David Scott Mitchell.

With the Author's Compts.

ANALYSES OF SOME OF THE WELL, SPRING, MINERAL, AND ARTESIAN WATERS OF NEW SOUTH WALES, AND THEIR PROBABLE VALUE FOR IRRIGATION AND OTHER PURPOSES.

By JOHN C. H. MINGAYE, F.C.S., M.A.I.M.E., Analyst and Assayer to the Department of Mines.

[With Plate III.]

[*Read before the Royal Society of N.S. Wales, June 1, 1892.*]

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As little information is on record respecting the composition of the various inland waters of New South Wales, and questions having arisen at times regarding their value for irrigation, watering stock, and other purposes, I have much pleasure in bringing before the Society with the permission of the Hon. the Minister for Mines and Agriculture, the following information obtained after some years of careful work, and examinations made of various samples of water submitted to the Department of Mines for analyses and report.

In some cases, the waters were examined with a view of ascertaining whether they were suitable for drinking purposes, and the larger portion for stock and irrigation purposes. The analyses were conduced according to the information required, a few of the samples sent being insufficient for a thorough examination, though in most cases the results obtained were sufficient for all ordinary purposes. The bulk of the analyses were conducted on from one to twelve gallons, especially in waters obtained from artesian bores and mineral springs, a large quantity of the water being taken for the estimation of the various salts present in small quantities.

The analyses of artesian and well waters furnished in this paper, must not be taken as representing the average waters usually obtained by boring or well sinking, as in nearly every case

the samples submitted for analyses were suspected waters ; and in few cases do the waters from the fresh water bores and wells find their way to the Laboratory. It is a well known fact that a number of these bores yield water suitable for stock and irrigation purposes, while in some cases the waters are so impregnated with saline matter as to render them dangerous to stock, and useless for irrigation.

This paper comprises some fifty-three analyses, the samples being obtained from quarries, rivers, creeks, wells, artesian and mineral springs. The analyses which are returned in grains per imperial gallon, have also been calculated into parts per 1,000 in order to compare the results with other analyses published in England, Germany, and America.

Potable Waters.

Nos. 1 and 2 are very pure spring waters, obtained from the Yarrangobilly and Fish River Caves. The analyses were made with a view of ascertaining their suitability for drinking purposes. Nos. 3, 4, 5 and 6 are from Nymagee and Byerock. The first three samples were condemned as unfit for human consumption from the excessive amount of albuminoid ammonia present, and various other tests made. No. 6 taken from a Government tank at Byerock, though not a first rate water, just passes.

No. 7, Well water from Lewis Ponds near Orange was found to be so largely contaminated with organic impurities, as to render the water a dangerous one for human consumption.

No. 8, Sample of water taken from the Parramatta Water Supply. An analysis of this water was made on the 22nd June 1885, which classes it as a second class potable water.

No. 9. From the same supply, the sample being taken after the water had passed through the filter beds in January 1889, there being very heavy rains experienced during that month. The filter beds were choked up with fine clay, the filtered water being of a reddish colour and turbid—due to finely suspended clay.

The analysis made, proved the water to be seriously contaminated, and in its then state totally unfit for human consumption. These impurities were without doubt due to the heavy rains, the water having run over a large catchment area, the surrounding district consisting largely of orchard lands which at stated times are manured; the impurities being derived from the fertilizers used in enriching the soil. The water was condemned about the same time by the Government Analyst, (Mr. W. M. Hamlet, F.I.C., F.C.S.) to use his own words—"The organic, impurity which from its character on analysis is probably due to decomposing animal matter, is so excessive, and such an amount compels me to condemn this water as being absolutely unfit for human consumption either filtered or unfiltered." The water has lately greatly improved in quality, but it is not in my opinion a suitable one for a town supply, on account of the orchard lands in and around the watershed, and if at any time heavy rains are experienced the same contamination will occur.

No. 10. Spring water from Jenolan Caves (house supply). An excellent quality of water suitable for all purposes.

Analyses of Potable Waters.—

(1.) Water from Yarrangobilly Caves.

	Grains per Gallon.	In 1000 parts.
Carbonate of Lime	6·552 ...	0·0936
Carbonate of Magnesia ...	nil ...	nil
Silica	·868 ...	·0125
Alumina	trace ...	trace
Chloride of Sodium	1·318 ...	·0188
Strong traces of Strontia, Nitrates and undetermined ...	·306 ...	·0043
	9·044 ...	·1292

Total Solid Residue dried at 220° F. = 9·044 grains per gall.
Free Ammonia... ... ... Nil per 100,000 parts.
Organic or Albuminoid Ammonia ·0026 „ „

An excellent description of spring water and useful for all purposes.

(2.) Spring Water from Jenolan Caves.

	Grains per Gallon.	In 1000 parts.
Carbonate of Lime	6·888 ...	0·0984
Carbonate of Magnesia ...	1·060 ...	·0151
Silica	·756 ...	·0108
Alumina	trace ...	trace
Chloride of Sodium	·856 ...	·0122
Trace of organic matter, Nitrates, &c.	·558 ...	·0079
	10·118 ...	0·1444

Total Solid Residue dried at 220° F. = 10·108 grains per gall.
Free Ammonia... ... ... ·0052 pts. per 100,000 pts.
Organic or Albuminoid Ammonia ·0040 ,, ,,

An excellent description of spring water suitable for all purposes.

(3.) Water from Nymagee, used for domestic purposes.

Soluble saline matter ...	13·300 grains per gallon.
Insoluble mineral matter ...	6·300 ,,
Loss on ignition	4·284 ,,
	23·884

Free Ammonia ... ... ·078 pts. per 100,000 pts.
Organic or Albuminoid Ammonia ·048 ,, ,,
Phosphoric Acid, strong trace.
Chlorine... ... ... 5·20 grains per gallon.

NOTE.—The water when heated gave off an unpleasant smell. The residue on ignition strongly darkened, emitting a foul odour, thus showing the presence of a considerable amount of organic matter. The soluble saline matter consists mainly of chloride of sodium, chloride of magnesium, with strong traces of sulphate of lime, nitrates, etc. The insoluble of clay of carbonates of lime and magnesia, silica, etc. The water was condemned as totally unfit for human consumption.

(4.) Water from Nymagee, used for domestic purposes.

Results expressed in—Grains per Gallon.	Parts per 100,000
Appearance in two feet tube ...	Reddish-brown colour
Odour when heated to 100° F....	slight	slight
Free Ammonia	trace	trace
Albuminoid Ammonia	·061 ...	·088
Nitrogen as Nitrates	present (not determined)
Nitrogen as Nitrites	ditto
Oxygen absorbed in 15 minutes	·182 ...	·261
Oxygen absorbed in 4 hours ...	·366 ...	·524
Total solids	104·58 ...	149·40
Insoluble solids	95·79 ...	136·84
Soluble solids	8·79 ...	12·56
Phosphoric Acid as Phosphates	strong traces
Chlorine as Chlorides	2·60 ...	5·14

Remarks.—Water of a reddish-brown colour, and extremely difficult to filter, turbid, due to finely suspended clay. On ignition the residue strongly darkened, thus showing the presence of organic matter. In its present state the water is totally unfit for human consumption.

(5.) Byerock, water from Government Tank.

Results expressed in—Grains per Gallon.	Parts per 100,000
Appearance in two feet tube ...	Reddish-brown colour
Odour when heated to 100° F....	slight	slight
Free Ammonia	·007 ...	·010
Albuminoid Ammonia	·034 ...	·049
Nitrogen as Nitrates	trace ...	trace
Nitrogen as Nitrites	trace ...	trace
Oxygen absorbed in 15 minutes	·059 ...	·085
Oxygen absorbed in 4 hours ...	·115 ...	·165
Total solids	11·368 ...	16·240
Insoluble solids	not determined
Soluble solids	ditto
Phosphoric Acid as Phosphates	strong traces
Chlorine as Chlorides	1·40 ...	2·00

Remarks.—Water turbid, due to fine suspended clay. The residue strongly darkened on ignition. The total solids largely consist of clay, the soluble portions being chloride of sodium, with traces of sulphate of lime, nitrates, nitrites, etc. This water in its present state is totally unfit for human consumption. The sample was taken after the heavy rains experienced in June 1890, and the pollution is no doubt due to the water having run off a large catchment area carrying impurities from the surface into the tanks. A second sample of this water was asked to be furnished three months after, which on analysis yielded as follows:

(6.) Byerock, water taken from Government tank (second sample).

Results expressed in—Grains per Gallon.		Parts per 100000
Appearance in two feet tube ...	Reddish-brown colour	
Odour when heated to 100° F....	nil	nil
Free Ammonia	·001 ...	·002
Albuminoid Ammonia	.011 ...	·016
Nitrogen as Nitrates	trace ...	trace
Nitrogen as Nitrites	trace ...	trace
Oxygen absorbed in 15 minutes	·025 ...	·036
Oxygen absorbed in 4 hours ...	·081 ...	·116
Total solids	13·104 ...	18·720
Phosphoric Acid as Phosphates	strong traces	
Chlorine as Chlorides	·900 ...	1·280
Loss on ignition...	2·128 ...	3·040

Remarks.—Water of a reddish-brown colour and turbid, due to finely suspended clay. The bulk of the total solids consists of clay, the soluble saline matter being chloride of sodium, with traces of lime, magnesia, sulphuric acid, nitrates and nitrites. The water has greatly improved in quality since the previous analysis was made, the organic ammonia being only ·016 per 100,000 against ·049 per 100,000 in the previous analysis.

(7.) Well water from Lewis Ponds near Orange.

Total solid residue	93·633	grains per gallon.
Loss on ignition	27·400	,,
Chlorine	9·400	,,
Free Ammonia	0·100	parts per 100,000
Albuminoid Ammonia ...	·040	,,

Remarks.—Water turbid, with a large amount of organic matter in suspension. Water heavily charged with sulphuretted hydrogen. The total solids were found to consist of carbonates of lime and magnesia, silica, alumina, sulphate of lime, sulphate of magnesia, chloride of sodium, and a large amount of organic matter, &c. The free and albuminoid ammonia, taken with the other constituents present in excessive quantities, renders the water totally unfit for human consumption, and it may be classed as a dangerous water.

(8.) Parramatta Water Supply (Analysis made June 22nd, 1885).

Total solid residue	11·60	grains per gallon.
Chlorine	5·90	,,
Free Ammonia	nil	parts per 100,000
Albuminoid Ammonia ...	·010	,,

Remarks.—Water turbid, with traces of suspended matter (clay). This water may be classed as a second class potable water. As regards organic impurities it is just a trifle above the Sydney water obtained from the Botany supply, and is a fair description of water considering the period of drought we have experienced.

Analysis of total solids—

	Grains per Gallon.	Parts per 1000
Chloride of Sodium	9·74 ...	0·1391
Oxide of Iron and Alumina...	·42 ...	·0017
Silica	·17 ...	·0024
Alumina	... ...	...
Lime (Ca.O)	·25 ...	·0035
Magnesia (Mg.O)	·32 ...	·0046
Sulphuric Anhydride ($S.O_3$)...	·22 ...	·0031
Organic Matter, CO_2 etc ...	·78 ...	·0111
	11·90	·1655

(9.) Parramatta Water Supply (Sample taken in January, 1899).

	Results expressed in—Grains per Gallon.	Parts per 100000.
Appearance in two feet tube ...	Reddish-brown colour	
Odour when heated to 100° F....	organic	organic

Results expressed in—Grains per Gallon.		Parts per 100000.
Free Ammonia	·007 ...	·010
Organic Ammonia	·046 ..	·066
Nitrogen as Nitrates		
Nitrogen as Nitrites		
Oxygen absorbed in 15 minutes	·400 ...	·570
Oxygen absorbed in 4 hours ...	5·200 ...	7·430
Total solids	33·880 ...	48·400
Loss on ignition...	5·740 ...	8·140
Phosphoric Acid as Phosphates	trace ...	trace
Chlorine as Chlorides	3·600 ...	5·140

NOTE.—The large amount of albuminoid ammonia as well as other impurities present in this water condems it in its present state as totally unfit for human consumption.

(10.) Spring water from Jenolan Caves.

Total solid matter	7·308	grains per gallon.
Chlorine in combination ...	·700	,,
Free Ammonia	·0040	parts per 100,000
Albuminoid Ammonia ...	·0052	,,
Oxygen absorbed in 15 minutes	·0008	,
Oxygen absorbed in 4 hours	·0018	,,

The total solids consist of carbonate of lime, with lesser quantities of carbonate of magnesia, silica, chloride of sodium, nitrates a trace, etc. An excellent sample of spring water suitable for all domestic purposes.

English Standard of purity of Potable Waters.

According to Wanklin no exception is taken to a water which contains not more than forty grains of total solids per gallon. The water as regards organic matter, etc. may be divided into three classes :—

Class I. Waters of extraordinary organic purity, yielding ·00 up to ·05 parts of albuminoid ammonia per million. This class comprises the most carefully distilled waters, deep spring waters and such waters as have been filtered through a silicated carbon filter. Waters of this class cannot be objected to organically.

Class II. Comprehends the general drinking waters yielding ·05 to ·10 parts per million of albuminoid ammonia, and any water falling into this class is organically safe.

Class III. Comprehends the dirty waters, and is characterised by yielding more than ·10 parts of albuminoid ammonia per million. Free ammonia however being absent, or very small, a water should not be condemned unless the albuminoid ammonia reaches something like ·10 parts per million, when it becomes a very suspicious sign, and over ·15 parts per million is sufficient to condemn a water.

The absence of chlorine, of more than one grain per gallon, is a sign that the organic impurity is of vegetable rather than of animal origin ; but it would be a great mistake to allow water highly contaminated with vegetable matter to be taken for domestic use. *In the Leek Workhouse there has been for years past a general tendency to diarrhœa, which could not be accounted for until the water was examined, and shown to be loaded with vegetable matter. The water was almost free from chlorine, containing only ·5 grains per gallon. A well on Biddulph Moor a few miles from Leek, yielded ·05 grains per gallon, and ·03 "free" and ·14 of albuminoid ammonia per million. The persons who were in the habit of drinking this water suffered from diarrhœa.

Valuable as is the chemical analysis of water, the information acquired is not an unfailing test as to dangerous pollution, and the sample under analysis may be found to pass the chemical analysis, and yet may contain the germs of disease. It is probable that cholera, typhoid fever etc. are frequently contracted by drinking such waters, containing prossibly the minutest trace of the excreta of persons suffering from these diseases.

The standard of purity of waters is one which I hope will be soon taken in hand in the Colonies, as many of the waters are of a totally different character from these examined in England, and for which the basis of the standard in use is taken.

* Water Analysis—Wanklin, p. 49.

No chemist could pass such waters as the samples obtained from Nymagee, Byerock (No. 1), Lewis Ponds, or the Parramatta Water Supply (second sample), they bearing direct evidence of having been heavily polluted with organic matter.

*It is a well known fact that a large population may drink a sewage polluted water with the utmost impunity under certain conditions, and yet the death rates from fever and dysentery, and all other diseases supposed to be propagated by the water may be remarkably low, in comparison with places drinking a pure water. On the other hand the water if containing diseased germs would propagate disease, and so be as fatal as a dose of poison.—(A. Wynter Blyth.)

Analyses of water taken from various quarries and wells, etc. at Broken Hill :—

(11.) *Jenkin's Quarry.*	Grains per Gallon.	In 1000 Parts.
Soluble saline matter ...	107·724	1·5389
Insoluble mineral matter	11·220	·1601
Total solids ...	118·944	1·6990
Analysis of total solids—		
Chloride of Sodium	61·300	0·8757
Sulphate of Soda	17·850	·2550
Sulphate of Lime	trace	trace
Sulphate of Magnesia	8·170	·1167
Carbonate of Lime	6·972	·0996
Carbonate of Magnesia	2·326	·0332
Alkaline Carbonates, etc.	20·404	·2914
Oxide of Iron	trace	trace
Alumina	·578	·0082
Silica	1·344	·0192
	118·944	1·6990

* Foods, Composition and Analysis—A Wynter Blyth.

REMARKS.—Water clear, had a strong saline taste. On ignition the residue considerably darkened giving off a foul odour somewhat resembling wool when burnt. No poisonous metals detected.

(12.) *Kidwell's Quarry.*	Grains per Gallon.	In 1000 Parts.
Soluble saline matter ...	144·990	2·0712
Insoluble mineral matter	15·036	·2148
	160·026	2·2860
Analysis of total solids—		
Chloride of Sodium	91·740	1·3106
Sulphate of Soda	22·160	·3165
Sulphate of Lime	trace	trace
Sulphate of Magnesia	11·650	·1664
Carbonate of Lime	11·172	·1596
Carbonate of Magnesia	1·652	·0236
Alkaline Carbonates, etc.	19·440	·2777
Oxide of Iron	trace	trace
Alumina	·728	·0104
Silica	1·484	·0212
Total solids	160·026	2·2860

REMARKS.—Water clear, with a small amount of suspended matter; saline to the taste. The residue considerably darkened on ignition, thus showing the presence of organic matter. No poisonous metals detected.

(13.) *Marden's Quarry.*	Grains per Gallon.	In 1000 Parts.
Soluble saline matter ...	134·596	1·9328
Insoluble mineral matter	19·460	·2677
Total solids ...	154·056	2·2005
Analysis of total solids—		
Chloride of Sodium	91·780	1·3111
Sulphate of Soda	8·530	·1218
Sulphate of Lime	2·470	·0352
Sulphate of Magnesia	24·600	·3514

	Grains per Gallon.	In 1000 Parts.
Carbonate of Lime	16·520 ...	·2360
Carbonate of Magnesia ...	·784 ...	·0112
Alkaline Carbonates, etc. ...	7·216 ...	·1030
Oxide of Iron	trace ...	trace
Alumina	·882 ...	·0126
Silica	1·274 ...	·0182
Total solids	154·056	2·2005

Remarks.—This water contained a small amount of suspended matter. The residue darkened on ignition. No poisonous metals detected.

(14) *Walsh's Quarry.*

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter	112·412 ...	1·6058
Insoluble mineral matter ...	11·880 ...	·1697
Total solids	124·292	1·7755
Analysis of total solids—		
Chloride of Sodium	63·930 ...	·9133
Sulphate of Soda	23·950 ...	·3421
Sulphate of Lime	trace ...	trace
Sulphate of Magnesia	7·550 ...	·1078
Carbonate of Lime	6·300 ...	·0900
Carbonate of Magnesia ...	3·760 ...	·0537
Alkaline Carbonates, etc. ...	16·982 ...	·2426
Oxide of Iron	trace ...	trace
Alumina	·672 ...	·0096
Silica	1·148 ...	·0164
Total solids	124·292 ...	1·7755

Remarks.—This water was clear, and contained a small amount of suspended matter. The residue considerably darkened on ignition, thereby showing the presence of organic matter. No poisonous metals detected.

The samples were received contained in spirit bottles and corked with corks which had been previously used, consequently no attempt was made to determine the organic impurities in the waters. All these samples contained a considerable amount of saline matter, which renders them very unsuitable for drinking purposes. With strangers drinking a quantity of these waters, especially that from Marden's Quarry, it would tend to act as a purgative. The quantity of water received in each case was small and insufficient for a thorough analysis.

(15.) *Water from Brewery, Broken Hill.*

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter ...	123·526	1·7644
Insoluble mineral matter	19·246	·2750
Total solids ...	142·772	2·0394

Free Ammonia... ... ... ·0026 parts per 100,000 pts.
Organic or Albuminoid Ammonia ·0260 ,,

Analysis of total solids—

	Grains per Gallon.	In 1000 Parts.
Chloride of Sodium ...	89·810	1·2830
Sulphate of Soda ...	6·111	·0873
Sulphate of Lime ...	trace	trace
Sulphate of Magnesia ...	15·950	·2278
Carbonate of Lime ...	15·036	·2148
Carbonate of Magnesia	3·146	·0449
Alkaline Carbonates, etc.	11·755	·1679
Oxide of Iron ...	trace	trace
Alumina ...	·308	·0044
Silica ...	·656	·0093
	142·772	2·0394

Remarks.—Water cloudy with a small amount of matter held in suspension. This water had a very foul odour, and the residue strongly darkened on ignition. No poisonous metals detected.

(16.) *Silverthorne's Well, Broken Hill.*

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter	101·920 ...	1·4560
Insoluble mineral matter ...	16·548 ...	·2364
	118·468	1·6924

Free Ammonia... ... ... ·010 parts per 100,000 parts
Organic or Albuminoid Ammonia ·032 ,,

	Grains per Gallon.	In 1000 Parts.
Chloride of Sodium	74·400 ...	1·0628
Sulphate of Soda	11·180 ...	·1597
Sulphate of Magnesia	4·250 ...	·0607
Sulphate of Lime	2·172 ...	·0314
Carbonate of Lime	11·256 ...	·1607
Carbonate of Magnesia ...	4·452 ...	·0635
Alkaline Carbonates, etc. ...	9·918 ...	·1416
Oxide of Iron	... ...	trace
Alumina	·210 ...	·0030
Silica	·630 ...	·0090
	118·468	1·6924

Remarks,—This water on opening the bottle emitted a foul odour, due to free sulphuretted hydrogen being given off. The residue strongly darkened on ignition.

(17.) *Stephen's Creek, Broken Hill.*

	Grains per Gallon.
Soluble saline matter	6·496
Insoluble mineral matter ...	11·284
Loss on ignition	3·640
Total solids	21·420

Free Ammonia... ... ... nil parts per 100,000
Organic, or Albuminoid Ammonia ·066 ,,
Chlorine ... ... 3·8 grains per gallon

Remarks.—Water of a reddish colour due to finely divided clay held in suspension. On opening the bottles, the water emitted a

foul odour, and the residue on ignition considerably darkened, and gave off a fetid smell. The insoluble matter consisted chiefly of clay, carbonates of limes and magnesia, silica, etc., and the soluble of chlorides of sodium and magnesium, with traces of sulphates of lime, alkaline nitrates and nitrites. No poisonous metals detected. The sample received for analysis being small, a more detailed analysis could not be attempted, but sufficient had been done to show that the water was totally unfit for human consumption.

(18.) *Water from Portion* 86, taken from a bore in a Limestone Quarry, Broken Hill.

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter ...	136·360	1·9335
Insoluble mineral matter	12·916	·1988
Total solids ...	149·276	2·1323
Analysis of total solids —		
Chloride of Sodium	80·410	1·1487
Sulphate of Soda	30·803	·4400
Sulphate of Magnesia	6·005	·0857
Sulphate of Lime	trace	trace
Carbonate of Lime	8·632	·1233
Carbonate of Magnesia	4·000	·0571
Alkaline Carbonates, etc.	19·278	·2754
Oxide of Iron	trace	trace
Alumina	·028	·0004
Silica	·120	·0017
	149·276	2·1323

Remarks.—Water clear and free from suspended matter. No smell observed on heating some of the water in a closed flask at 100° F. No poisonous metals detected.

Free Ammonia...	nil	parts per 100,000
Organic, or Albuminoid Ammonia	·002	,,

(19.) *Well water from Silverton, Broken Hill.*

	Grains per Gallon.
Total fixed matter	40·50
Which loses on ignition ...	1·50
Total Chlorine	22·40
Free Ammonia	·0120 pts. per 100,000 pts.
Organic, or Albuminoid Ammonia	·0130 ,,

Remarks.—The residue from this water gave no reaction for nitrates; it contains a little sulphate of calcium in solution; but the major part of the solids are present chiefly as chlorides of sodium, potassium and magnesia. The smallness of the sample (about ½ litre) precluded a more detailed examination, but enough had been done to show that it was a fair water. Poisonous metals were not detected.

(20.) *Water from soakage, Broken Hill.*

	Grains per Gallon.
Total fixed matter	3·75
Which loses on ignition ...	1·48
Containing Chlorine	1·30
Free Ammonia..	·020 pts. per 1000,000 pts.
Organic, or Albuminoid Ammonia	·320 ,,

Remarks.—On opening the bottle, the sample gave a faint reaction for sulphuretted hydrogen. On tasting the water it had a bad taste, and smell. Water thoroughly unfit for human consumption.

(21.) *Wilcannia*—Water from Tarella.

Analysis of total solids—	Grains per Gallon.	In 1000 Parts.
Chloride of Sodium	140·986 ...	2·0141
Sulphate of Soda	... ...	...
Sulphate of Lime	1·941 ...	·0277
Sulphate of Magnesia	42·391 ...	·6045
Carbonate of Lime	23·576 ...	·3358
Carbonate of Magnesia ...	6·370 ...	·0909
Alkaline Carbonates, etc. ...	9·008 ...	·1286

	Grains per Gallon.	In 1000 parts.
Oxide of Iron	nil ...	nil
Alumina	·448 ...	·0064
Silica	1·526 ...	·0218
Total solids	226·246 ...	3·2298

Remarks.—The analysis of this water was chiefly undertaken with a view of ascertaining if the water was suitable for watering stock.

Miscellaneous Analyses.

(22.) *Wilcannia.*

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter	876·22 ...	12·5176
Insoluble mineral matter ...	20·48 ...	·2925
Total solids	896·70	12·8101

Remarks.—The soluble saline matter consists largely of chlorides of sodium and magnesium, sulphate of lime, sulphates of soda and potash; the insoluble, of clay, silica, carbonates of lime and magnesia, etc. Had a very foul odour due to sulphuretted hydrogen gas. The use of this water was stated to cause sickness among the cattle though the symptoms given rise to were not stated, but were probably due to the large excess of the magnesia salts present (Epsom's salts) which tend to act as a purgative. The water is unfit for stock purposes, human consumption, and for irrigation. The quantity sent (about $\frac{1}{4}$ litre) was much too small for a more complete examination.

(23). *Liverpool Plains.*—Water from Spring Ridge. From a well twenty-two feet deep in the centre of a black soil plain, about 1,100 feet above the sea level.

	Grains per Gallon.	In 1000 parts.
Chloride of Sodium	864·83 ...	12·3549
Chloride of Magnesium ...	170·25 ...	2·4322
Sulphate of Soda	54·80 ...	·7828
Carbonate of Soda	60·57 ...	·8603

	Grains per Gallon.	In 1000 parts.
Carbonate of Lime	18·15 ...	·2592
Carbonate of Magnesia ...	33·25 ...	·4750
Silica, Oxide of Iron and Alumina	2·10 ...	·0300
Organic matter	12·90 ...	·1842
	1216·85 ...	17·3786

Remarks.—Water saline to taste, of a yellow colour with a strong odour of sulphuretted hydrogen. The analysis was made with a view of ascertaining if suitable for watering stock, but the large amount of salts, and organic matter present renders it totally unfit for that purpose, of no use for irrigation purposes.

(24.) *Myall Creek.*

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter	189·80 ...	2·7114
Insoluble mineral matter ...	16·00 ...	·2285
Total solids	205·80 ...	2·9399
Chlorine	54·50 ...	·7785

Remarks.—The soluble solids consist of chlorides of sodium, and largely of magnesia combined with chlorine and sulphuric acid, alkaline carbonates, organic matter etc. The insoluble, of carbonates of lime and magnesia, silica, alumina, etc. The sample received was much too small to permit an analysis of the total solids being made.

(25.) *Nyngan.*—Water stated to be used for watering stock.

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter ...	... 1473·92 ...	21·1564
Insoluble mineral matter	... 79·38 ...	1·1340
	1553·30 ...	22·2904
Chlorine	77·20 ...	1·1028

Remarks.—The soluble saline matter consisted largely of sulphates and chlorides of sodium, potassium and magnesium, sulphate of lime, nitrates, organic matter etc. The insoluble of, carbonates of lime and magnesia, alumina, trace of oxide of iron,

silica, alumina, etc. On heating, the water gave off a strong aromatic odour, somewhat resembling the essential oils yielded from the Eucalypti, also a foul smell on opening the bottle. On tasting the water it was strongly saline, and on ignition the residue strongly darkened, thereby showing the presence of a considerable amount of organic matter. The small amount of water sent precluded a more detailed analysis being made, but sufficient has been shown that the water is totally unfit for stock purposes or for irrigation.

(26.) *Rylstone.*

	Grains per Gallon.	In 1000 parts.
Soluble saline matter ...	652·40	9·3201
Insoluble mineral matter	30·24	·4320
Total solid matter	682·64	9·7521
Sulphuric Anhydride (SO_3)	310·807	4·4401
Chlorine	95·200	1·3600

Remarks.—The soluble saline matter was found to consist largely of magnesia, soda, potash, lime, etc., combined with sulphuric acid and chlorine. The insoluble, of carbonates of lime and magnesia, alumina, silica, etc. The water had a peculiar harsh taste due to Epsom's salts in solution, and should possess medicinal properties. The quantity of water received was small, and precluded a more detailed analysis of the total solids being made. A larger sample of this water was asked for, but up to date has not yet been received.

(27). *Curlewis.*—Water from a well one hundred and ten feet deep, containing fifty feet of water.

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter ...	849·60	12·1373
Insoluble mineral matter	79·20	1·1314
Total solids ...	928·80	13·2687
Chlorine	530·720	7·5818

(28.) *Wentworth.*—Water from Avoca Station.

	Grains per Gallon.	In 1000 Parts.
Total fixed matter ...	... 1504·0	... 21·4861
Chlorine	... 189·0	... 2 7005
Free Ammonia... ...	... ·018	parts per 100,000
Organic, or Albuminoid Ammonia	·016	„

Remarks.—An examination of this water was made with a view of ascertaining if it was suitable for watering stock. Its taste was strongly saline, and the residue consisted largely of sodium and magnesia salts. It was reported as totally unfit for watering stock and unsuitable for irrigation purposes.

(29.) *New England.*—Water from A. Pike's well about a mile S.W. of Curlewis Station, G.N. Railway Line ; twenty-five feet of water in well, one hundred and fifty feet deep. Used for steam and drinking purposes.

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter ...	... 48·75	... ·6964
Insoluble mineral matter	... 14·28	... ·2040
Volatile at red heat ...	... 116·20	... 1·6600
Total solids ...	... 179·23	... 1·5604

Remarks.—The free and albuminoid ammonia were not determined, as with the large amount of organic matter present, it is a very undesirable water for steaming purposes, and quite unfit for human consumption.

(30.) *Dennison Town, near Mudgee.*—Water from well on Patrick's Station, twenty miles from Dennison Town ; said to be poisonous to stock.

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter ...	... 73·50	... 1·0500
Insoluble mineral matter	... 80·92	... 1·1560
Volatile at red heat ...	... 129·40	... 1·8486
	283·82	... 4.0546

REMARKS.—The sample received was much too small for a proper examination. The symptoms to which this water gives rise to when supplied to cattle is not stated. It is thought however that they may be due to salts of magnesia and to the organic matter present in the water which is very high.

(31.) *Dennison Town.*—Water from a well on Patrick's Station, three miles from the above.

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter	15·60 ...	0·2228
Insoluble mineral matter ...	28·56 ...	·4080
Volatile at red heat	2·84 ...	·0405
	47·00	·6713
Chlorine	6·18 ...	·6713

REMARKS.—The sample received in a small medicine bottle was much too small to enable a proper examination of the total solids to be made.

(32.) *Barragan, near Mudgee.*	Grains per Gallon.	In 1000 Parts.
Chloride of Sodium	11·128 ...	0·1589
Chloride of Potassium	6·395 ...	·0913
Carbonate of Soda	13·337 ...	·1905
Carbonate of Lime	15·060 ...	·2152
Carbonate of Magnesia	3·783 ...	·0540
Nitrate of Soda	1·740 ...	·0248
Sulphate of Potash	3·001 ...	·0428
Silica	5·572 ...	·0796
Alumina	trace ...	trace
Total solids	60·016 ...	·8571

Free Ammonia ... ... ·018 pts. per 100,000 pts.
Organic, or Albuminoid Ammonia ·026 ,,

REMARKS.—The water when viewed through a two feet tube was of a pale green colour. It was akaline, and a minute trace of

iodine and strontia were detected. The analysis was conducted on the filtered water. Suitable for irrigation and stock purposes, but not a good description of water for domestic purposes.

(33.) *Belabula River, Clifden Run.*

	Grains per Gallon.	In 1000 Parts.
Bicarbonate of Calcium...	21·028	·3004
Bicarbonate of Magnesium	3·897	·0556
Chloride of Sodium	1·820	·0260
Sulphate of Soda	2·140	·0306
Sulphate of Potash	·183	·0026
Silica	·280	·0040
Alumina	trace	trace
	29·348	·4192

Specific gravity of water at 60° F. = 1·00041

This water is suitable for irrigation purposes.

(34.) *Mount Hope.* Water from Holy Box Well.

Total fixed matter about (about) 370·04 grains per gallon
Chlorine (about) ... ... 173·95 „

NOTE.—The quantity of this sample received was very small.

Mount Hope, Mossgiel.—Water from a well at Holy Box.

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter	408·40	5·8344
Insoluble mineral matter	25·20	·3600
Loss on ignition	3·60	·0514
Total solids	437·20	6·2458
Chlorine in combination	135·00	1·9286
Free Ammonia	nil	per 100,000 parts
Albuminoid Ammonia	·002	„

REMARKS.—A water unsuitable for human consumption, also for irrigation, and not desirable for stock purposes.

(35.) *Gunnedah.*—Water from a well seventy feet deep, with twenty-eight feet of water, which is soft and potable when fresh.

	Grains per Gallon.	In 1000 Parts.
Soluble saline matter	50·14 ...	·7163
Insoluble mineral matter	8·42 ...	·1202
Total solids	58·56	·8365
Chlorine in combination	9·00 ...	·1285

Remarks.—The soluble matter was found to consist largely of sulphate and chloride of sodium and potasium, alkaline, carbonates etc. The insoluble of carbonates of lime and magnesia, silica, alumina, etc. This water may be used for watering stock, and irrigation purposes. The sample received was very small and not properly taken, consequently the organic impurities were not determined.

(36.) *Dubbo.*—Spring water obtained from the base of a high mountain near Dubbo.

Total solid matter	6·608 grains per gallon
Chlorine in combination ...	2·500 „
Free Ammonia	trace per 100,000 parts
Albuminoid Ammonia	·010 „

Remarks.—The total solids consisted mainly of chlorides of magnesium and sodium, sulphate of lime, organic matter with traces of silica, oxide of iron, and alkaline carbonates. The water when viewed through a two feet tube was of a pale green colour. A small amount of suspended matter was present, consisting of small particles of vegetable matter, which accounts for the albuminoid ammonia found. The residue darkened on ignition, thus showing the presence of organic matter. It was thought that this water might possess medicinal qualities, and may be described as an ordinary spring water having no medicinal properties, but useful for domestic, stock and irrigation purposes.

(37.) *Wellington.*—Spring water from Maryville near Wellington.

	Grains per Gallon.	In 1000 Parts.
Total solid residue at 220° F.	1305·248	18·6467
Chlorine in combination	613·816	8·7689
Sulphuric Acid in combination	133·952	1·9136
Free Ammonia	·012 parts per 100,000 pts.	
Albuminoid Ammonia	·008 „	

Taste, very saline; reaction, alkaline; odour, earthy. Colour in a two feet tube, light pale green.

Remarks.—The total solids consist largely of soda, potash, lime and magnesia combined with chlorine, sulphuric and carbonic acids, traces of alumina and silica. The water is strongly impregnated with mineral matter, a large portion of the total solids consisting of chloride of sodium (common salt) which gives it a brackish taste. Unsuitable for human consumption, and of no value for irrigation purposes. On no account should it be used for watering stock.

(38.) *Gladesville near Sydney.*—Water from a bore.

	Grains per Gallon.	In 1000 Parts.
Total fixed matter	31·40	·4485
Insoluble solids	7·20	·1028
Soluble solids	22·75	·3250
Volatile at red heat	1·45	·0207
Protoxide of Iron	1·45	·0207
Chlorine	15·10	·2155
Free Ammonia	nil per 100,000 parts	
Organic, or Albuminoid Ammonia	nil „	

Remarks.—Water fairly bright. The soluble solids were found to consist of chloride of sodium, sulphates of lime and magnesia, silica, oxide of iron, alkaline carbonates etc. The insoluble of carbonates of lime and magnesia, etc. The amount of protoxide of iron in this water is small, and it can be got rid of by exposing the water for some time when it will be precipitated. This water may be used for domestic purposes, and is useful for irrigation.

Girilambone.—Water from diamond drill bore.

	Grains per Gallon.	In 1000 Parts.
(39) 1—Total fixed matter ...	812·48 ...	11·6060
Chlorine...	365·65 ...	5·2226
(40) 2—Total fixed matter ...	775·04 ...	11·0722
Chlorine...	343·28 ...	4·9040
(41) 3—Total fixed matter ...	777·92 ...	11·1133
Chlorine...	346·12 ...	4·9447

Remarks.—The total fixed matter consists mainly of chloride of sodium, with lesser quantities of lime, magnesia, potash, etc., combined with chlorine, sulphuric and carbonic acids. The quantity sent of each was rather small, but enough has been done to show that the samples are unfit for human consumption or irrigation purposes, and not by any means desirable waters to be used for stock.

(42.) *Wilcannia.*—Water from a bore put down in a trial shaft seventeen miles from Wilcannia.

Analysis of total solids—

	Grains per Gallon.	In 1000 Parts.
Chloride of Sodium	297·266 ...	4·2467
Chloride of Potassium... ...	183·558 ...	2·6234
Chloride of Magnesium ...	36·672 ...	·5239
Chloride of Ammonium ...	·185 ...	·0026
Sulphate of Lime	63·021 ...	·9003
Sulphate of Magnesia	53·247 ...	·7606
Carbonate of Lime	21·419 ...	·3059
Carbonate of Magnesia ...	13·981 ...	·1997
Total solids	669·349 ...	9·5631

Remarks.—Water turbid, due to fine clay held in suspension. On standing for twenty-four hours the whole of the suspended matter settled, the analysis being conducted on the clear water, which was filtered before use. No silica, alumina, or oxide of iron were detected in this water. A faint reaction was given for nitrates. Zinc was detected, the amount present being 1·067

grains per gallon = $ZnCl_2$ 2·232 grains per gallon. Total matter in suspension 17·22 grains per gallon. A strongly mineralized water unfit for human consumption, irrigation, or for stock.

Analyses of Artesian Waters.

(43.) *Cuttabura.*—Water taken from bore.

	Grains per Gallon.	In 1000 Parts
Chloride of Sodium	349·040 ...	4·9863
Chloride of Potassium ...	trace ...	trace
Chloride of Calcium	27·580 ...	·3940
Chloride of Magnesium ...	4·190 ...	·0598
Chloride of Ammonium ...	·642 ...	·0092
Carbonate of Lime	6·664 ...	·0952
Carbonate of Magnesia ...	·336 ...	·0048
Silica	1·596 ...	·0238
Alumina	trace ...	trace
Protoxide of Iron	·112 ...	·0016
Alkaline Carbonates, Organic matter, strong trace of Bromine, traces of Iodine, Nitrates, etc.	6·712 ...	·0959
	396·872 ...	5·6706

Remarks.—Water clear and free from matter in suspension. To the taste strongly saline. Not suitable for domestic purposes, and useless for irrigation,

(44.) **Bourke.*—Artesian water taken from a depth of 1175 feet and flowing at the rate of 200,000 gallons per day. Temperature 102° F. (Private bore.)

	Grains per Gallon.	In 1000 Parts
Silica	4·088 ...	·0584
Carbonate of Lime	4·750 ...	·0678
Carbonate of Magnesia ...	·037 ...	·0006
Alumina	trace ...	trace
Sulphate of Potash	1·250 ...	·0178
Chloride of Sodium	9·720 ...	·1388

	Grains per Gallon.	In 1000 parts.
Carbonate of Potash	12·260 ...	·1751
Carbonate of Soda	21·663 ...	·3094
Total Solids	53·768 ...	·7679

REMARKS.—Water gave a slight acid reaction, due to carbonic acid. As the sample was contained in a stoneware jar, corked with a cork which had been previously used, the sanitary analysis of the water was not attempted.

(45.) **Bourke.*—Artesian water taken from a depth of 450 feet and flowing at the rate of 35,000 gallons per day. Temperature 102° F.

	Grains per Gallon.	In 1000 Parts
Silica	1·960 ...	·0280
Carbonate of Lime	nil ...	nil
Carbonate of Magnesia ...	trace ...	trace
Carbonate of Soda	20·941 ...	·2991
Carbonate of Potash	2·952 ...	·0421
Chloride of Sodium	8·445 ...	·1206
Organic Matter	trace ...	trace
Total solids	34·298	·4898

(46.) **Bourke.*—Artesian water from a bore at Corrella Station, No. 1 bore, depth 900 feet.

	Grains per Gallon.	In 1000 Parts
Silica	1·288 ...	·0184
Carbonate of Lime	1·000 ...	·0142
Carbonate of Magnesia ...	·336 ...	·0047
Alumina	trace ...	trace
Sulphate of Potash	nil ...	nil
Chloride of Sodium	8·733 ...	·1146
Carbonate of Potash	7·170 ...	·1024
Carbonate of Soda	27·813 ...	·3973
Organic Matter	trace ...	trace
Total solids	46·340 ...	·6516

(47.) *Water from a bore put down at Youngerrina, depth 168 feet, temperature 82° F.

	Grains per Gallon.	In 1000 Parts
Total fixed matter	32·984 ...	·4712
Soluble saline matter	31·892 ...	·4556
Insoluble mineral matter ...	1·092 ...	·0156
Chlorine in combination ...	5·100 ...	·0728
Equal to Chloride of Sodium ...	8·404 ...	·1200

The soluble saline matter consists mainly of alkaline carbonates, chloride of sodium, silica, with strong traces of lime, magnesia, sulphuric acid, etc. The insoluble matter almost entirely consists of silica, with traces of carbonates of lime and magnesia. Water clear, free from odour and matters in suspension. Before evaporation, and after, gave a strong alkaline reaction. Suitable for domestic uses, stock, and irrigation purposes.

(48.) *Water from a bore put down at Native Dog, depth 475 feet, temperature 92° F.

	Grains per Gallon.	In 1000 Parts
Total fixed matter	45·108 ...	·6440
Soluble saline matter	44·044 ...	·6292
Insoluble mineral matter ...	1·064 ...	·0152
Chlorine in combination ...	4·500 ...	·0642
Equal to Chloride of Sodium ...	7·415 ...	·1059

The soluble saline matter consists mainly of alkaline carbonates, chloride of sodium, silica, and strong traces of lime, magnesia, and sulphuric acid. The insoluble of silica, and traces of carbonate of lime and magnesia. The water gave an alkaline reaction before and after evaporation. The quantity of water received in both samples was too small to enable a more detailed analysis being made. Both these waters may be used for irrigation purposes, and are suitable for all domestic uses.

*It will be observed that the saline matter consists mainly of carbonated alkali, which are known when present in large quantities to exert a serious influence on plant life, by their corrosive action on the young roots etc. The action can to a great extent be remedied by the addition of a small quantity of gypsum to the soil prior to irrigation. The amount of alkaline carbonates present in these waters is much too small to condemn them for irrigation purposes.

(49.) *Paroo.*—Water from a bore at Mallara.

	Grains per Gallon.	In 1000 Parts
Soluble saline matter ...	133·19 ...	1·9027
Insoluble mineral matter ...	8·56 ...	·1222
	141·75 ...	2·0249
Chlorine	79·70	1·1385

The soluble solids were found to consist of soda, potash, lime and magnesia combined with chlorine and carbonic acid. The insoluble of carbonates of lime and magnesia, silica, alumina, etc. Not a suitable water for human consumption or irrigation purposes except when used with discretion.

Mineral Waters.

(50.) *Mittagong*—Chalybeate water.

	Grains per Gallon.	In 1000 parts.
Chloride of Magnesium ...	1·296 ...	·0185
Chloride of Potassium ...	2·042 ...	·0291
Chloride of Sodium	2·158 ...	·0308
Bicarbonate of Calcium ...	2·041 ...	·0291
Bicarbonate of Magnesium ...	2·243 ...	·0320
Bicarbonate of Iron	5·985 ...	·0855
Total solids... ...	15·765	·2250

Free Ammonia	... nil per 100,000 parts.
Organic, or Albuminoid Ammonia ...	nil ,,
Nitrogen as Nitrates... ...	... nil ,,
Nitrogen as Nitrites	... nil ,,

Colour in a two feet tube, light-brown colour. Reaction, acid, due to carbonic acid gas. Taste, inky. Odour, earthy.

REMARKS.—May be classed as a Chalybeate Water. Useful as a general tonic and stimulant, especially in chlorosis and anæmia.

(51.) *Jarvisville near Picton.*—Water stated to possess medicinal properties.

	Grains per Gallon.	In 1000 Parts.
Chloride of Sodium	100·620 ...	1·4374
Chloride of Magnesium ...	26·211 ...	·3744
Bicarbonate of Calcium ...	19·340 ...	·2762
Bicarbonate of Magnesium ...	50·390 ...	·7208
Sulphate of Potash	12·172 ...	·1738
Sulphate of Lime	1·985 ...	·0284
Silica and Silicates	·812 ...	·0116
Alumina	trace ...	trace
Oxide of Iron	trace ...	trace
Organic matter	trace ...	trace
	211·530	3·0226

Free Ammonia	trace per 100,000 parts.
Albuminoid Ammonia	·012 ,,
Oxygen absorbed in 15 minutes	·0196 ,,
Oxygen absorbed in 4 hours ...	·0640 ,,
Nitrates and Nitrites	traces ,,

Reaction, alkaline. Taste, saline. Odour when heated, organic. Colour in a two feet tube, pale green. Poisonous metals, nil.

(52.) **Ballinore, Talbragar River near Dubbo.*—Artesian.

	Grains per Gallon.	In 1000 Parts.
Bicarbonate of Sodium ...	183·10 ...	2·6157
,, Potassium ...	12·83 ...	·1833
,, Lithium ...	·05 ...	·0007
,, Calcium ...	11·38 ...	·1625
,, Magnesium ...	9·36 ...	·1337
,, Strontium ...	trace ...	trace
,, Iron	·70 ...	·0100
Chloride of Sodium	6·92 ...	·0988
Alumina	trace ...	trace
Silica	·28 ...	·0040
Total solids	224·62 ..	3·2087

Trace of Phosphoric Acid detected.

No Bromine or Iodine present.

Free Ammonia ... ... ·052 parts per 100,000

Organic, or Albuminoid Ammonia ·003 ,,

Remarks.—This water had a pleasant taste, and was highly charged with carbonic acid. Obtained when boring for coal in a series of sandstone shales at a depth of 500 feet. An excellent description of table water and should command a ready sale when bottled.

(53.) **Rock-Flat Spring, near Cooma, Monara District.*

	Grains per Gallon.	In 1000 parts.
Bicarbonate of Sodium	45·29 ...	·647
,, Potassium... ...	17·15 ...	·245
,, Lithium	nil ...	nil
,, Calcium	52·08 ...	·774
,, Magnesium ...	22·40 ...	·320
,, Strontium	strong trace	
,, Iron	nil ...	nil
Chloride of Sodium	5·04 ...	·072
Nitrate of Soda	trace ...	trace
Silica	·56 ..	·008
Alumina	trace ...	trace
Total solids	142·52 ...	2·066

Waters suitable for Stock purposes.

It will be observed on comparing the analyses of many of the deep bores and well waters, that they yield a large amount of total fixed matter, the larger portion of which is saline matter. These salts consist chiefly of chloride of sodium (common salt), sulphate of soda (Glauber's salt), and sulphate of magnesia (Epsom's salt).

The medicinal action of these salts when frequently taken into the system is well known, the salts of magnesia and soda pro-

* Previously described, Proc. Aust. Assoc. Adv. Sci. for 1892, Vol. IV.

ducing a purging effect, while excessive quantities of common salt cause an increased thirst, and by their action on the kidneys impoverish the blood and hence produce debility.

It is a well known fact that stock which have been reared on a station where these saline waters exist, manage to thrive after a time, while the effect produced is often disastrous to those newly brought into contact with them. Stock are also very fond of these waters and will drink a large quantity, which must create a thirst.

These strongly saline waters therefore are very unsuitable for continually watering stock, and I have no doubt that on some occasions large numbers of stock have sickened and died through the effects of drinking large quantities, while the death of these animals have been erroneously charged to disease. In one case especially which came under my notice some seven years ago, the death of a large number of cattle were proved to be due to their continually drinking large quantities of saline water which was conserved on the run. A sample of this water yielded on analysis as follows :—Total fixed matter over 1,500 grains per gallon, the bulk of which consisted of chloride of sodium (common salt) and chloride of magnesium, and sulphates of magnesia and soda. The cattle had to be removed from the run on which this water was conserved.

In America the action of these waters on stock has received a certain amount of study. A spring water obtained from the foothills of the Coast Range, in Western Tulare Country, near San Francisco, said to produce disease in cattle drinking the water, yielded on analysis as follows :—

	In 1000 Parts.
Total solid residue on evaporation	
Again soluble in water after evaporation ...	13·22
Insoluble in water after evaporation	5·11
Silica	·96
Organic matter and combined water	2·51
Total solid residue	21·80

The water was clear and odourless, with a flat brackish taste, and had a strong alkaline reaction. The soluble portion contained chiefly common salt and Glauber's salt, while the insoluble part was composed mainly of gypsum, with a little carbonate of magnesia and silica. The sample was reported as being unfit for man or beast. An analysis of a somewhat similar water is the sample obtained from Nyngan (No. 25). The total solid residue was 22·2904 parts per 1000, the amount soluble being 21·1564 parts per 1000.

*Two spring waters from Ventura Country, South America, and stated to be too strongly mineral to be used otherwise than as a purgative medicine, mitigated somewhat for the animal system by the carbonate of soda, but rendered more injurious to the soil yielded on analysis as follows :—

	No. 1. In 1000 Parts.	No. 2.
Total solid residue on evaporation ...	5·57 ..	6·33
Soluble part after evaporation	3·25 ...	4·17
Insoluble part after evaporation	1·47 ...	1·31
Chemically combined water and organic matter	·86 ...	·85

Remarks.—The soluble matter after evaporation consisted in the main of sulphate of soda (Glauber's salt), with some carbonate and chloride of sodium, and a little sulphate of potash. The common salt was more abundant in No. 2 than the other.—(Prof. E. W. Hilgard.)

In consequence of the many enquiries made to the Department of Mines, and the various analyses of water conducted with a view of ascertaining their suitability for watering stock, the matter being in my opinion, as to their use, more of a medical question, the opinion of Mr. Edward Stanley, M.R.C.V.S., Government Veterinarian was asked for. The following is a copy of Mr. Stanley's Report :—

* Report of Examination of Waters and Water Supply and Related Subjects during the years 1886-89 by Professor E. W. Hilgard, College of Agriculture, California.

"*Re the effects of Saline Waters on Stock.*

"For the information of the Chief Inspector of Watering Places, I have the honour to report having ascertained from some of the analyses of some of the wells in the Western District contained in the Departmental Reports, that the salts most frequently found are magnesia and soda, combined with sulphuric acid and chlorine.

"As these salines are used in veterinary medicine, their effects are well known when administered in definite medicinal quantities. Magnesia salt in doses of about 1lb. acts as a purgative for cattle, and a quarter of a pound as a purge for sheep or swine. It is not suitable for horses, as it excites too much irritation of the bowels and causes inflammation. From two to four ounces repeated daily to cattle or a proportionate quantity to sheep, would set up indigestion, dissolve the semi-fluid feces, with excited action of the kidneys, gradually reducing the animal's strength and vitality. Such water being nauseous and bitter to taste would prevent stock from drinking it, unless they are pressed by thirst. Soda salts are used, but much less frequently in purgative doses for stock. Cattle will take about 1lb, and sheep about three or four ounces. They are too violent and uncertain in their action to be used for horses. Common salt (chloride of sodium) is an essential article of food aiding digestion, it assists in the formation of the gastric juices and bile, and generally assists nutrition in quantities of one to three ounces daily for cattle, half the quantity for horses and one or two drams for sheep. Large and repeated doses of salt in drinking water causes increased thirst, excites the action of the kidneys, which excrete an excessive quantity of pale urine, and impoverish the blood of its chemical constituents, leading to loss of condition and general debility. There is no doubt that many animals located on a station can and do, accomodate themselves to saline waters, while others less robust in condition will waste away and die. It is easy to understand that starving or even thirsty travelling stock may suffer disastrously from drinking at once a large quantity of water containing a high percentage

of saline matter. Horses and cattle will drink from five (5) to twelve (12) gallons a day, sheep from one (1) to two (2) gallons a day.

"Drovers could be cautioned at saline drinking places of the danger of permitting stock to drink too freely, until they have been accustomed to the medicinal properties of the water."

(Signed) EDWARD STANLEY, Govt. Veterinarian.

Value of water for Irrigating purposes.

The value of a water for irrigation purposes depends not simply on the nutrient matters in solution, but the sediment in suspension must also be taken into account. The ingredients contained in water and valuable for this purpose are mainly the nitrogen, potash, and phosphoric acid. Large quantities of alkaline salts excite a serious influence on the soil, and injure all useful vegetation, their action being a corrosive one; chiefly upon the root crowns and upper roots of plants. The alkaline carbonates, (carbonates of aoda and potash) damage the soil if present in excessive quantities, by the dissolution of the humus, which is often shown by the dark colour of the water and the black rings left were such waters have evaporated. This can to some extent be remedied when the salts consist chiefly of carbonate of soda, by the addition of small quantities of gypsum (plaster of Paris) to the soil prior to leaching, which renders the humus soluble again, and thus prevents waste. The neutral salts *i.e.*, chloride of sodium (common salt), sulphate of soda (Glauber's salts), sulphate of potash, etc., are only injurious when present in large quantities, and relief can only be obtained by washing them out of the soil by under drainage, etc.

"According to (A. Stood, Chem. Journ. Aug. 1889) water containing more than one gramme of common salt per one thousand damages vegetation, and even if the amount be only 0·5 grammes per 1000, the germination of seeds is destroyed (33%). A further action which is also detrimental to plant growth is that by the reaction of zeolites, tricalcic phosphate, etc. with chloride of sodium, the valuable constituents are rendered soluble and washed

away out of the reach of plants, and this can occur when there is only 0·05 grammes per litre. Districts therefore in which salt appears either in the waters of irrigation or as underground or bottom water, cannot support plants in a healthy state; for apart from the solvent action of the common salt in warm weather, it is carried up by capillary attraction to the upper parts of the soil, becoming there concentrated and so directly inimical to life. Analyses of soils thus affected show not only a large increase of common salt, chlorine, and total ash in the residue, but a decrease in potash and sulphuric acid."—(A. Stood, Chem. Journ. Aug. 1889.)

Mr. A. N. Pearson, Government Agricultural Chemist for Victoria, in his valuable report to the Secretary for Water Supply states as follows :—"It is known that an excess of common salt and of other chlorides will diminish the productiveness of soils. Voelcker states as a result of experiment that $\frac{1}{10}$ per cent. of salt in a soil makes it absolutely barren, probably the limit varies according to many circumstances. The usual dressing of salt as an alterative to the soil is about two cwt. per acre ; five cwt. is a maximum dressing, which should not be given often. Now if a water contains thirty parts of chlorine, which would represent about fifty parts of salt in 100,000 parts, one acre of that water ten inches deep would contain half a ton of salt, which as we have seen before is excessive dressing.

"It may be considered that fifteen parts of chlorine per 100,000 of water is a safe limit for general irrigation purposes ; that a water containing more than this should be used sparingly ; and that one containing forty or fifty should be condemned.

"These limits I have fixed upon however only on general considerations such as above given. I am putting the matter to a direct test on a laboratory scale by using solutions of different strengths for watering pot plants. It is possible that if a soil were deep drained, and occasionally flooded so that an excessive accumulation of salt in it could be washed out, a water containing a somewhat high percentage of salt may be used."—(A. N. Pearson.)

In the use of a water for irrigation purposes the following questions may arise :—

1st. As to the composition of the soil it is proposed to irrigate, also whether alkaline ; as the water added for irrigation purposes if alkaline represents so much alkali added to a soil perhaps already alkaline.

2nd. The nature of the crop or vegetation it is proposed to irrigate.

3rd. The climate and temperature, also rainfall, these to a great extent determining the class of products that can be grown with a profit.

4th. The analysis of the water supply, and its freedom from excessive quantities of alkali and other injurious substances.

5th. Drainage, and thereby washing out the accumulation of salts deposited in the soil.

The benefit derived from Irrigation.

The value of irrigation in arid districts and the benefits derived therefrom, are well known in India, America and elsewhere. In the southern parts of California irrigation has transformed seeming deserts into a maze of gardens, orchards and orange groves. This is now the case in South Australia at Messrs. Chaffey Bros. Irrigation Works at Renmark and Mildura in Victoria, these districts through the energy of the Messrs. Chaffey Bros., and the help of the Government are being converted into gardens, orchards, and orange groves, thus giving employment to some thousands of the "Sons of the Soil." The entire population of the Mildura settlement last year numbered over 3,000 people, and the township will possess an Agricultural College where settlers may acquire a training in the science and art of horticulture and agriculture.

As yet little has been done in New South Wales, excepting in a small way, to utilise our waters for irrigation purposes, although it is proposed shortly to start on the large scale and form an Irrigation Colony in the Mulgoa District near Penrith ; the water is to be conserved from the Nepean River and its various tributaries and will be the means of opening up a large tract of country,

and thus give employment to a large number of fruit growers, who have had to contend against the great difficulty experienced, *i.e.*, want of water.

Mr. H. G. McKinney, M.E., M. Inst. C.E., in a valuable paper read before the Royal Society of New South Wales on Sept. 4th 1889, entitled "Irrigation in its relation to the Pastoral Industry of New South Wales," points out that the total area of land in New South Wales is estimated at 196,000,000 acres, that an area of 168,000,000 acres is devoted to pastoral purposes, while the extent under cultivation amounts to only 1,042,000 acres. That it is a question of great interest whether irrigation cannot be made to assist in the development of the pastoral resources of the Colony; also that in his opinion, the losses to which the pastoralists are liable through drought, can to a large extent be minimized by a proper system of irrigation. First the irrigation of extensive areas of the native grasses; second the irrigation of timber areas, of lucerne, and other fodder crops.

Mr. McKinney also points out how profitable the irrigation of the native grasses can be made when the water supply is available from river sources, the water being brought to the ground by channels, etc. How profitable irrigation of the native grasses can be made under such favourable circumstances is very clearly pointed out. With an expenditure of little over £1,200 on the Coorong Run, Mr. Gwydir succeeded in irrigating over 17,000 acres of grass land during every flood in the Lachlan. The cost of irrigating an acre, taking cost of maintenance, interest, etc., amounted to only three-seventeenths of a shilling, or slightly over two pence. Before irrigation the land barely sufficed for 4,000 sheep, after irrigation it supported 12,000 sheep and 200 horses, besides fattening 125 head of cattle.

Utah and Colorado entirely depend on irrigation. The latter State in 1883 raised in value £1,100,000 of grain and root crops, the former £700,000. In California, the Australian Eucalypti—*Eucalyptus globulus*, *E. viminalis*, and the red gum *Eucalyptus rostrata* are planted on extensive areas, some 700 to 1000 trees

being set to the acre, and from them excellent supplies of firewood are obtained. Land planted with Eucalyptus which was previously valued at £2 to £5 per acre becomes worth from £20 to £80 in six or eight years, The official returns show a profit of £3 10s. per acre upon plantations which raised the value of property from £20 to £120 per acre in eleven years.

Mr. J. H. Maiden, F.L.S. &c., has pointed out the profit derived from the cultivation of the wattle barks, and I would suggest an increased value by means of irrigation where the water supply can be conserved at a small expense, say in flood time.

Value of Spring, Well, and Artesian Supplies for Irrigation.

To a large extent in various parts of the Colony, especially in the Western District where the supply from rivers and creeks are not available, we will have to rely on our artesian bores and wells. The use of these waters are largely availed of in America for the irrigation of small farms and orchards.

In the Los Angeles District and San Bernardino Countries in California, there are springs or marshes which are capable of irrigating from 20 to 400 acres each, and together supply an area of 7,000 acres of cultivated land.

At San Gabriel, California, a vineyard 1,200 acres in extent is supplied solely by artesian wells of which there are twenty-one on the estate, varying from seventy-five to one hundred feet deep.

In Santa Clara Country, Cal., there is an artesian tract yielding 2,000,000 gallons every twenty-four hours.

In California at Florin, water is raised from depths of ten to twenty feet in a steady stream by means of windmills, one of which it is stated can supply two to three acres of land with water, the machinery costing about £25 complete.

The New River from which the London Water Supply is obtained, is partly supplied from artesian wells at Amwell and Chatfield, yielding some 4,500,000 gallons per day.

In Algeria and the Sahara, the arid districts have been fertilized with a wonderful effect by artesian irrigation.

One of the largest artesian wells in the world is situated at Huron, North Dakota. It is estimated to yield from 8,000 gallons to 10,000 gallons per minute, and throws up water to a height of 100 feet. It is stated, taken even at the lowest figure, enough water is given to furnish every man, woman, and child in the State of North Dakota with at least four gallons every four hours. The pressure is known to be considerably more than 200lbs. to the square inch.

On referring to the list given of the various wells, bores, and artesian wells in New South Wales (See Appendix A.) it will be observed that many of them yield large quantities of water, sufficient for the irrigation of some acres of land. The Native Dog artesian bore yields over 2,000,000 gallons per diem, the analysis made proving the water to be a good one for irrigation purposes. This is also the case with the artesian water at Youngerrina, though the yield per diem is smaller, being only 175,000 gallons.

As previously pointed out, the analyses furnished of a large number of the wells and bores, must not be taken as representing anything like the average water obtained by sinking and boring, as in many cases only suspected waters find their way into the Laboratory for examination. It is greatly to be regretted that no systematic analyses have been made of the various supplies, as they would prove of great value in determining their composition, and thus ascertaining their value for stock and irrigation purposes. I understand from Mr. Boultbee, the officer in charge of the Water Conservation Branch, that this matter is to be taken in hand, and an examination made of the waters of the various wells, tanks, artesian and other supplies.

The analyses of some of the typical soils in the irrigable districts would also prove of value as regards the amount of alkali present. The aeration of the artesian waters before use for irrigation is one which has received lately much attention in America.

Mineral Waters.

Mineral waters are those in which an unusually large amount of salts are held in solution, their medicinal or therapeutic properties depending largely on the composition of the waters and the amount of the constituents present. There are various classes of mineral waters, some of which constitute excellent table waters, others possess medicinal qualities and are largely used for various complaints.

The following is a description of some of the waters in use in Great Britain, the Continent, America and elsewhere :—

The Carbonated Waters, which consist largely of the so-called bicarbonates of soda, potash, lime and magnesia, are represented by the Apollinaris Water and Seltzer Waters (Germany) and the Rock Flat and Cooma Waters (N.S. Wales).

The Chalybeate Waters which contain salts of iron in solution, and impart to the waters an inky taste, such as those of the Tunbridge Well spring and the Cheltenham Waters (England), and the water described in this paper from Mittagong.

The Sulphurous Waters, sulphuretted hydrogen gas being the predominant ingredient, giving the waters a nauseous taste and smell. These waters are represented in the Harrogate Waters (England), and the Moffat Waters (America), also in a spring at Wilcannia (N.S. Wales).

Sulphated or Purgative Waters, their chief ingredients being the sulphates of magnesia (Epsom's salt) and soda (Glauber's salt), are represented by the springs at Epsom, Fredrickshall, Ofen, Hungary (Hunjadi Janos Water) and the waters obtained in various places in the Broken Hill District (N.S. Wales).

The Bromated and Iodiated Waters, which are represented by the Saratoga, Champion, and Congress Waters (New York) and

others contain silica, organic matter, etc., and are said to possess medicinal properties.

Many of these springs are of a temperature higher than that of the surface of the earth where they make their appearance. At Carlsbad and Aix-la-Chapelle the temperature varies from 160° to 190° F. Such hot springs generally occur in the vicinity of volcanoes and are represented by the hot springs of New Zealand. In New Zealand some of these springs are situated at 1,200 feet above the sea, some being cold, others warm, and the rest hot, having a temperature of 117° F. In the North Island, the springs flow through probable natural artesians, coming up to the surface from a depth of some 3000 feet. The waters obtained from a bore at Youngarina and Native Dog (N.S. Wales) had a temperature of 82° and 92° F., while water taken from an artesian bore at depths of 1,175 feet and 450 feet at Bourke (N.S. Wales) gave a temperature of 102° F.

There is a large field open for the examination of our mineral waters, a number of which if thoroughly tested would no doubt be found to possess medicinal properties, and hence be of value. The districts might be made health resorts or sanatoriums, where visitors could stay and enjoy all the advantages of a club-house, and the benefit derived from the waters of the spring.

"In Queensland Mr. H. Faash has leased the Innot Hot Springs from the Government, and constructed baths and a two storied house for the convenience of patients. The water when taken is stated to have an aperient action, but patients undergoing treatment combine bathing with the drinking of the waters, two or three baths of a duration of twenty or thirty minutes being taken daily. These springs have already gained a considerable reputation for their curative virtues in chronic rheumatism, gout, liver, and kidney diseases."—(Mineral Springs of Australia, by Ludwig Bruck.)

In Victoria at some of the springs accomodation houses have been built, so as to allow persons desirous of taking a course of these waters the full benefit and comforts of a home. The best known springs in Australia as yet found are at Hepburn, Daylesford, Clifton Ballan, Stratford and Krambuk in Victoria. The Queensland springs are situated at Nestles Creek, near the Wild and Herbert Rivers (Innot Hot Springs) Tinana, Barcaldine, Eagle Farm, and other districts, some of which are highly spoken of.

Rock Flat and Cooma Mineral Springs.

The waters from the Ballinore Artesian Spring and the Cooma Natural Spring have a pleasant taste, and are strongly effervescent due to the large amount of carbonic acid gas present. In taste they resemble somewhat that of Seltzer-water. They may be described as carbonated mineral waters, and when put up into proper bottles or stored in block tin syphon drums, should command a ready sale as table waters. The spring at Cooma is held under a lease by the Government to the Australian Natural Mineral Water Company, at an annual rental of £20, and the water is retailed by the drum or per glass.

In a small book entitled "The Mineral Springs of Australia" by Mr. Ludwig Bruck, the information contained therein being reprinted from the "Australasian Medical Gazette," for January 1891, a description is given of these waters. The Ballinore Water is compared to the Vichy Waters of France, and stated to be a valuable water for gout, gravel, catarrh of the bladder, diabetes also for dyspepsia, splenic and hepatic disorders.

*"Mr. Slee, F.G.S., Superintendent of Drills, in a report to the Department of Mines states with regard to the Ballinore bore—"That at a depth of five hundred and forty feet the drill passed through a seam of coal five feet two inches thick, and while boring

* Annual Report, Department of Mines 1886, page 179.

for a second seam of coal ten feet below the first seam, artesian water commenced to flow to the surface, and it is now flowing at the rate of 1000 gallons per hour, through tubing thirty feet above the surface."

The Rock Flat Mineral Spring is situated about ten miles to the S.E. of Cooma, and occurs in close proximity to the western bank of Rock Flat Creek, in the parish of Dangelong, County of Beresford. For a description of this spring and the geological formation of the surrounding district and the geology of the immediate vicinity of the spring, I refer you to a paper by Mr. Wm. Anderson, Geological Surveyor, entitled—"On the Mineral Spring at Rock Flat Creek, near Cooma."*

The Ballinore artesian water is in my opinion the best table water of the two, and they may be both classed as excellent.

† A water similar in composition to these waters is found in a spring at Napa Country (America), the water being clear, strongly effervescent and of a pleasant taste :—

Analysis—	In 10,000 Parts.
Total solid residue after evaporation	15·080
Soluble part after evaporation	5·254
Insoluble part after evaporation	8·986
Chemically combined water, Carbonic Acid etc. ...	·840
Soluble part consists of—Bicarbonate of Soda ...	5·648
Sulphate of Soda ..	·044
Common Salt	2·888
Chloride of Magnesium...	·408
Potash Salts	traces
Insoluble part consists of—Carbonate of Lime ...	2·950
Carbonate of Magnesia ..	1·339
Carbonate of Iron ...	·134
Silica	·832

Free Carbonic Acid gas, 335 cubic inches per gallon.

* Records of the Geological Survey of N.S. Wales, Vol. I. part iii. p. 117.
† Waters and Water Supply by Prof. Hilgard, University of California.

Chalybeate Water from Mittagong.

This sample should prove useful for medicinal purposes as previously pointed out in cases of chlorosis and other complaints, where tonics are required in assisting blood formation. There are various ferruginous springs in New South Wales which are strongly impregnated with iron, and they are to be found chiefly in the Western Mountain District, and the Southern Districts at Berrima, Mittagong, Burradoo and Mereworth.

The Jarvisville water obtained from near Picton is stated to possess medicinal properties, but the amount of chloride of sodium present is high. With the exception of the Cooma and Ballinore waters, and the chalybeate water from Mittagong, I have examined no other waters which could be classed as mineral waters possessing value and saleable as table or medicinal waters. The mineralized waters of New South Wales are as a rule largely impregnated with common salt (chloride of sodium) which spoils their value for most medicinal purposes.

In appendix A. is given a list of the tanks, wells, and artesian bores in New South Wales, compiled from returns furnished by the Chief Inspector of Mines and Superintendent of Diamond Drills, also from the Officer-in-Charge of Water Conservation.

Plate III. shows the position on the map of the various wells, bores, and artesian supplies, compiled from information furnished by the Government Geologist, the Chief Inspector of Public Watering Places, and the Superintendent of Diamond Drills.

APPENDIX A.—

Number of Well.	County.	Parish.	Name of Run.	Depth of Well.	Size of Well. ft. ft.	Water struck at feet from surface.	Water stands at feet from surface.	Yield per day in gallons.
1	Arrawatta ...	... ...	King's Plains ...	70	5½ x 5½	65	65	Neverfailing
2	,, ...	... ...	,, ...	90	8 x 4	... ...	9	,, ...
3	,, ...	... ...	Swamp Oak ..	45	6 x 4	... ...	21	,, ...
4	,, ...	... ...	,, ...	40	6 x 4	... ...	4	,, ...
5	,, ...	... ...	Byron	21	4 x 4	20	15	,, ...
6	Macquarie ..	... ...	Cutarbat	50	8*	... ...	25	... ...
7	,, ...	... ...	Huntington ...	101	8*	... ...	71	... ...
8	Manara ...	... ...	Kilfera	189	5 x 2½	80	80	50,000
9	,, ...	... ...	,, ...	162	5 x 2½	50	60	Unlimited ..
10	Franklin ...	... ...	Moolbong	110	6 x 3	... ...	100	20,000
11	,, ...	... ...	,, ...	250	... ...	115 & 250	... ...	Unlimited
12	Windeyer ...	... ...	Buckalow	150	6 x 4	130	110	24,000
13	Taila	... ...	Malee Cliff... ...	70	5 x 3	... ...	... ...	... ...
14	,, ...	... ..	,, ...	18	5 x 3½	15	12	3,000
15	,, ...	... ...	Bedura ...					
16	Wentworth ...	... ...	Gall Gall ...					
17, 18, 19	Taila	.. ...	O. B. Turlee					
20	Wentworth ..	... ...	Gall Gall C...	75 to 150	... ...	... ...	... ...	... ...
21, 22	,, ...	... ...	West Perengi, A.					
23 to 27	,, ...	... ...	Wamberrar ..					
28 to 34	,, ...	... ...	Outer Tapio					
35 to 37	,, ...	... ...	Octer Tilato					
38	Menindie ...	... ...	Burta	280	6 x 3	250	250	Not tested..

* Circumference.

INDEX TO WELLS—*continued.*

Number of Well.	Quality.	Nature of surrounding country.	Strata.	Remarks.
1	Brackish	N., granite ridges; E. S., and W., ridges and plain.	Black soil, granite, rotten slaty bottom.	This well is only used in time of drought.
2	,, ...	Forest, plain, ridges, chiefly white gum timber.	Black soil, rotten granite and pipeclay.	Water stands 5′ from top in wet seasons.
3	,, ...	N., barren ridges; E. and W. do; S. forest and ridge.	Top brown soil, then basalt to bottom.	
4	,, ...	... ...	... ...	In a wet season overflows.
5	Slightly brackish...	Black soil plains and open forest country.	Black soil 15′, basalt 6′.	
6	Fresh and hard ...	Undulating, ridges running into rocky mountains	Black alluvial soil, pipeclay, and slate rock.	The well is believed to be down to the level of river water. The water is hard, but used for household purposes.
7	Hard...	Low ranges, with creeks running to river.	Soft slaty rock	Sunk on a low ridge, believed to be down to level of river water; used for household purposes.
8	Good stock... ..	Salt-bush plains, lignum S side.	... ...	Salt at 80′; got much better as we went deeper; last spring struck almost fresh, 100′ open shaft, 89 bore, 3½″ diameter.
9	Salt	,, ,,	Gypsum, sandstone, and clay.	Salt at 50′; improved slightly when bored; open shaft 100′, bore 62′.
10	Good and fresh ...	Salt and cotton bush, dark clayey soil.	Alluvial	Selection of site for well a matter of chance in some parts of Riverina. Good stock water is obtained at a depth of 100′ to 130′; in other parts two wells within one mile of each other salt water was obtained; midway between another shaft was put down and good water obtained.
11	Fresh	,, ,,	Alluvial.	
12	Slightly brackish...	Broken plains	Alluvial, 120′ pipeclay and drift 30′.	This well is in a sandy box swamp and gives one of the best supplies in the district; other shafts have been tried in the Mulga country and failed to strike water; two of them sunk 220′.
13	... ...	S., mallee and porcupine grass; W., N., and E., black oak.	Loamy soil 15′, drift sand 55′.	
14	Slightly brackish...	Pine ridges, mallee, porcupine grass, and salt-bush.	... ...	This well is covered by the Murray water when in flood.
15	Salt	Red sandy soil or clay on salt-bush plains.	... ...	One well on Gall Gall, C, we pumped for a considerable time in the summer, hoping the water would improve, but it did not do so. Have several soakage wells, with good stock water, all at shallow depths of not more than 20′, all sunk in the beds of dry creeks where the flood waters back up, and all within five miles of the river; the supply is not good, and are only made useful by making large chambers and drives at bottom of shaft.
16				
17, 18, 19		Red sandy soil in belar or oak scrub.		
20				
21, 22		Red sandhills in mallee		
23 to 27		Red clayey soil in box flats.		
28 to 34				
35 to 37		White clay flats, with box timber.		
38	Good stock... ...	Salt and cotton bush, light scrub, and undulating.	Hard clay, with gravel 100′, alluvial 80′, pipeclay and mica 30′, soft sandstone rock and clay 70′.	Open shaft 200′, bore 80′. This well is to be sunk to full depth of bore, when the supply is expected to increase. A Tiffen borer was used.

APPENDIX A.—

Number of Well.	County.	Parish.	Name of Run.	Depth of Well.	Size of Well. ft. ft.	Water struck at feet from surface.	Water stands at feet from surface.	Yield per day in gallons.
39	Windeyer ...	... ...	Mallara	64	6 x 3	64	20	Not tested..
40	Perry	... ...	Moorara	100	6 x 3	82	82	17,000
41	,, ...	... ...	Pan Ban	100	6 x 3	80	80	Unlimited
42	,, ...	... ...	North Pan Ban ...	78	6 x 3	78	75	8,000
43	Rankin... ...	... ...	Barnato	150	6 x 3	135	135	5,000
44	,, ...	... ...	,, ...	200	6 x 3	190	140	7,000
45	Woore	... ...	Fulham	175	5 x 2½	169	168	3,296
46	,, ...	... ...	Moama	170	6 x 3	170	... ...	3,000
47	,, ...	... ...	Baden Park ...	200	6 x 3	.. ...	... ...	6,000
48	,, ...	... ...	Emerald	140	6 x 3	126	... ...	... ...
49	Booroondara ...	... ...	Paddington ...	200	8 x 4	.. ...	... ...	5,000
50	Woore	... ...	Warfield	220	6 x 3	... ...	... ...	6,000
51	Blaxland ...	... ...	Bedooba	300	... ...	300	115	... ...
52	Mouramba ...	... ...	Priory	230	8 x 4	.. ...	... ...	... ...
53	Canbeligo ...	... ...	Booroomugga ...	100	6 x 3½	... ...	... ...	... ...
54	,, ...	... ...	Girilambone ...	155½	Bore ...	155	128	... ...
55	,, ...	... ...	,, ...	120	,,	116	105	... ...
56	,, ...	... ...	,, ...	100	,,	... ...	... ...	... ...
57	Rankin... ...	... ...	Donald's Plains A.	160	6 x 3	... ...	133	4,000
58	... ...	... ...	Mount Manara ...	... ...	... ...	... ...	...	... ...

INDEX TO WELLS—*continued.*

Number of Well.	Quality.	Nature of surrounding country.	Strata.	Remarks.
39	Salt and poisonous	Sandhills and oak ridges like decomposed limestone.	Pipeclay and drift ...	A good many trial shafts have been sunk on this run, salt water being struck in drift under 100′ in all of them.
40	Good stock... ...	Open salt and cotton bush plains, with oak clumps, &c.	Alluvial 82′, fine drift 18′	Have sunk fifty trial shafts on different parts of run, from 80′ to 100′; salt water struck in all; unfit for use.
41	Fair stock	Open salt-bush plains, with oak ridges, &c.	Clay throughout ...	50,000 gallons per day have been obtained, but the supply seems practically inexhaustible; slightly brackish.
42	,, ...	,, ,, ,,	Alluvial 20′, fine drift 58′	Cool, cloudy weather seems to increase the supply.
43	Good stock—slightly sweet...	Sandstone ridges; red clay flats; mulga pine; beefwood.	Alluvial gravel, cement and sandstone rock.	There is a 30′ drive in this well.
44	Good stock... ...	Pine sandhill; mulga and belar ridges.	Gravel and cement 100′, sandstone 60′ cement and blue clay 40′.	,, ,, ,,
45	,, ...	Loamy flats, rocky ridge, and mallee sandhills.	Loam, clay, and cement 167′, drift 8′	Eight miles from this well a trial shaft was sunk 188′; no water struck; half-a-mile from the above well a shaft 6′ x 3′ was sunk to a depth of 96′, then a bore 130=226′, no water being struck; boring still going on.
46	Very brackish ...	Box flats and pine sandhills.	Alluvial 100′, sandstone flags 70′, water in blue clay.	
47	Good stock... ...	Red clay flats and pine sandhills.	Cement and sandstone.	
48	,, ...	Open mulga, with ridges of malee.	Hard sandstone 69′, chalk 1′, hard sandstone 70′.	The sandstone rock in this well required to be blasted; it is intended to put a drive in this well to increase the supply.
49	Brackish	Ironstone rises; box flats; mulga; &c.	Alluvial pipeclay, cement, and sandstone rock.	
50	Good stock... ...	Red flats and pine sandhills.	Pipeclay and cement, hard sandstone.	
51	Good and fresh ...	Undulating	Blue slate...	This well was sunk before present owners bought station. There are two long drives at bottom, not required for use.
52	Good stock... ...	Undulating barren and box flats and ironstone rises.	Cement and hard sandstone, water in sandstone.	
53	... ...	Undulating ridges; volcanic hills.	Red clay 3′, red sandy drift 4′, coarse red drift 6, red clay 7′, white sandy rock 10′, pipeclay 3′, white sandy rock 12′, fireclay 4′, white sandy rock, with occasional thin strata of fire and pipeclay 51′.	This well is not yet finished.
54	Good stock... ...	... ...	Hard sandstone, rock, cement, quartz, and gravel.	
55	Very salt	... ...	Quartz, gravel, and hard sandstone.	A shaft put down here would make 6,000 gallons per day.
56	... ...	... ...	Hard slate, quartz, and hard rock, &c.	
57	Fresh	... ...	Pipeclay and cement ...	This well is in the bed of Tiltagoona Creek.
58	... ...	... ...	... ...	Government well condemned as being unfit for stock. A well half-a-mile to the N.W. good water, supposed to be soakage.

APPENDIX A.—

Number of Well.	County.	Parish.	Name of Run.	Depth of Well.	Size of Well. ft. ft.	Water struck at feet from surface.	Water stands at feet from surface.	Yield per day in gallons.
105	Mossgiel			360			180	
106	,,			312				
107	Gunderbooka			194	Bore	72/6″	10	
108	,,			198	,,	198	38	
109	Barrona			114	,,	80	Artesian	440
110	,,			201	,,	192	,,	
111	,,			474	,,	427	,,	
112	Pottinger			53	,,	40		
113	,,			25	,,	23		
114	,,			23	,,	23		
115	,,			41	,,	28		
116	,,			60	,,	57		
117	,,			41		38		
118	,,			30	Bore	27		
119	,,			48	,,	38		
120	,,			34	,,	24		
121	,,			132	,,	70		9,600
122	Murchison		Bingera	80		80		
123	Couralie	Near Moree		130		130	90	
124	Denham		Gorion	174		174	78	24,000
125	,,		,,	188		164	90	576
126	Yancowinna	Near Silverton		40		40		
127	Delalah		Elsinora	390	Bore	370		Unlimited
128	Clarence			184		126		
129	Pottinger			78			54	
130	,,			82		77	62	
131	,,			81		81	4	
132	,,			90				
133	,,			136			85	
134	,,			60			35	
135	,,			40			28	
136	,,			70			60	
137	,,			71			41	
138	,,			40				
139	Robinson			640		579		

INDEX TO WELLS.

Number of Well.	Quality.	Nature of surrounding country.	Strata.	Remarks.
105	Fresh.			
106	,,			
107	Salt	... ...	Sandstone 40′, clay 24′, clay and sand 130′.	Water also struck at 22′, 60′, 64′ 6″ and 69′, all salt.
108	,, ...	... ...	Sandstone 20′ 9″, clay 39′ 3″, clay, sand, and drift 138′.	Salt water struck at 12′ and 24′. Fresh water at 31′, 32′ 6″, 45′, 53′ and 55′. Salt water struck at 198′, hard sandstone and conglomerate, and rose to 38′ very quickly.
109	Fresh	... ...	Clays 20′, mud and drift 43′, clays, 120′ sandstone 31′.	Salt water struck at 20′; a large supply. Fresh water at 80′, rose 21′ over surface.
110	,, ...	... ...	Clay and sand 82′, sandstone 105′, shale, granite, pebbles, rock, &c. 14′.	Fresh water struck at 80′, 100′ rose 8′ over surface, 180 gallons per hour; 107′ rose 8′ over surface; 122′, 6″ over surface, 600 gallons per hour; 192′ rose 10′ over surface.
111	,, ...	... ...	... ...	Salt water struck at 110′, rose to within 23′ of surface; 349′, brackish, rose 3′ over surface; 427′ fresh water, rose to 3′ 3″ over surface.
112	,, ...	... ...	Clay and gravel.	
113	,, ...	... ...	Clay and sandy loam 20′, drift 5′.	Large supply.
114	,, ...	... ...	Sandy loam and clay 20′, drift 3′.	
115	,, ...	... ...	Clay, sand, and gravel.	
116	,, ...	... ...	Clay & gravel 57′, rock 3′	
117	,, ...	... ...	Sand and gravel ...	Very good water.
118	,, ...	... ...	Loam, clay, gravel, and boulders.	
119	,, ...	... ...	Sand, clay, and gravel.	
120	,, ...	... ...	Clay, drift, and clay ...	Large supply.
121	,, ...	... ...	Sand and gravel, clay and rock.	Water tapped at 32′, and at 70′; large supply.
122	,, ...	... ...	... ...	Plentiful supply.
123	,,			
124	,, ...	... ...	Clay, sand, and drift ...	Salt water at 80′; brackish, 143′; fresh 174′.
125	,, ...	... ...	,, ,,	Salt water at 80′; brackish, 141′; fresh 161′.
126	,, ...	... ...	... ...	150 gallons per day, after striking the water expected to increase to 1,000 gallons.
127	,,			
128	Salt	... ...	... ...	Strong supply. Coal struck at 184′
129	Fresh	Black soil, flat... ...	Soil 18′, rock 60′ ...	Short supply.
130	,, ...	... ...	Red soil 77′, 5′ sand ..	Water in sand inexhaustible.
131	,, ...	Level plain	Soil 34′, sand 1′ 8″, marl 45′ 4″.	Water in gravel, good. At 80′ kangaroo bones and bivalve shells.
132	,, ...	... ...	Pipeclay at surface. Unknown.	Overflowed once in consequence of ringbarking.
133	,, ...	... ...	Black soil 40′, stones, &c. 10′, red soil 30′, cement 5′, gravel, &c. 51′.	
134	,, ...	Open plain	Loam, 45′, drift 15′ ...	Good water.
135	,, ...	,, ...	Black soil 12, clay and gravel 16′, sand 12′.	Water abundant.
136	,, ...	Ironbark country ...	Black soil 65′, sand 5′ ...	Supply excellent.
137	,, ...	Black soil	Black soil 7′, rotton rock 64′.	Excellent and good supply. Came through fissure in rock.
138	,, ...	... ...	... ...	Water supply in sand abundant.
139	,, ...	... ...	... ...	Bore 75′ 10″ at bottom of shaft—Cobar Copper Mine. Water in slate

APPENDIX A.—

Number of Well.	County.	Parish.	Name of Run.	Depth of Well.	Size of Well. ft. ft.	Water struck at feet from surface.	Water stands at feet from surface.	Yield per da in gallons.
186	Pottinger		T. S. Reserve	97				
187	Manara		,,	126			97	
188	,,		,,					
189	,,		,,					
190	Young		,,					
191	Yungnulgra		,,					
192	,,		,,					
193	Yantara		,,					
194	Tongowoko		,,					
195	Blaxland		,,	167			161	Unlimited
196	,,		,,	136			118	10,000
197	Sturt		,,	107			56	
198	Nicholson		,,	106			100	
199	Franklin		,,	135				

INDEX TO WELLS AND BORES—*continued.*

No.	Locality.	District.	Strata.	Remarks.
200	Youngarrina Springs	Albert		Well 6. ft deep; estimated 800 to 1,000 gallons good water per diem.
201	M'Crae's Well, Baongumyarra.	,,		Well 27 ft. deep; 8 or 9 ft. in rock; good supply for stock; too brackish for domestic purposes.
202	Buckley's Well, Yantabulla.	,,	Bottom on sandy drift	Well 40 ft. deep; water fairly good, but slightly impregnated with soda; daily yield about 150 gallons.
203	Rudder's Well, Warroo Station.	,,		Well 20 ft. deep; water rose 10 ft.; very salt.
204	Tynganie Spring	,,		Well 40 ft. deep; excellent water; estimated at about 10,000 gallons per diem.
205	Brindingabba, Moolort Block.	,,		Well 94 ft. deep; watered 12,000 sheep through a drought; excellent quality
206	,, ,,	,,		Well 120 deep; water excellent; rose 90 ft. in shaft.
207	Kilfera, Kilfera Block	,,		Well 150 ft. deep; supply 100 gals. per diem; good water
208	Kenmare Block	,,		Well 38 ft. deep; bore 197 ft. water salt.
209	,,	,,		Well 35 ft. deep; water very salt; very bitter; no supply
210	Kilfera Block	,,		Well 100 ft. deep; said to contain powerful mineral poison.
211	Polygonum Hut	Darling		On road Booligal to Wilcannia.
212	Barringan Well	Albert		On the "Border Run."
213	Wanganilla	Murrumbidgee		On South Wanganella Block
214	Pretty Pine	,,		Lower Deniliquin Run.
215	Beefwood Well, on "The Wells" Block	County Yungnulgra, Albert District.		
216	New Well, on Block Byjerk South, Paroo River.	County Landsborough, Albert District.		
217	Well	County Yungnulgra, Albert District.	Coolawundy	Well 157 ft. deep; good water
218	Well, Block Germano East.	County Yungnulgra.	Coparto	Well 50 ft. deep; water rises to 20 ft.
219	Junction Well, Germano East.	Albert		Well 80 ft. deep; good water rises to 50 ft. of surface

INDEX TO WELLS—*continued.*

Number of Well.	Quality.	Nature of surrounding country.	Strata.	Remarks.
186	... ...	... ...	... ...	Not finished. No water.
187	Fresh	... ...	... ...	Not finished.
188	... ...	... ...	... ...	,,
189	... ...	... ...	... ...	,,
190	... ...	... ...	... ...	,,
191	... ...	... ...	... ...	,,
192	... ...	... ...	... ...	,,
193		... ...	... ...	,,
194				
195	Fresh			
196	,,			
197	,,			
198	,,			
199	,,			

INDEX TO WELLS AND BORES—*continued.*

No.	Locality.	District.	Strata.	Remarks.
220	Danbery Well, Danbery North Block.	,, ...	... ...	Good stock water.
221	Minamithtoo Well, Dilkoorba North Block.	... ...	... ...	300 ft. deep; good water rose to 65 ft. from surface.
222	Parkungi Block ...	Albert	... ...	298 ft. deep; good water rose to 80 ft. from surface.
223	Well	... ...	Poolamacca ...	236 ft. deep; good water.
224	Thackaringa Well ...	Albert	... ...	236 ,, ,,
225	Wanga Well	,, ...	... ...	270 ,, ,,
226	North Ita Well ...	... ...	... ...	240 ,, ,,
227	Melang West Well ...	.. ..	... ...	20 ,, ,,
228	Moredevil Station ...	Liverpool Plains	... ...	Artesian fresh water.
229	Myalmundi	Narromine ...	... ...	194 ft. deep; good water.
230	Gap Well (45 miles West of Cobar).	South Warrego	... ...	Salt.
231	Top Well, Newcombe	Muggare Back B Block.	... ...	70 ft. deep; good water.
232	Dungle Well (5 miles north of previous well).	... ...	... ...	70 ft. good for stock; at 75 ft. salt.
233	Walgett Wells ...	Town of Walgett	... ...	40 to 50 ft.; good water in black soil flats.
234	Triangi Well	Narromine ...	... ...	350 ft.; good water; equal to 5,000 to 6,000 gals. per day
235	Chapman's Well ...	,, ...	... ...	350 ft.; water brackish.
236	Randwick Asylum ...	Randwick ...	... ...	Fresh water.
237	Bingagong Well ...	Yanko Creek ...	... ...	120 ft. deep; fresh water rose 52 ft. in shaft.
238	Goree Well	,, ...	... ...	172 ft. deep; good water rose 105 ft.
238A	Packsaddle	Albert	Blue clay on drift.	102 ft. deep; 14,000 gals. in 24 hours, brackish.
239	,, ...	,, ...	... ...	Supply unlimited; 250 ft. dp.
240	Tarella	,, ...	Shaly clay and	250 ft. deep; water obtained by driving 10,000 gallons in twenty-four hours.
241	,, ...	,, ...	Conglomerate cement.	Untested fresh; rose 60 ft. in shaft.
242	Packsaddle	,, ...	... ...	Trial shaft 40 ft., salt, large supply.
243	Cobbham	,, ...	... ...	Supply large; fresh water.
244	Big Plain Well ...	... ...	... ...	Fresh water.
245	Bulgrandra Well ...	... ...	... ...	Fresh water.
246	Old Gunbar Well ...	... ...	... ...	Salt water.
247	Gunbar Road (13 miles from Hay).	... ...	... ...	Fresh water.

INDEX TO WELLS AND BORES—*continued.*

No.	Locality.	District.	Strata.	Remarks.
248	Gunbar Road (13 miles from Hay).	... ...	... ...	Fresh water.
249	75 miles W. of Bourke	... ...	... ...	Artesian water, 950 ft. deep.
250	101½ miles ,,	... ...	... ...	Artesian water, 952 ft. deep.
251	Tibooburra	Whillabrimah ..	Cretaceous ...	Fresh water, good supply, rose from 300 ft. to 70 ft. from surface.
252	Salisbury Downs			
253	Kallara			
254	,,			
255	Mara			
256	Buckimba	... ...	... ...	Incomplete.
257	Dunlop			
258	,,			
259	Kerrabra			
260	Beladic.			

GOVERNMENT BORES (LET).

No. on Map	Name.	Parish.	County.	Road.	Contractor.
14	Coonamble ...	Morambilla...	Leichhardt	At Coonamble ...	Wm. Watkins
16	Warroo	Waroo ...	Irrara ...	Bourke to Hungerford	Petrolia Co.
17	Engonia	Engonia ...	Culgoa ...	Bourke-Barringun ...	,,
18	Louth (No. 2) ...	... ...	Barrona ...	Louth to Wanaaring	Wm. Pickering
19	77 M.	... ...	Ularara ...	Wanaaring to Milparinka.	,,
20	41 M.	... ...	Yantara ...	,, ,,	,,
21	25 M.	... ...	,, ...	,, ,,	,,
22	10 M.	... ...	Evelyn ...	,, ,,	,,
23	No. 1	... ...	Yantara ...	Cobham to Silverton	Petrolia Co.
24	No. 2	... ...	Mootwingee	,, ,,	,,
25	No. 3	... ...	,,	,, ,,	,,
26	No. 4	... ...	,,	,, ,,	,,
27	No. 5	... ...	Farnell ...	,, ,,	,,
28	174 M.	Makingah ...	Livingstone	Ivanhoe to Menindie	J. H. Stubbs
29	151 M.	Huco	,,	,, ,,	,,
30	130 M.	Tolarno ...	,,	,, ,,	,,
31	111 M.	Linbee ...	Manara ...	,, ,,	,,
32	21 M.	Casey... ...	,, ...	Ivanhoe	,,
33	77 M.	Pulpa... ...	Wentworth	Euston to Pooncarie	,,
34	Anumpo	Buraguy ...	,,	,, ,,	,,
35	38 M.	... ...	Taila ...	,, ,,	,,
36	19 M.	Pringle ...	,, ...	,, ,,	,,
37	33 M.	... ...	,, ...	Box Creek to Anumpo	,,
38	Willandra Well...	Whitminbah	Manara ...	Balranald to Ivanhoe	Petrolia Co.
39	Dolmoreve Well	Cubarla ...	,, ...	,, ,,	,,
40	Holy Box Well ...	Pittenweem...	Mossgiel ...	Booligal to Ivanhoe...	,,
41	Polygonum Hut...	Annan ...	Waljeers ...	,, ,, ...	,,
42	Jumping Sandhill Well.	Yarto... ...	,, ...	,, ,, ...	,,
43	Hay	... ...	Waradgery	Hay to Booligal ...	,,
44	Angledool ...	Mundoo ...	Finch ...	Collarindabri to Angledool.	Chas. Mayes
51	No. 1	Tulloona ...	Stapylton...	Moree to Bogabilla...	,,
52	No. 2	Illingrimindi	,, ...	,, ,, ...	,,

GOVERNMENT BORES (APPROVED BUT NOT LET).

No. on Map	Name.	Parish.	Country.	Road.
50	Wakool	Wombah	Caira	Balranald to Wakool.
49	Yellow Waterholes...	Bama	Caddell ...	Deniliquin to Moama.

PRIVATE BORES, NEW SOUTH WALES.

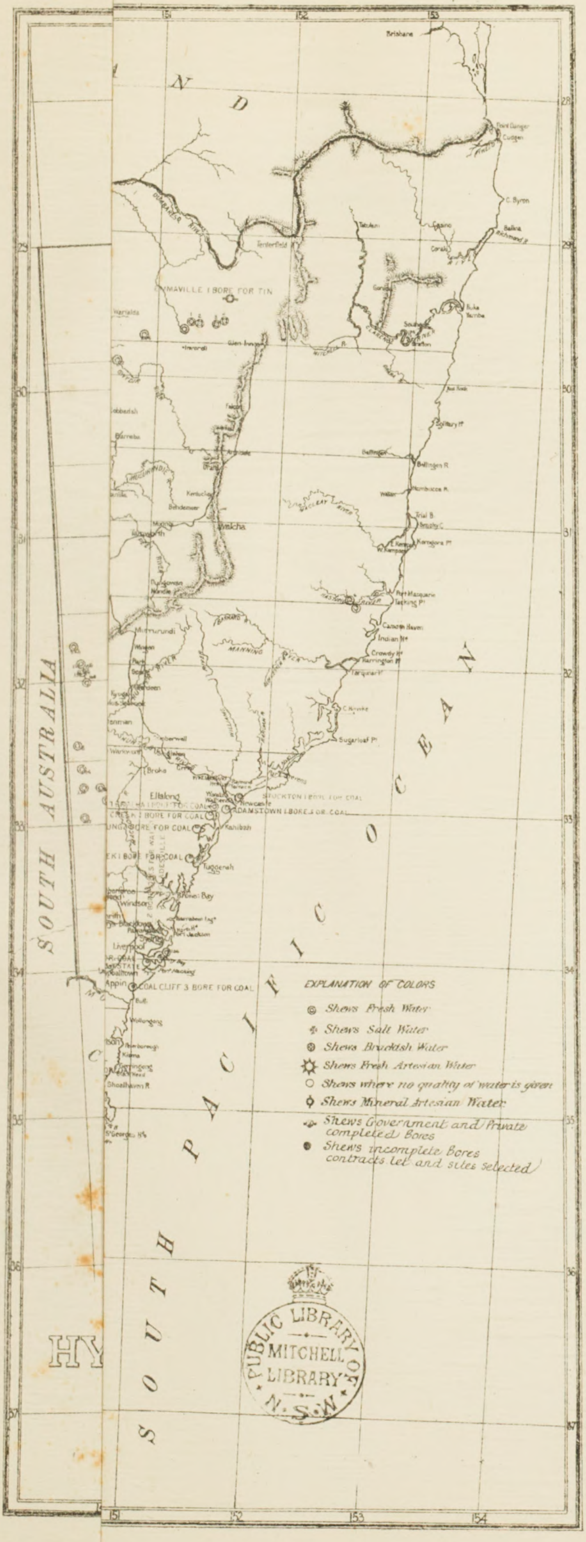
Station.	Parish.	County.	Depth in feet.	Artesian supply in gallons per diem.	Ref. No. on Map.
Buckanbe	Wygilla ...	Rankin... ...	725	Nil... ...	1
Marra, No. 1	Balara	Killara... ...	1,482	Nil... ...	2
,, No. 2	... ...	,, ...	895	Nil... ...	3
Dunumbral	... ...	Finch	2,070	300 ...	4
Dunlop, No. 1	Sargorimba ...	Barrona ...	620	43 ...	5
,, No. 2	Goolgumbla ...	Landsbrough...	940	576,000 ...	6
,, No. 3	Coonong ...	,, ...	860	600,000 ...	7
,, No. 4	,, ...	,, ...	750	500,000 ...	8
,, No. 5	Tweandah ...	,, ...	1,200	15,000 ...	9
Nocoleche, No. 1 ...	... ...	Barrona ...	916	140,000 ...	10
,, No. 2	... ...	Ularara ...	1,500	Nil... ...	11
,, No. 3	... ...	Barrona ...	1,227	700,000 ...	12
Belalie, No. 1	... ...	Culgoa	1,693	600,000 ...	13
,, No. 2	... ...	Irrara	1,160	In progress	14
,, No. 3	... ...	,, ...	1,600	,,	40
Yanda, No. 1	... ...	Cowper ...	750	Nil... ...	15
,, No. 1	... ...	,, ...	1,008	Nil... ...	16
Salisbury Downs, No. 1 ...	... ...	Yantara ...	1,365	200 ...	17
,, No. 2 ...	... ...	,, ...	1,568	9,000 ...	18
Kerribree, No. 1 ...	... ...	Barrona ...	1,073	350,000 ...	20
,, No. 2	Moseta... ...	,, ...	1,340	1,750,000 ...	21
Wangamana	... ...	,, ...	1,600	224,000 ...	22
Pirillie	... ...	Irrara	613	No information.	23
Kallara, No. 1	Mulyee... ...	Kallara ...	46	9,000 ...	24
,, No. 2	Undelcarra ...	,, ...	140	4,000 ...	25
,, No. 3 (Kingswell bore).	Dinpooker ...	,, ...	600	10,000 ...	26
,, No. 4 (Toonburra bore).	Parkin	Fitzgerald ...	820	1,000 ...	27
,, No. 5 (Moonooloo bore).	Moonooloo ...	Kallara... ...	900	1,500 ...	25
,, No. 6 (Box bore) ...	... ...	,, ...	1,411	2,000 ...	29
,, No. 7 (Nefeenyah bore).	Tutly	,, ...	540	500,000 ...	33
,, No. 8 (Paradise bore)	Calpacaira ...	,, ...	931	60,000 ...	31
,, No. 10 (Gum Lake bore).	Paroo	,, ...	676	50,000 ...	32
,, No. 11 (Tonga bore)	Mullawoolka ...	,, ...	700	7,000 ...	33
,, No. 12 (Mungundi Lake bore)	... ...	,, ...	760	Not stated	34
Yancannia, No. 1	Cockulby ...	Yanbara ...	268	In progress	35
,, No. 2	Bingiwilpa ...	,, ...	203	480,000 ...	36
Fort Bourke	... ...	Gunderbooka ..	1,284	Nil... ...	37
Weilmoringle, No. 1 ...	... ...	Culgoa	2,005	28,000 ...	38
,, No. 2	... ...	,, ...	1,590	1,728,000 ...	39
Pirillie, No. 2	... ...	... ...	803	60 ...	43
Momba, No. 1	Charlton ...	Fitzgerald ...	1,505	Nil... ...	44
,, No. 2	Parkingi ...	Yungunlgra ...	1,261	Nil... ...	45

Particulars not to hand of Corella, Nos. 1 and 2, and Lissington, Nos. 1, 2, and 3, and Brindingabba bores.

LIST OF ARTESIAN WELLS IN NEW SOUTH WALES,

Governtment Wells (complete or in progress.)

No. on Map	Name.	Parish.	County.	Road.	Depth in feet.	Supply per diem in gallons.	Temperature.	Ap'rox Height above sea level.	Contractor.
7	121 Mile ...	... ...	Ularara	Milparinka to Wanaaring.	1,304	... ...	In progress		Wm. Pickering
8	106 Mile ...	... ...	,,	,,	1,299	... ...	,,		Wm. Pickering
1	Bourke ...	East Bourke	Cowper	At Bourke	1,467	Nil ...	...	350	Petrolia Co.
12	Moongulla	Bukkulla ...	Finch...	Collarindabri to Angledool.	2,000	... ...	In progress		Chas. Mayes.
13	Nyngan ...	Nyngan ...	Oxley...	At Nyngan	700	... ...	,,		Wm. Watkins
10	Louth ...	... ...	Landsborough	Louth-Wanaaring...	810	... ...	,,		Wm. Pickering
5	Youngerina	Youngerina	Irrara ..	Bourke-Hungerford	165	175,000	82°	450	
6	Native Dog	Leila ...	Gunderbooka	Bourke-Barringun	475	2,000,000	92°	...	
15	Yantabulla	Mucruss ...	Irrara ..	Bourke-Hungerford	210	100 000	92°	...	Petrolia Co.
11	Barringun	Barringun	Culgoa	Bourke-Barringun	815	... ...	...	...	
48	Ballimore...	Murrungundie.	Lincoln	Near Dubbo ...	561 1/2	24,000	...	...	
4	Cuttaburra	Paroo ...	Irrara ..	Bourke-Wanaaring	965 5/6	22,464	...	450	
2	Goonery ...	Goonery ...	Barrona	,,	89 1/6	24,000	...	...	
9	91 Mile ...	... ...	Ularara	Wanaaring-Milparinka.	72	Nil ...	...	...	Put down by the Superintendent of Drills.
45	Tibooburra No. 1	... ...	Tongowoko.	At Tibooburra ...	288	Not flow'g	...	...	
46	,, No. 2	... ...	,,	,, ...	53	,,	...	...	
47	Milparinka	... ...	Evelyn	At Milparinka ...	99 3/4	,,	...	...	
3	Tincheloooka	Wanga ...	Barrona	Bourke-Wanaaring	... ...	33,000	...	...	



NEW SOUTH WALES
HYDROGRAPHICAL MAP

SHEWING POSITION OF WELLS, BORES, & ARTESIAN SUPPLES.

SCALE

Compiled from information furnished by the Government Geologist, the Chief Inspector of Public Watering Places, and the Superintendent of Diamond Drills.

EXPLANATION OF COLORS

- Shews Fresh Water
- Shews Salt Water
- Shews Brackish Water
- Shews Fresh Artesian Water
- Shews where no quality of water is given
- Shews Mineral Artesian Water
- Shews Government and Private completed Bores
- Shews Incomplete Bores contracts let and sites selected

COLONY OF QUEENSLAND

SOUTH AUSTRALIA

COLONY OF VICTORIA

SOUTH PACIFIC OCEAN