1500 to 2000 feet, 18s. 3d.; 2000 to 2500 feet, 19s. 3d.; 2500 to 3000 feet, 21s. 3d.; 3000 to 3500 feet, 23s. 9d.; 3500 to 4000 feet, 30s. The increased cost per lineal foot for the first 1000 feet is owing to the insertion of the three strings of casing.

3. **Victoria.**—Victoria lies altogether outside the Great Australian Artesian Basin, and as water is obtainable in most parts of the State at shallow depths, there has not been much occasion for artesian boring. As early as 1884, however, an artesian well was bored at Sale, which for a number of years gave a supply of about 100,000 gallons per day until, either through corrosion of the casing or by choking up with sand from below, the flow ceased. In 1905 a new bore was therefore 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, which at present is stated to be about 145,000 gallons per day. Further trouble, however, has been experienced owing to failure of casing, and a fresh bore is being put down.

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, forty-two bores have been sunk, and their depths vary from 150 to 600 feet, the water rising to within from 200 to 7 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 499 preceding.

At the end of 1912 the number of existing Government bores in use in Victoria was 58, from which supplies are obtained by pumping. The total depth bored amounted to 22,000 feet, while the maximum and minimum depths at which water was struck were 588 and 131 feet respectively. There are also seventy-two existing private bores, with a total depth of about 162,000 feet.

4. Queensland.—A return relating to the 30th June, 1912, classifies the Queensland artesian bores under the following headings:—

QUEENSLAND ARTESIAN BORES ON 30th JUNE, 1912.

Sunk by—	Artesian Flows.	Sub-Artesian or Pumped Supplies.	In Progress, Abandoned, or Uncertain.	Total
Government ... ..	35	36	151	222
Local governing authorities ... ..	19	9	18	46
Private owners ... ..	731	284	428	1,443
Total ... ..	785	329	597	1,711

Of the 785 flowing bores, 57 were of less than 10,000 gallons per day; 161 from 10,001 to 150,000 gallons; 318 from 150,001 to 750,000 gallons; 145 from 750,001 to 1,500,000 gallons; 65 from 1,500,001 to 2,500,000 gallons; and 39 from 2,500,001 to 4,500,000 gallons. 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. A well at Cunnamulla is stated to have a daily flow, when uncontrolled, of no less than 4,500,000 gallons. 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, 1913 :—

**QUEENSLAND ARTESIAN AND SUB-ARTESIAN BORES ON 30th JUNE, 1913.**

Particulars.	State and Local Authorities.	Private.	Total.
Bores existing ... .. No.	249	1,816	2,065
Total depth bored ... .. feet	194,411	2,010,405	2,204,816
Daily flow ... .. gallons	32,181,215	497,626,145	529,807,360
Depth at which artesian water was struck—			
Maximum ... .. feet	4,256	5,045	...
Minimum ... .. "	354	10	...
Temperature of flow—			
Maximum ... .. °Fahr.	198	211	...
Minimum ... .. °Fahr.	85	81	...

5. **South Australia.**—The information about artesian wells is somewhat meagre. Early in 1908 a list of twenty-five of the principal Government bores was published, of which four were under 1000 feet in depth, twelve from 1000 to 2000 feet, two from 2000 to 3000 feet, and seven over 3000 feet. The deepest flowing well was at Goyder's Lagoon, on the Hergott to Birdsville route, measuring 4580 feet, and yielding \*600,000 gallons per day. A bore at Patchawarra, 35 miles north of Innamincka, was, in October, 1912, down to 5161 feet, but had not at that depth struck the subterranean water. The maximum flow, viz., 1,250,000 gallons, is obtained at Coonie Creek.

The following table shews particulars as to South Australian bores at the end of December, 1912 :—

**SOUTH AUSTRALIAN BORES, 1912.**

Particulars.	Artesian and Sub-artesian.
Bores existing ... ..	94
Total depth bored ... .. feet	74,674*
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 ...	£202,559
Expenditure during year on boring operations ...	£15,268

\* Exclusive of abandoned bores.

† Not available.

(i.) *Bores along Bordertown Railway.* 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 all these bores water was found in porous beds of Eocene (Tertiary) age.

(ii.) *Bores along and near Pinnaroo Railway Line.* Several bores have been successfully put down in the Pinnaroo country. In 1904 the first bore was sunk in this district at Cotton, and numerous successful bores have since been put down by the Public Works Department, and subsequently by the residents of the district. The depth of water level from the surface ranges from 15 to 200 feet, and the maximum outflow is 48,000 gallons per day at the Gosden bore. Several wells, ranging in depth from 55 ft. to 221 ft., have also been sunk in this district.

The latest Government bore is situated  $7\frac{1}{2}$  miles south of Brown's Well, near the terminus of the proposed railway from Tailem Bend. The depth of this bore is 220 ft., and the water, which is in large supply, rises to within 52 ft. of the surface. The water is fresh, containing  $\frac{1}{4}$  oz. salts and other solid matter per gallon.

6. **Western Australia.**—(i.) *The Goldfields Water Supply of Western Australia.* The scheme by which the Government of Western Australia undertook to provide a permanent supply of water for the population on the eastern goldfields of that State comes properly under the heading of "Water Supply Works." A description of the scheme 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 new department, the 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*.

At the end of the year 1912 the total number of Government bores west of the Darling Range was 64, and there were 86 private bores recorded in addition. This record is, however, incomplete, and the following particulars refer to Government bores only. The total depth bored is given as 75,102 feet. The total cost of construction of State bores at the end of the year 1912 was about £123,900, of which amount £11,500 was spent in 1912. The total daily flow of the Government bores is stated as 24,000,000 gallons. The maximum and minimum depths of State bores were 4016 feet and 175 feet respectively, and the maximum and minimum temperatures 140° and 60° Fahrenheit. The maximum outflow, 4,000,000 gallons per day, was obtained at Leederville in connection with the Metropolitan Water Supply at 2097 feet. The expenditure for the year 1912-13 was £8000, and the total expenditure since the inception of the work approximates £126,000.

As already stated, no artesian water has been found east of the Darling Ranges, although a large number of shallow bores yield either fresh or salt water.

### § 3. 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.) *Irrigation Trusts.* The first action by the Government of this State for the establishment of irrigation settlements was taken under Acts of Parliament which authorised the formation of irrigation trusts in the vicinity of Wentworth in 1890, Hay in 1892, and Balranald in 1893. The Wentworth Trust controlled

an area of 10,600 acres, but has been dissolved and its powers assumed by Government. A pumping plant has been provided and channels laid out for the irrigation of an area of 1500 acres, of which 1000 acres are at the present time under successful occupation, largely for the production of horticultural crops and a small amount of lucerne. The original area under the Hay Trust was 12,847 acres, but in 1896 this was reduced to 3000 acres. The pumping plant and channels provide for the irrigation of 900 acres, which are under occupation, principally in connection with the growth of fodder crops for dairying, a small area being under horticultural crops. No works for the supply of water have yet been carried out by the Balranald Trust, which controls an area of 1000 acres. It is improbable that any irrigation will be provided in this area in the near future.

(ii.) *Private Irrigation.* Irrigation by private individuals is almost entirely carried out by pumping plants licensed under the provisions of the Water Rights Act. The largest plants draw their supplies from the River Murray for irrigating areas of from 600 to 700 acres of lucerne grown for stock-feeding purposes.

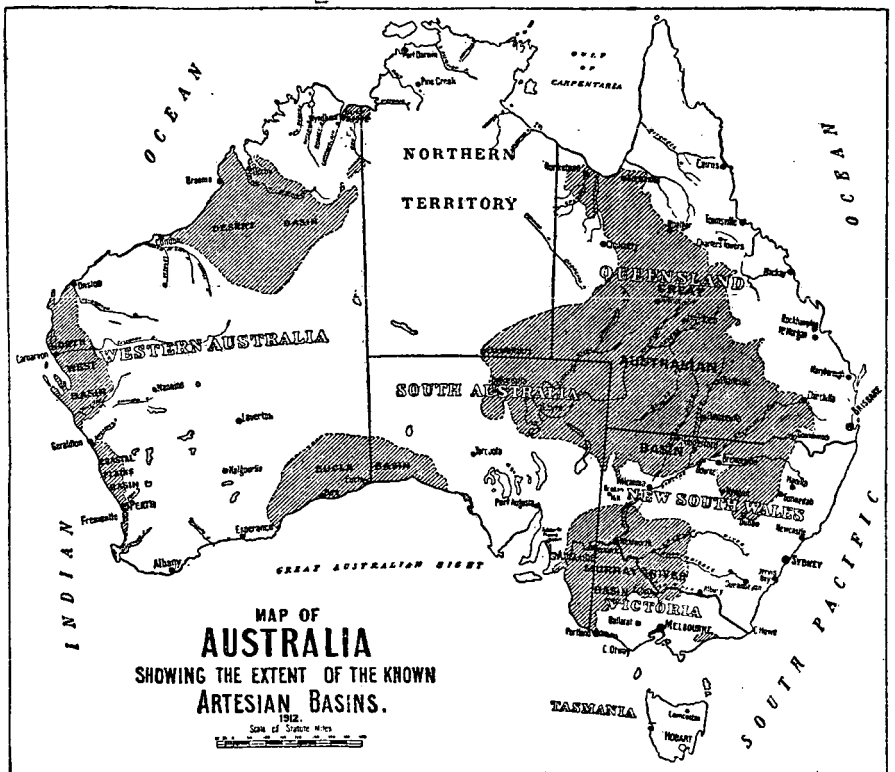
(iii.) *The Murrumbidgee Northern Irrigation Scheme.* This scheme provides for the utilisation of a large proportion of the waters flowing from the Murrumbidgee catchment area in normal seasons. The works which are necessary to provide for the conservation of these waters consist in the first place of a large storage reservoir in which the water is to be retained by a weir known as the "Burrinjuck Dam." This dam is being constructed across the channel of the Murrumbidgee River, about three miles below the confluence of the Goodradigbee River. The catchment area above this point is 5000 square miles.

The retaining wall will have a total height of 240 feet from its crest to the deepest foundation level; the total length will be 784 feet curved in plan to a radius of 1200 feet; the thickness at the crest will be 18 feet and at the base 170 feet. The maximum depth of the water stored will be 224 feet, the total volume being 33,630 million cubic feet. The wall itself will contain about 600,000 tons of material, and will require about 50,000 tons of cement for its construction. The work is now partially completed and it is estimated that it will be finished in 1914. The object of constructing this weir is to regulate the supply of water, so that the large volumes which are afforded by the winter rains and the melting snows of the spring may be retained and made available to supplement the natural flow of the river in the dry months of the summer, when irrigation water is most required. The volumes of water thus made available for irrigation requirements will be conveyed in the channel of the Murrumbidgee River for a distance of 200 miles from the storage to a point above the town of Narrandera at Berembled, where a reservoir, known as the Berembled Weir, is in course of construction, with the object of diverting supplies by gravitation into the irrigation lands. A main canal, capable of carrying 1005 cubic feet per second, is being constructed from the Berembled Weir for the purpose of conveying the waters to the irrigable lands situated along the base of the hills to the west of the town of Narrandera.

It is proposed that the State Government shall acquire and subdivide for the purposes of intense culture the whole of these irrigable areas, which consist of about 200,000 acres of first-class and 360,000 acres of second-class land. The main canal will be capable of carrying to these areas only about one half of the water which will be made available for irrigation by the construction of the Burrinjuck dam. No determination has yet been arrived at as to whether the additional available volumes will be utilised for irrigating further areas of these same lands on the northern side of the river, or whether a separate canal will be constructed for the purpose of carrying supplies to lands on the southern side.

It is stated that the conditions as regards water-supply, soil, and climate are such as to ensure the success of the scheme, and it is anticipated that when the whole of the lands are settled there will be an addition of at least 50,000 people to the population within the district. It is expected that, in addition to the horticultural crops which

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, 83,000 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 Eucla Basin, the Coastal Plains Basin, the North-West Basin, the Desert Basin, and the Gulf Basin. (See also pages 498 to 503.)





will be grown, the supplies of fodder which will be afforded by the irrigation settlement will be sufficient to obviate the evil effects of droughts in the surrounding pastoral districts and will thus largely increase their stock-carrying capacity and productiveness.

(iv.) *Other Irrigation Schemes.* The following proposals are under investigation by the State Irrigation Department :—

- (a) *Lachlan River.* The construction of a storage reservoir on this river at a place known as Wyangala, below the confluence of the Abercrombie River, for the purpose of affording water in the river channel for pastoral purposes and for the irrigation of small areas along the river banks by pumping.
- (b) *Macquarie River.* The construction of a storage reservoir on this river at Burrendong, below the confluence of the Cudgegong River, for the purpose of affording water by gravitation for the irrigation of certain lands to the west of Narromine.
- (c) *Murray River.* The construction of a storage reservoir across the Murray River at Camberona, above Albury, in order to supply water by gravitation through a canal which will be taken off at Bungowannah, below Albury, for the irrigation of high-class lands lying between the Murray and the Billa-bong Creek near the town of Berrigan.
- (d) *Hunter River.* The construction of storage reservoirs on the Upper Hunter or Goulburn River with a view to supplying water by pumping from the Hunter River to the adjoining lands and supplementing the water supply of Newcastle. It is stated that the valley of this river is one of the most fertile districts in the State and that it is capable of carrying a dense population under the conditions of intense culture by irrigation.
- (e) *Darling River.* The conversion of Lake Menindie into a large permanent storage by means of a diversion weir across the Darling River and of a canal through Lake Pamamaroo, the water so stored to be utilised in the irrigation of the bed of Lake Cawndilla and of certain lands to the south-west.
- (f) *Warragamba River.* A scheme has been prepared for the construction of a large storage dam on the Warragamba River, so as to retain a depth of 225 feet and a volume of 103,000 million gallons of water. This would be available for the supply of 80 million gallons daily for the domestic services of Sydney, 30 million gallons daily for trade purposes, and 80 million gallons daily for irrigation purposes in the county of Cumberland.

It is proposed that the water for domestic purposes should be conveyed and delivered at Potts Hill through 48 miles of open concrete channel and pipes; that the supplies for trade purposes should be delivered in the vicinity of the Great Western Railway, between St. Mary's and Penrith; and that the lands situated along the banks of the Nepean River and in the valley of South Creek should be irrigated.

3. **Victoria.**—(i.) *Classification of Works.* The Water Conservation Works in Victoria naturally divide themselves into those providing mainly a domestic supply, such as the Yan Yean works, controlled by the Melbourne and Metropolitan Board of Works; the Coliban, Broken River, Kerang Lakes, and Mallee Supply Works, which, although now administered by the State Rivers and Water Supply Commission, are properly local

government works; other works for domestic supply controlled by Water Works Trusts or Municipal Corporations; and irrigation works proper. With the exception of the last-named class 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 of 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, which was created by the Water Act 1905, in force since 1st May, 1906. The works under the control of this body, which is composed of three members, may be classified as follows:—(a) Irrigation schemes; and (b) Domestic and stock schemes, included in which are a number for providing town supplies, the principal being the Coliban system.

(a) *Irrigation Schemes.* This division comprises the schemes constructed and under construction for the supply of water to between twenty to thirty irrigation districts. Up to 1906 these schemes were controlled by local Trusts which had obtained the moneys for the construction on loans from the State. By the Water Act 1905 all local control was abolished 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, 1913, on water supply in the irrigation and water supply districts under the control of the Commission was £4,527,358. The irrigation works draw their supplies mainly from headworks constructed on the Murray, Goulburn, and Loddon rivers. The cost of these works, which now stands at £1,194,776, is not debited to the districts benefited, but is borne entirely by the State. Within the last three years the State has adopted the policy of purchasing large areas of land commanded by these schemes and subdividing them for intensive culture. The settlement of the areas on these lines will mean a large increase in 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 was passed, transferring to the Water Supply Commission the entire management, leasing, and general supervision of all lands 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 to very large tracts of country. The principal works of this division are situated in the Wimmera and Mallee districts, and cover an area of about 6000 square miles. Since its inception, the Commission has spent upon the various works in the Wimmera and Sea Lake district the sum of £250,000. In addition to the Commission's districts some large areas are still administered by local authorities.

It should be mentioned that in 1899 the State deemed it advisable to write off the sum of £1,073,000 from capital accounts of the local bodies then controlling the works in each of the above divisions.

(iii.) *Mildura.* The first settlement of Mildura dates from 1884. After being managed until 1887 by Chaffey Bros., and then until 1895 by the Mildura Irrigation Company Limited, it was in that year taken over by the First Mildura Irrigation Trust and has since then made great progress. Its population at the Census of 1911, was 6145. Water is pumped from the Murray River by five pumping stations, each capable of raising 2,500,000 gallons per hour. The length of the irrigation channels is 280 miles. For the year ending 30th June, 1913, the receipts of the Trust aggregated £30,695, and its expenditure £28,964. For the same period the area of land under cultivation and the record of water acres were 12,307 and 36,960 acres respectively, the value of the fruit crops for the year being £400,000.

No precise figures are available as to the capital cost of the works at Mildura; probably the sum was not less than £180,000. The amount due to Government is £73,929, exclusive of £13,303 for accumulations of interest.

(iv.) *Lands supplied with Water within the State.* The area of country lands within the State artificially supplied with water for domestic and ordinary use and for watering stock is approximately 20,500 square miles, equal to about 13,120,000 acres. The extent of land under irrigated culture, for all kinds of crop, is 249,983 acres, an increase of 20,150 acres over the area irrigated in the previous year. The above total includes about 14,500 acres, watered under yearly permits granting authority to divert water from streams throughout the State. Further progress has been made during the year in bringing all such diversions under the control of the Commission, 719 permits authorizing diversions for irrigation, domestic and stock, and power purposes being now in force.

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 Fairymeade, 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 596 irrigators in the State in 1912, chiefly farmers and graziers, and the area irrigated was 9420 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. At present the extent of the land assessed for the purpose of the trust is approximately 5200 acres, and maintains a population of 2500. The value of Renmark products has now reached the sum of over £130,000 per annum. It is claimed that without irrigation the land would barely feed 500 sheep.

(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, and the first report of the Director has now been issued. The Government is at present proceeding with the irrigation schemes along the Murray as fast as possible. The Cobdogla station, formerly held under grazing permits, has been resumed by the Crown, and as a result of the surveys to 30th June, 1913, 11,400 acres at Cobdogla and 3000 acres at Berri have been found available for irrigation. The area comprises practically the whole of the original Lake Bonney irrigation scheme, and is contiguous to the Berri irrigation area, which contains a further 19,000 acres of the Cobdogla run. It is proposed to start the reticulation with channels for an area of 5000 acres, between the Cobdogla homestead and Lake Barmera (formerly Lake Bonney), which lends itself to economical irrigation. A large central pumping station will be erected at the south end of the lake, and will command the whole of the irrigation area, including the 5000 acres, the maximum lift being about 90 feet. In the section dealing with Closer Settlement (page 250) the subject of irrigation areas in South Australia has already been referred to.

6. **Western Australia.**—A Bill for the conservation and utilisation of water for industrial irrigation and for the construction of irrigation works is now before Parliament. Preliminary surveys have been made to ascertain suitable sites for impounding water on several rivers, and the results indicate the possibilities of impounding 4,113,000,000 gallons of water, which, it is estimated, would serve 100,000 acres of irrigated land. Works have been commenced on the Harvey River, which will be the first scheme to be put into active operation.

7. **Conflicting Interests.**—The relative rights of the States of New South Wales, Victoria, and South Australia to the waters of the Murray River are undetermined. Territorially the south bank of the Murray was the boundary between the two former States, *i. e.*, the region of the River itself, up to the point where it enters South Australia, was wholly within New South Wales.

At the Federal conventions which preceded the establishment of the Commonwealth the South Australian representatives expressed their fear lest too much irrigation on the Murray and Darling might impair the navigability of the latter river, and the result was the insertion of a provision in the Commonwealth Constitution which reads as follows:—  
“*Section 100.*—The Commonwealth shall not, by any law or regulation of trade or commerce, abridge the right of a State or the residents therein to the reasonable use of the waters of rivers for conservation and irrigation.”

Under this section negotiations have for several years been in progress between the three interested States. In January, 1911, a conference took place in Melbourne between the Premiers of New South Wales, Victoria, and South Australia on the Murray Waters question. Briefly stated, the results of the conference were that South Australia was to be allowed to carry out storage works at Lake Victoria, New South Wales, and lock her own portion of the Murray at her own expense, but New South Wales and Victoria would not recognise the claims of navigation in any way, and would not bind themselves to deliver any quantity of water at the point of intake into South Australia. No rights to navigation were conceded by New South Wales and Victoria, and the upper portions of the river were left free for irrigation.

In 1913 the three States appointed a board of engineers to carry out investigations, with a view to ascertain means which would be conducive to a settlement of the question of the River Murray and its tributaries. The board in its report stated that it was agreed that the interests of irrigation are more important than those of navigation, and that the heavy expense of maintaining the latter is not warranted.

The following agreement was suggested for apportionment of the cost of works and of water between the three States:—

The States of New South Wales and Victoria to bear in equal shares the cost of the Cumberoona and any further storages on the streams above Albury, and, in proportion to proposed diversions, the cost of any joint works in the River Murray to raise the level for purposes of diversion.

South Australia to bear the cost of all works proposed to be constructed by her in the Lake Victoria agreement, as ratified by the State Parliament, together with all works within her own territory.

The flow of the River Murray at Albury, including the natural or regulated flow of the Mitta and Kiewa rivers, and as regulated by the Cumberoona storage, to be shared equally by New South Wales and Victoria, subject to any quantity agreed to be sent down the river for riparian use and for supply to South Australia.

New South Wales and Victoria to each have full use of her own tributaries below Albury, and to have the right to divert the flows thereof, or, alternatively, equivalent volumes from the Murray below their affluences, subject to the provision from such

tributaries, or her share of the flow at Albury, or both, of contributions towards the share allotted to South Australia, and the allowance for riparian use on the main stream from the affluence of such tributary, or from Albury to Lake Victoria.

The proportion of the contribution by New South Wales and Victoria to the share allotted to South Australia, and for riparian use in the main stream to be that which the mean natural flow of the tributaries of each State below Albury measured at the points of affluence with the Murray, with half the actual mean flow at Albury added in each case, bear to each other. In calculating the mean flow of the Darling for this purpose, a deduction is to be made to the extent of any water diverted by the State of Queensland.

The minimum quantity to be allowed to pass to South Australia in each year to be sufficient to fill Lake Victoria storage once, and, in addition, to maintain, with the aid of the water returned from Lake Victoria, a regulated supply at Lake Victoria outlet of 114,000 acre feet per month during the months August to April inclusive, and 47,000 acre feet per month for the months May to July inclusive, these being the provisions for domestic and stock supply, losses by evaporation and percolation in Lake Victoria, like losses and lockage in the river from Lake Victoria to the river mouth (but not including Lakes Alexandrina and Albert), and for irrigation in the form of a regulated supply of 67,000 acre feet per month for nine months. Provided that these allowances and the allowance to the up-stream States to be reduced *pro rata* in such abnormal seasons as those of 1902 and 1903.

Divided in accordance with this agreement the share of regulated water in each State would be approximately:—New South Wales: 1,957,000 acre feet, of which some 85,000 acre feet are now diverted for use. Victoria: 2,219,000 acre feet, of which some 600,000 acre feet are now diverted for use. South Australia: 603,000 acre feet, of which some 56,000 acre feet (plus losses in distribution) are now diverted for use.