SECTION III.

PHYSIOGRAPHY.

§ 1. General Description of Australia.

1. **Geographical Position.**—The Australian Commonwealth, which includes the island continent of Australia proper and the island of Tasmania, is situated in the Southern Hemisphere, and comprises in all an area of about 2,974,581 square miles, the mainland alone containing about 2,948,366 square miles. Bounded on the west and east by the Indian and Pacific Oceans respectively, it lies between longitudes 113° 9′ E. and 153° 39′ E., while its northern and southern limits are the parallels of latitude 10° 41′ S. and 39° 8′ S., or, including Tasmania, 43° 39′ S. On its north are the Timor and Arafura Seas and Torres Strait, on its south the Southern Ocean and Bass Strait.[1]

Tropical and Temperate Regions. Of the total area of Australia the lesser portion lies within the tropics. Assuming, as is usual, that the latitude of the Tropic of Capricorn is 23° 30′ S.[2], the areas within the tropical and temperate zones are approximately as follows :—

AREAS OF TROPICAL AND TEMPERATE REGIONS OF STATES WITHIN TROPICS.

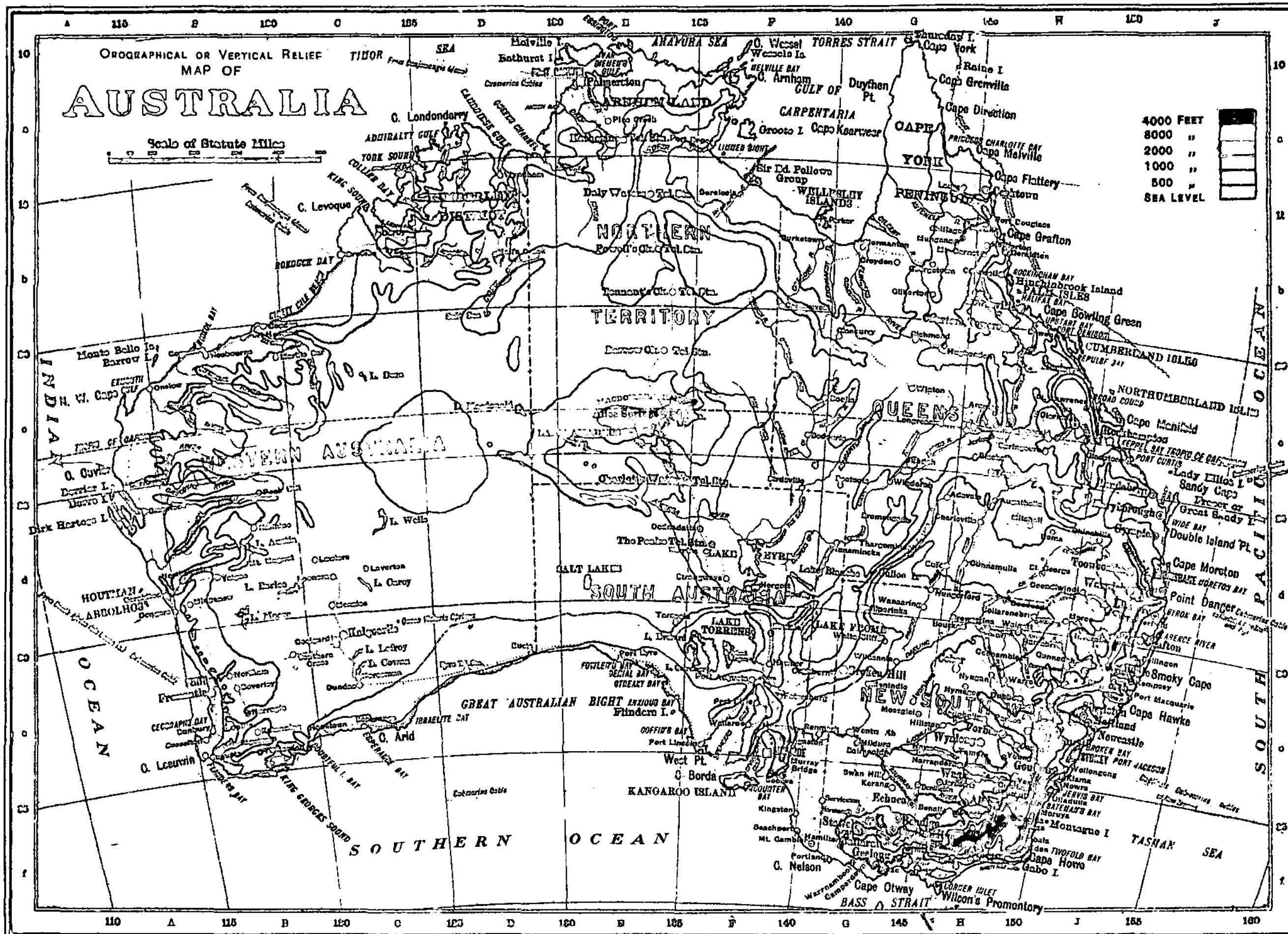
Areas.	Queensland.	Western Australia.	Northern Territory.	Total.
	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.
Within Tropical Zone	359,000	364,000	426,320	1,149,320
Within Temperate Zone	311,500	611,920	97,300	1,020,720
Ratio of Tropical part to whole State ...	0.535	0.373	0.814	0.530
Ratio of Temperate part to whole State ...	0.465	0.627	0.186	0.470

Thus the tropical part is roughly about one-half (0.530) of the three territories mentioned above, or about five-thirteenths of the whole Commonwealth (0.386). See hereafter Meteorology 3.

2. **Area of Australia compared with that of other Countries.**—That the area of Australia is greater than that of the United States of America, that it is four-fifths of that of Canada, that it is nearly one-fourth of the area of the whole of the British Empire, that it is nearly three-fourths of the whole area of Europe, that it is more than 25 times as large as any one of the following, viz., the United Kingdom, Hungary, Italy, the Transvaal, and Ecuador, are facts which are not always adequately realised. It is this great size, taken together with the fact of the limited population, that gives to the problems of Australian development their unique character, and its clear comprehension is essential in any attempt to understand those problems.

1. The extreme points are "Steep Point" on the west, "Cape Byron" on the east, "Cape York" on the north, "Wilson's Promontory" on the south, or, if Tasmania be included, "South East Cape." The limits, according to the 1903-4 edition of "A Statistical Account of Australia and New Zealand," p. 2, and, according to Volume XXV. of the "Encyclopædia Britannica," tenth edition, p. 787, are respectively 113° 5′ E., 153° 16′ E., 10° 39′ S., and 39° 11½′ S., but these figures are obviously defective. A similar inaccuracy appears in the XI. edition of the Encyclopædia.

2. Its correct value for 1916 is 23° 27′ 0″.76, and it decreases about 0″.47 per annum.



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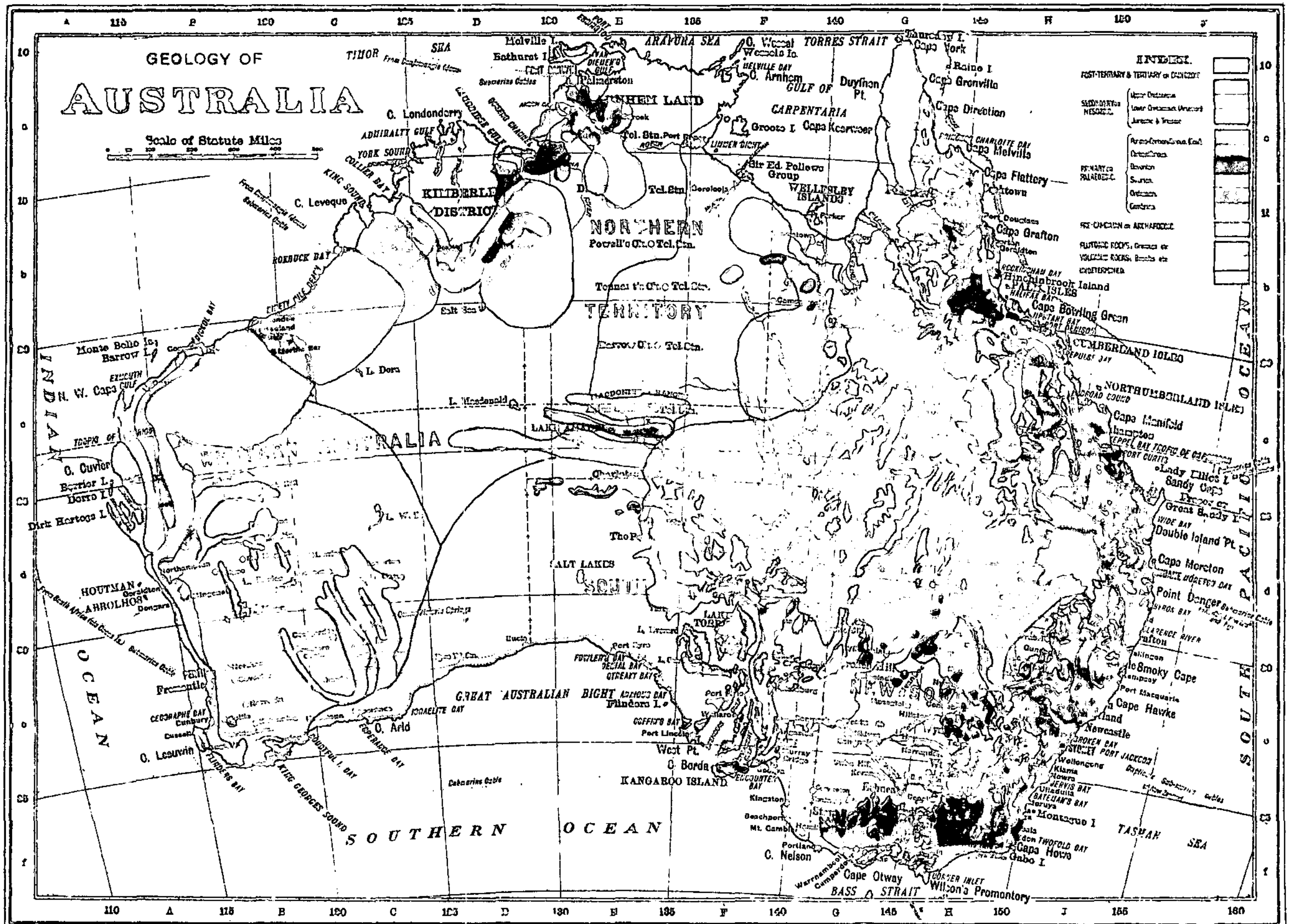

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The relative magnitudes may be appreciated by a reference to the following table, which shews how large Australia is compared with the countries referred to, or *vice versa*. Thus, to take line 1, we see that Europe is about $1\frac{3}{10}$ times (1.29676) as large as Australia, or that Australia is about three-quarters (more accurately 0.77) of the area of Europe.

SIZE OF AUSTRALIA IN COMPARISON WITH THAT OF OTHER COUNTRIES.

Commonwealth of Australia ... 2,974,581 square miles.

Country.	Area.	Australian Commonw'lth in comparison with—	In comparison with Australian C'wealth.
Continents—	Sq. miles.		
Europe	3,857,323	0.77	1.29676
Asia	16,852,853	0.18	5.66562
Africa	12,236,601	0.24	4.11372
North and Central America and West Indies ...	8,560,315	0.35	2.87782
South America	7,446,202	0.40	2.50327
Australasia and Polynesia	3,462,572	0.86	1.16605
Total, exclusive of Arctic and Antarctic Conts.	52,415,866	0.06	17.62126
Europe—			
Russia (inclusive of Poland, Ciscaucasia & Finland)	2,122,998	1.40	0.71371
Austria-Hungary (incl. of Bosnia & Herzegovina)	261,259	11.39	0.08783
Germany	208,780	14.25	0.07018
France	207,054	14.37	0.06969
Spain	194,778	15.27	0.06548
Sweden	172,963	17.20	0.05814
Norway	124,643	23.86	0.04190
United Kingdom	121,633	24.45	0.04089
Italy	110,632	26.89	0.03719
Denmark (inclusive of Iceland)	55,338	53.73	0.01861
Rumania	53,489	55.61	0.01798
Bulgaria	43,305	68.69	0.01455
Greece	41,933	70.94	0.01409
Portugal	35,490	83.82	0.01193
Serbia	33,891	87.76	0.01139
Switzerland	15,976	186.22	0.00537
Netherlands	12,582	236.42	0.00423
Belgium	11,373	261.78	0.00382
Albania	11,317	262.84	0.00380
Turkey	10,882	273.34	0.00366
Montenegro	5,603	530.88	0.00188
Luxemburg	998	2941.18	0.00034
Andorra	175	16997.61	0.00006
Malta	118	25423.76	0.00004
Liechtenstein	65	45793.55	0.00002
San-Marino	38	78278.45	0.00001
Monaco	8	371822.63	...
Gibraltar	2	1487290.50	...
Total, Europe	3,857,323	0.77	1.29676
Asia—			
Russia (inclus. of Transcaucasia, Siberia, Steppes, Transcaspia, Turkestan and inland waters) ...	6,641,587	0.45	2.23278
China and Dependencies...	3,913,560	0.76	1.31567
British India...	1,093,074	2.72	0.36747
Independent Arabia	1,000,000	2.97	0.33618
Feudatory Indian States...	709,555	4.19	0.23854
Turkey (including Samos)	699,522	4.25	0.23516
Persia	628,000	4.74	0.21112
Dutch East Indies	583,211	5.10	0.19606
Japan (and Dependencies)	263,084	11.31	0.08844

Country.	Area.	Australian Commonwe'lth in comparison with—	In comparison with Australian C'wealth.
ASIA (continued)—	Sq. Miles.		
Afghanistan	250,000	11.90	0.08405
Siam	195,000	15.25	0.06555
Philippine Islands (inclusive of Sulu Archipelago)	120,000	23.60	0.04236
Laos	111,940	26.57	0.03763
Bokhara	83,000	35.83	0.02790
Omán	82,000	36.27	0.02757
British Borneo and Sarawak	73,106	40.68	0.02457
Cambodia	67,724	43.92	0.02277
Annam	61,718	48.20	0.02075
Nepál	54,000	55.10	0.01815
Tonking	46,223	64.35	0.01554
Federated Malay States	27,506	108.14	0.00925
Ceylon	25,332	117.42	0.00852
Malay Protectorate (including Johore) ...	24,970	119.13	0.00839
Khiva	24,000	123.94	0.00807
Cochin China...	21,988	135.28	0.00739
Bhután	20,000	148.73	0.00672
Aden and Dependencies	9,005	330.32	0.00303
Timor, etc. (Portuguese Indian Archipelago) ...	7,330	406.50	0.00246
Brunei	4,000	743.64	0.00134
Cyprus	3,584	833.33	0.00120
Kiauchau (Neutral Zone)	2,500	1189.83	0.00084
Goa, Damaõ, and Diu	1,638	1818.18	0.00055
Straits Settlements	1,600	1851.85	0.00054
Sokotra	1,382	2152.22	0.00046
Hong Kong and Dependencies	391	7607.62	0.00013
Kwang Chan Wan	386	7706.17	0.00013
Wei-hai-wei	285	10623.50	0.00009
Bahrein Islands	250	11898.32	0.00008
Kiauchau (German)	200	14872.90	0.00007
French India (Pondicherry, etc.)	198	15023.14	0.00007
Macao, etc.	4	743643.25	...
Total, Asia	16,852,853	0.18	5.66566
Africa—			
French Sahara	1,544,000	1.93	0.51907
French Equatorial Africa	1,003,600	2.96	0.33739
Soudan	984,520	3.02	0.33098
Belgian Congo	909,654	3.27	0.30582
French Military District of the Niger ...	534,124	5.57	0.17956
Angola	484,800	6.14	0.16298
Union of South Africa	473,100	6.28	0.15905
Rhodesia	438,575	6.78	0.14744
Portuguese East Africa	426,712	6.97	0.14345
Tripoli and Benghezi	406,000	7.33	0.13649
German East Africa	384,180	7.74	0.12915
Abyssinia	350,000	8.50	0.11766
Egypt	350,000	8.50	0.11766
Mauretania	344,967	8.62	0.11597
Algeria (including Algerian Sahara)... ...	343,500	8.66	0.11548
Nigeria and Protectorate	336,000	8.85	0.11296
German South-west Africa	322,450	9.23	0.10840
Senegambia and Niger	302,136	9.84	0.10157
Bechuanaland Protectorate	275,000	10.82	0.09245
British East Africa Protectorate	246,822	12.05	0.08298
Madagascar	226,016	13.16	0.07598
Morocco	219,000	13.58	0.07362
Kamerun	191,130	15.56	0.06425

Country.	Area.	Australian Commonw'lth in comparison with—	In comparison with Australian C'wealth.
AFRICA (continued)—	Sq. miles.		
Italian Somaliland	139,430	21.34	0.04687
Ivory Coast	125,538	23.69	0.04220
Uganda Protectorate	109,119	27.26	0.03668
French Guinea	92,249	32.25	0.03101
Gold Coast Protectorate (with North. Territories)	80,000	37.18	0.02689
Senegal	74,012	40.19	0.02488
Rio de Oro, etc.	73,000	40.75	0.02454
British Somaliland	68,000	43.74	0.02286
Tunis	50,000	59.49	0.01681
French Somali Coast	46,320	64.21	0.01557
Eritrea	45,800	64.95	0.01540
Liberia	40,000	74.36	0.01345
Nyassaland Protectorate...	39,315	75.66	0.01322
Dahomey	37,527	79.26	0.01261
Togoland	33,700	88.26	0.01133
Sierra Leone and Protectorate	31,000	95.95	0.01042
Portuguese Guinea	13,940	213.22	0.00469
Spanish Guinea (Rio Muni, etc.)	12,000	247.88	0.00403
Basutoland	11,716	253.89	0.00393
Swaziland	6,536	455.10	0.00219
Gambia and Protectorate	4,504	660.43	0.00151
Cape Verde Islands	1,480	2000.00	0.00050
Zanzibar	1,020	2941.18	0.00034
Réunion	965	3082.47	0.00032
Fernando Po, etc.	814	3654.28	0.00027
Mauritius and Dependencies	809	3676.86	0.00027
Comoro Islands	694	4286.14	0.00023
St. Thomas and Prince Islands	360	8262.73	0.00012
Seychelles	156	19067.82	0.00005
Mayotte, etc....	143	20801.27	0.00005
Spanish North and West Africa	87	34190.59	0.00003
St. Helena	47	63288.95	0.00002
Ascension	34	87487.65	0.00001
Total, Africa	12,236,601	0.24	4.11372
North and Central America and West Indies—			
Canada	3,729,665	0.80	1.25385
United States (exclusive of Alaska, etc.) ...	2,973,890	1.00	0.99976
Mexico	785,881	3.78	0.26420
Alaska	590,884	5.03	0.19864
Newfoundland and Labrador	162,734	18.28	0.05471
Nicaragua	49,200	60.46	0.01654
Guatemala	48,290	61.61	0.01623
*Greenland	46,740	63.65	0.01571
Honduras	44,275	67.18	0.01488
Cuba	44,215	67.28	0.01486
Costa Rica	23,000	129.32	0.00773
San Domingo...	18,045	164.74	0.00607
Haiti	10,204	291.55	0.00343
British Honduras	8,598	345.96	0.00289
Salvador	7,225	411.52	0.00243
Bahamas	4,404	675.43	0.00148
Jamaica	4,207	707.05	0.00141
Porto Rico	3,606	824.90	0.00121
Trinidad and Tobago	1,868	1592.39	0.00063
Leeward Islands	715	4160.25	0.00024
Guadeloupe and Dependencies	687	4329.81	0.00023
Windward Islands	527	5644.37	0.00018

* Danish colony only. Total area has been estimated as between 827,000 and 850,000 square miles.

Country.	Area.	Australian Commonwe'lth in comparison with—	In comparison with Australian C'wealth.
N. & C. AMERICA & W. INDIES (continued)—	Sq. miles.		
Curaçao and Dependencies	403	7381.09	0.00014
Martinique	381	7807.30	0.00013
Turks and Caicos Islands	166	17925.18	0.00005
Barbados	166	17925.18	0.00005
Danish West Indies	138	21554.94	0.00005
St. Pierre and Miquelon	93	31984.74	0.00003
Cayman Islands	89	33422.26	0.00003
Bermudas	19	156556.89	...
Total, N. and C. America and W. Indies ...	8,560,315	0.35	2.87782
South America—			
Brazil (inclusive of Acré)...	3,364,564	0.88	1.13110
Argentine Republic	1,153,119	2.58	0.38766
Peru	722,461	4.12	0.24288
Bolivia	514,155	5.79	0.17285
Colombia (exclusive of Panama)	440,846	6.75	0.14820
Venezuela	398,594	7.46	0.13400
Chile	289,829	10.26	0.09744
Paraguay	165,000	18.03	0.05546
Ecuador	116,000	25.64	0.03900
British Guiana	89,480	33.24	0.03008
Uruguay	72,153	41.22	0.02426
Dutch Guiana	46,060	64.60	0.01548
French Guiana	34,061	87.33	0.01145
Panamá	32,380	91.86	0.01088
Falkland Islands	6,500	456.62	0.00219
South Georgia	1,000	2974.58	0.00034
Total, South America	7,446,202	0.40	2.50327
Australasia and Polynesia—			
Commonwealth of Australia	2,974,581	1.00	1.00000
Dutch New Guinea	151,789	19.60	0.05103
New Zealand and Dependencies	104,751	28.39	0.03522
Papua	90,540	32.85	0.03044
Kaiser Wilhelm Land	70,000	42.50	0.02353
Bismarck Archipelago	20,000	148.73	0.00672
British Solomon Islands	14,800	204.36	0.00497
New Caledonia and Dependencies	8,548	347.99	0.00287
Fiji	7,435	400.08	0.00250
Hawaii	6,449	460.83	0.00217
German Solomon Islands, etc.	5,160	576.46	0.00173
New Hebrides	5,100	583.25	0.00171
French Establishments in Oceania	1,520	1960.78	0.00051
German Samoa	1,000	2974.58	0.00034
Tonga	390	7627.13	0.00013
Guam	210	14164.67	0.00007
Gilbert and Ellice Islands	187	15906.85	0.00006
Samoa (U.S.A. part)	102	29162.56	0.00003
Norfolk Island	10	297458.10	...
Total, Australasia and Polynesia ...	3,462,572	0.86	1.16405
British Empire...	12,755,484	0.23	4.28816

3. **Relative Size of Political Subdivisions.**—As already stated, Australia consists of six States and the Northern and Federal Territories. The areas of these, in relation to one another and to the total of Australia, are shewn in the following table :—

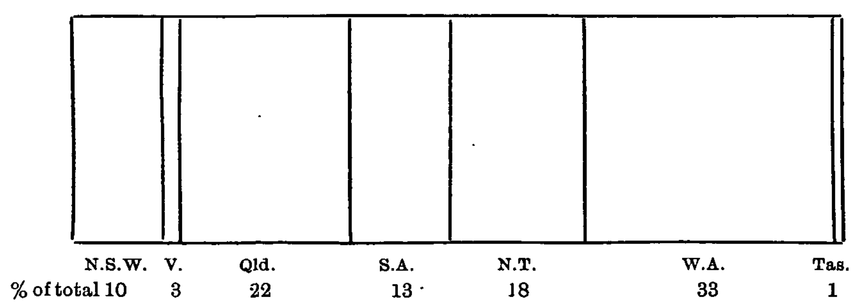
RELATIVE SIZE OF STATES AND COMMONWEALTH.

State.	Area.	Ratio which the Area of each State and Territory bears to that of other States, Territories and Commonwealth.							
		N.S.W.	Vic.	Q'land.	S.A.	W.A.	Tas.	N. Ter.	C'wlth.
	Sq. miles.								
New South Wales	309,460	1.000	3.522	0.462	0.814	0.317	11.806	0.591	0.104
Victoria ...	87,884	0.284	1.000	0.131	0.231	0.090	3.352	0.168	0.030
Queensland ...	670,500	2.166	7.629	1.000	1.764	0.687	25.577	1.280	0.225
South Australia	380,070	1.228	4.325	0.567	1.000	0.389	14.498	0.726	0.128
West. Australia	975,920	3.153	11.105	1.455	2.568	1.000	37.228	1.864	0.328
Tasmania ...	26,215	0.085	0.298	0.039	0.069	0.027	1.000	0.050	0.009
North. Territory	523,620	1.691	5.958	0.781	1.378	0.537	19.974	1.000	0.176
Federal Territory	912	0.003	0.010	0.001	0.003	0.001	0.034	0.002	0.000[1]
Commonwealth	2,974,581	9.610	33.847	4.436	7.827	3.048	113.469	5.681	1.000

1. The correct decimal is 0.0003.

Thus, looking at the top line, New South Wales is seen to be over three-and-a-half times as large as Victoria (3.522) and less than one-half the size of Queensland (0.462); or again, looking at the bottom line, the Commonwealth is shewn to be more than nine-and-a-half times as large as New South Wales (9.610), and nearly thirty-four times as large as Victoria (33.847).

These relative magnitudes are shewn in the small diagram below. It may be added that Papua (or British New Guinea), with its area of 90,540 square miles, is 0.030 of the area of the Commonwealth. The comparatively small size of the Federal Territory prevents its being shewn in this diagram.



4. **Coastal Configuration.**—There are no striking features in the configuration of the coast; the most remarkable indentations are the Gulf of Carpentaria on the north and the Great Australian Bight on the south. The York Peninsula on the extreme north is the only other remarkable feature in the outline. In Year Book No. 1, an enumeration of the features of the coast-line of Australia was given (see pp. 60 to 68).

(i.) *Coast-line.* The lengths of coast-line, exclusive of minor indentations, both of each State and of the whole continent, are shewn in the following table:—

SQUARE MILES OF TERRITORY PER MILE OF COAST LINE.

STATES AND CONTINENT.

State.	Coast-line.	Area ÷ Coast-line.	State.	Coast-line.	Area ÷ Coast-line.
	Miles.	Sq. miles.		Miles.	Sq. miles.
New South Wales[1]	700	443	South Australia ...	1,540	247
Victoria	680	129	Western Australia	4,350	224
Queensland ...	3,000	223	Continent[2] ...	11,310	261
Northern Territory	1,040	503	Tasmania ...	900	29

1. Including Federal Territory. 2. Area 2,948,366 square miles.

For the entire Commonwealth this gives a coast-line of 12,210 miles, and an average of 244 square miles for one mile of coast line. According to Strelbitski, Europe has only 75 square miles of area to each mile of coast line, and, according to recent figures, England and Wales have only one-third of this, viz., 25 square miles.

(ii.) *Historical Significance of Coastal Names.* It is interesting to trace the voyages of some of the early navigators by the names bestowed by them on various coastal features—thus Dutch names are found on various points of the Western Australian coast, in Nuyt's Archipelago, in the Northern Territory and in the Gulf of Carpentaria; Captain Cook can be followed along the coasts of New South Wales and Queensland; Flinders' track is easily recognised from Sydney southwards, as far as Cape Catastrophe, by the numerous Lincolnshire names bestowed by him; and the French navigators of the end of the eighteenth and the beginning of the nineteenth century have left their names all along the Western Australian, South Australian, and Tasmanian coasts.

5. Geographical Features of Australia.—In each preceding issue of this Year Book, fairly complete information has been given concerning some special geographical element. Thus No. 1 Year Book, pp. 60-68, contains an enumeration of Coastal features. No, 2, pp. 66-67, deals with Hydrology, No. 3, pp. 59-72, with Orography, No. 4, pp. 59-82, with the Lakes of Australia, No. 5, pp. 51-80, with the Islands of Australia, No. 6, pp. 55-66, with the Mineral Springs of Australia, and No. 7, pp. 56-58, with the Salient Features in the Geological History of Australia, with special reference to changes of climate. This practically completes the description of the ordinary physical features. An orographical or vertical relief map of Australia will be found on p. 49.

§ 2. The Fauna of Australia.

An authoritative article describing in some detail the principal features of the Fauna of Australia was given in Year Books No. 1 (see pp. 103 to 109) and No. 2 (see pp. 111 to 117), while a synoptical statement appeared in No. 3 (see pp. 73 to 76). Considerations of space will, however, preclude the inclusion in this issue of more than a passing reference to the subject.

§ 3. The Flora of Australia.

In Year Books No. 1 (see pp. 109 to 114) and No. 2 (see pp. 117 to 122) a fairly complete though brief account was given of the Flora of Australia, and in Year Book No. 3 similar information in a greatly condensed form will be found on pp. 76 to 78. Space in this issue will not permit of more than a mere reference to preceding volumes.

A special article dealing with Australian fodder plants, contributed by J. H. Maiden, Esq., F.L.S., Government Botanist of New South Wales, and Director of the Botanic Gardens, Sydney, appeared in Official Year Book No. VI., pp. 1190-6. A special article on the grasses and saltbushes of Australia, contributed by E. Breakwell, B.A., B.Sc., Agrostologist at the Botanic Gardens, Sydney, appeared in Year Book No. 9, pp. 84-90.

§ 4. Seismology in Australia.

A brief statement regarding the position of seismology and seismological record in Australia appears in Year Book No. 4, pp. 82 and 83.

Barisàl Guns. Reference may be made here to an interesting pamphlet published by Dr. J. Burton Cleland, in which the author sums up the available information regarding the peculiar explosive or booming noises heard at times in Australia as well as in other parts of the world. As far as inland Australia, at all events, is concerned, it seems clear that the explosions are of earth origin, and are probably due to the sudden sundering of immense rock masses, either as a result of climatic influences, or through folding movements in the earth's crust.

§ 5. The Geology of Australia.

1. **General.**—Independent and authoritative sketches of the geology of each State were given in Year Books No. 1 (see pp. 73 to 103) and No. 2 (see pp. 78 to 111). Want of space has precluded the insertion of these sketches in the present issue of the Year Book, and it has not been considered possible to give anything like a sufficient account of the geology of Australia by presenting here a mere condensation of these sketches. Reference must, therefore, be made to either Year Book No. 1 or No. 2, *ut supra.*

2. **Geological Map of Australia.**—The map of the Geology of Australia on page 50, shews the geographical distribution of the more important geological systems and formations.

3. **The Building Stones of Australia.**—Independent and authoritative descriptions of the building stones of each State (with the exception of Queensland) will be found in Official Year Book No. 9, pp. 446-466. It is not proposed to repeat the information in this issue.

§ 6. Climate and Meteorology of Australia.[1]

1. **Introductory.**—In preceding Year Books some account was given of the history of Australian meteorology, including reference to the development of magnetic observations and the equipment for the determination of various climatological records. (See Year Book No. 3, pp. 79, 80.) In Year Book No. 4, pp. 84 and 87, will be found a short sketch of the creation and organisation of the Commonwealth Bureau of Meteorology and a resumé of the subjects dealt with at the Meteorological Conference of 1907. Space will not permit of the inclusion of this matter in the present issue.

2. **Meteorological Publications.**—The following publications are issued daily from the Central Meteorological Bureau, viz.:—(i.) Weather charts. (ii.) Rainfall maps. (iii.) Bulletins, Victorian and Interstate, shewing pressure, temperature, wind, rain, cloud extent, and weather. Similar publications are also issued from the divisional offices in each of the State Capitals.

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1. Prepared from data supplied by the Commonwealth Meteorologist, H. A. Hunt, Esquire, F.R.Met.Soc.

The Bulletins of Climatology are as follow:—No. 1.—A general discussion of the climate and meteorology of Australia, illustrated by one map and diagrams. No. 2.—A discussion of the rainfall over Australia during the ten years (1897-1906) compared with the normal, illustrated by one map. No. 3.—Notes and statistics of the remarkable flood rains over south-eastern Australia during the winter of 1909, illustrated by five maps and diagrams. No. 4.—A discussion of the monthly and seasonal rainfall over Australia, illustrated by one map and diagram. No. 5.—An investigation into the possibility of forecasting the approximate winter rainfall for Northern Victoria, illustrated by two diagrams. No. 6.—The physiography of the proposed Federal Territory at Canberra, illustrated by a relief map and 21 plates. No. 7.—On the climate of the Yass-Canberra district, illustrated by one map. No. 8.—Physiography of Eastern Australia, with 28 text illustrations. No. 9.—The climate of Australia, with charts and diagrams, prepared for the Federal Handbook of Australia. No. 10.—Relation between cirrus directions as observed in Melbourne and the approach of the various storm systems affecting Victoria, illustrated by a number of charts. No. 11.—The climatic control of Australian Production, with 43 illustrations. No. 12.—A graphical method of shewing the daily weather and especially cloud types, with two graphs. No. 13.—Initial investigations in the upper air of Australia, with 35 illustrations. No. 14.—The control of settlement by Humidity and Temperature, with 21 charts and diagrams.

Commencing with January 1910, the "Australian Monthly Weather Report," containing statistical records from representative selected stations, with rain maps and diagrams, etc., is being published. Complete rainfall and other climatological data are published in annual volumes of meteorological statistics for each State separately.

The first text book of Australian meteorology, "Climate and Weather of Australia," was published in 1913.

3. **General Description of Australia.**—In the general description of Australia, page 48, it is pointed out that a considerable portion (0.530) of three divisions of the Australian Commonwealth is north of the tropic of Capricorn, that is to say, within the States of Queensland and Western Australia, and the Northern Territory, no less than 1,149,320[1] square miles belong to the tropical zone, and 1,020,720 to the temperate zone. The whole area of the Commonwealth within the temperate zone, however, is 1,825,261[2] square miles, thus the tropical part is about 0.386, or about five-thirteenths of the whole, or the "temperate" region is half as large again as the "tropical" (more accurately 1.591). By reason of its insular geographical position, and the absence of striking physical features, Australia is, on the whole, less subject to extremes of weather than are regions of similar area in other parts of the globe; and latitude for latitude Australia is, on the whole, more temperate.

The altitudes of the surface of Australia range up to a little over 7300 feet, hence its climate embraces a great many features, from the characteristically tropical to what is essentially alpine, a fact indicated in some measure by the name Australian Alps given to the southern portion of the great Dividing Range.

While on the coast the rainfall is often abundant and the atmosphere moist, in some portions of the interior the rainfall is very limited, and the atmosphere dry. The distribution of forest, as might be expected, and its climatic influence, is consequently very variable. In the interior there are on the one hand fine belts of trees, on the other there are large areas which are treeless, and where the air is hot and parched in summer. Again, on the coast, even as far south as latitude 35°, the vegetation is tropical in its luxuriance, and also somewhat so in character. Climatologically, therefore, Australia may be said to present a great variety of features. The various climatological characteristics will be referred to in detail.

1. In the article "Australia" in the Encyclopædia Britannica, Vol. II., p. 946 (XI. Edition), this area is given as 1,145,000 square miles.

2. Given as 1,801,700 square miles in the work above quoted, where, however, the statistics are said "to refer only to the continental States of the Federation, not to Tasmania."

4. **Meteorological Divisions.**—The Commonwealth Meteorologist has divided Australia, for climatological and meteorological purposes, into five divisions. The boundaries between these may be thus defined :—(*a*) Between divisions I. and II., the boundary between South and Western Australia, viz., the 129th meridian of east longitude ; (*b*) between divisions II. and III., starting at the Gulf of Carpentaria, along the Norman River to Normanton, thence a straight line to Wilcannia on the Darling River, New South Wales; (*c*) between divisions II. and IV., from Wilcannia along the Darling River to its junction with the Murray ; (*d*) between divisions II. and V., from the junction of the Darling and Murray Rivers, along the latter to Encounter Bay ; (*e*) between divisions III. and IV., starting at Wilcannia, along the Darling, Barwon, and Dumaresq Rivers to the Great Dividing Range, and along that range and along the watershed between the Clarence and Richmond Rivers to Evans Head on the east coast of Australia ; (*f*) between divisions IV. and V., from the junction of the Darling and Murray Rivers along the latter to its junction with the Murrumbidgee, along the Murrumbidgee to the Tumut River, and along the Tumut River to Tumut, thence a straight line to Cape Howe ; (*g*) division V. includes Tasmania.

The population included within these boundaries at the Census of the 3rd April, 1911, was approximately as follows :—

Division	I.	II.	III.	IV.	V.
Population	282,000	429,000	607,000	1,540,000	1,597,000

In these divisions the order in which the capitals occur is as follows :—(i.) Perth, (ii.) Adelaide, (iii.) Brisbane, (iv.) Sydney, (v.) Melbourne, (vi.) Hobart; and for that reason the climatological and meteorological statistics will be set forth in the indicated order in this publication.

Special Climatological Stations. The latitudes, longitudes, and altitudes of special stations, the climatological features of which are graphically represented hereinafter, are as follows :—

SPECIAL CLIMATOLOGICAL STATIONS.

Locality.	Height above Sea Level.	Latitude. S.		Longitude. E.		Locality.	Height above Sea Level.	Latitude. S.		Longitude. E.	
	Feet.	deg.	min.	deg.	min.		Feet.	deg.	min.	deg.	min.
Perth	197	31	57	115	50	Darwin ...	97	12	28	130	51
Adelaide ...	140	34	56	138	35	Daly Waters ...	691	16	16	133	23
Brisbane ...	137	27	28	153	2	Alice Springs ...	1926	23	38	133	37
Sydney	146	33	52	151	12	Dubbo ...	870	32	18	148	35
Melbourne ...	115	37	49	144	58	Laverton ...	1530	28	40	122	23
Hobart	177	42	53	147	20	Coolgardie ...	1402	30	57	121	10

5. **Temperatures.**—In respect of Australian temperatures generally it may be pointed out that the isotherm for 70° Fahrenheit extends in South America and South Africa as far south as latitude 33°, while in Australia it reaches only as far south as latitude 30°, thus shewing that, on the whole, Australia has a more temperate climate when compared latitude for latitude with places in the Southern Hemisphere.

The comparison is even more favourable when the Northern Hemisphere is included therein, for in the United States the 70° isotherm extends in several of the western States as far north as latitude 41°. In Europe the same isotherm reaches almost to the southern shores of Spain, passing, however, afterwards along the northern shores of Africa till it reaches the Red Sea, when it bends northward along the eastern shore of the Mediterranean till it reaches Syria. In Asia nearly the whole of the land area south of latitude 40° N. has a higher isothermal value than 70°.

The extreme range of shade temperatures in summer and winter in a very large part of Australia amounts to probably only 81°. In Siberia, in Asia, the similar range is no less than 171°, and in North America 153°, or approximately double the Australian range.

Along the northern shores of the Australian continent the temperatures are very equable. At Darwin, for example, the difference in the means for the hottest and coldest months is only 8.3°, and the extreme readings for the year, that is, the highest maximum in the hottest month and the lowest reading in the coldest month, shew a difference of under 50°.

Coming southward the extreme range of temperature increases gradually on the coast, and in a more pronounced way inland.

The detailed temperature results for the several capitals of the States of Australia are shewn in the Climatological Tables hereinafter.

(i.) *Hottest and Coldest Parts.* A comparison of the temperatures recorded at coast and inland stations shews that, in Australia as in other continents, the range increases with increasing distance from the coast.

In the interior of Australia, and during exceptionally dry summers, the temperature occasionally reaches or exceeds 120° in the shade, and during the dry winters the major portion of the country to the south of the tropics is subject to ground frosts. An exact knowledge of temperature disposition cannot be determined until the interior becomes more settled, but from data procurable, it would appear that the hottest area of the continent is situated in the northern part of Western Australia about the Marble Bar and Nullagine goldfields, where the maximum shade temperature during the summer sometimes exceeds 100° for days, and even weeks, continuously. The coldest part of the Commonwealth is the extreme south-east of New South Wales and extreme east of Victoria, namely, the region of the Australian Alps. Here, the temperature seldom, if ever, reaches 100° even in the hottest of seasons.

In Tasmania, although occasionally hot winds may cross the Straits and cause the temperature to rise to 100° in the low-lying parts, yet the island as a whole enjoys a most moderate and equable range of temperature throughout the year.

(ii.) *Monthly Maximum and Minimum Temperatures.* The mean monthly maximum and minimum temperatures can be best shewn by means of graphs, which exhibit the nature of the fluctuation of each for the entire year. In the diagram (on page 67) for nine representative places in Australia, the upper heavy curves shew the mean maximum, the lower heavy curves the mean minimum temperatures based upon daily observations. On the same diagram the thin curves shew the relative humidities (see next paragraph).

6. **Relative Humidity.**—Next after temperature the degree of humidity may be regarded as of great importance as an element of climate; and the characteristic differences of relative humidity between the various capitals of Australia call for special remark. For six representative places the variations of humidity are shewn on the graph on page 67, which gives results based upon daily observations of the dry and wet bulb thermometers. Hitherto difficulties have been experienced in many parts of Australia in obtaining satisfactory observations for a continuous period of any length. For this reason it has been thought expedient to refer to the record of humidity at first order stations only, where the results are thoroughly reliable. Throughout, the degree of humidity given will be what is known as *relative humidity*, that is, the percentage of aqueous vapour actually existing to the total possible if the atmosphere were saturated.

The detailed humidity results for the several State capitals are given in the Climatological Tables hereinafter. From these, it is seen that, in respect of relative humidity, Sydney and Hobart have the first place, while Brisbane, Melbourne, Perth, and Adelaide follow in the order stated, Adelaide being the driest. The graphs on page 67 shew the annual variations in humidity. It will be observed that the *relative* humidity is ordinarily but not invariably great when the temperature is low.

7. **Evaporation.**—The rate and quantity of evaporation in any territory is influenced by the prevailing temperature, and by atmospheric humidity, pressure and movement. In Australia the question is of perhaps more than ordinary importance; since in its drier regions water has often to be conserved in "tanks"[1] and dams. The magnitude of the

1. In Australia artificial storage ponds or reservoirs are called "tanks."

economic loss by evaporation will be appreciated from the records on pages 68 and 79 to 84, which shew that the yearly amount varies from about 33 inches at Hobart to 96 inches at Alice Springs in the centre of the Continent.

(i.) *Monthly Evaporation Curves.* The curves shewing the mean monthly evaporation in various parts of the Commonwealth will disclose how characteristically different are the amounts for the several months in different localities. The evaporation for characteristic places is shewn on diagram shewing also rainfalls (see page 68).

(ii.) *Loss by Evaporation.* In the interior of Australia the possible evaporation is greater than the actual rainfall. Since, therefore, the loss by evaporation depends largely on the exposed area, tanks and dams so designed that the surface shall be a minimum are advantageous. Similarly, the more protected from the direct rays of the sun and from winds, by means of suitable tree planting, the less will be the loss by evaporation: these matters are of more than ordinary concern in the drier districts of Australia.

8. **Rainfall.**—As even a casual reference to climatological maps, indicating the distribution of rainfall and prevailing direction of wind, would clearly shew, the rainfall of any region is determined mainly by the direction and route of the prevailing winds, by the varying temperatures of the earth's surface over which they blow, and by the physiographical features generally.

Australia lies within the zone of the south-east trade and prevailing westerly winds. The southern limit of the south-east trade strikes the eastern shores at about 30° south latitude. Hence, we find that, with very few exceptions, the heaviest rains of the Australian continent are precipitated along the Pacific slopes to the north of that latitude, the varying quantities being more or less regulated by the differences in elevation of the shores and of the chain of mountains, upon which the rain-laden winds blow, from the New South Wales northern border to Thursday Island. The converse effect is exemplified on the north-west coast of Western Australia from the summer south-east trade winds. Here the prevailing winds, blowing from the interior of the continent instead of from the ocean, result in the lightest coastal rain in Australia.

The westerly winds, which skirt the southern shores, are responsible for the very reliable, although generally light, rains enjoyed by the south-western portion of Western Australia, by the south-eastern agricultural areas of South Australia, by a great part of Victoria, and by the whole of Tasmania.

(i.) *Factors determining Distribution and Intensity of Rainfall.*

(ii.) *Time of Rainfall.*

In preceding Year Books (see No. 6, pp. 72, 73, 74) some notes were given of the various factors governing the distribution, intensity and period of Australian rainfall.

(iii.) *Wettest and Driest Regions.* The wettest known part of Australia is on the north-east coast of Queensland, between Port Douglas and Cardwell, where three stations situated on, or adjacent to, the Johnstone and Russell Rivers have an average annual rainfall of between 148 and 166 inches. The maximum and minimum falls there are:—Goondi, 241.53 in 1894 and 67.88 inches in 1915, or a range of 165.29 inches; Innisfail, 211.24 in 1894 and 69.87 inches in 1902, or a range of 141.37 inches; Harvey's Creek, 238.45 in 1901 and 80.47 inches in 1902, or a range of 157.98 inches.

On four occasions more than 200 inches have been recorded at Goondi, the last of these being in 1910, when 204.82 inches were registered. The record at this station covers a period of 30 years.

Harvey's Creek in the shorter period of 20 years has twice exceeded 200 inches, the total for 1910 being 201.28 inches.

The driest known part of the continent is about the Lake Eyre district in South Australia (the only part of the continent below sea level), where the annual average is but 5 inches, and where the fall rarely exceeds 10 inches for the twelve months.

The inland districts of Western Australia have until recent years been regarded as the driest part of Australia, but authentic observations taken during the past decade at settled districts in the east of that State shew that the annual average is from 10 to 12 inches.

(iv.) *Quantities and Distribution of Rainfall generally.* The departure from the normal rainfall increases greatly and progressively from the southern to the northern shores of the continent, and similarly also at all parts of the continent, subject to capricious monsoonal rains, as the comparisons hereunder will shew. The general distribution is best seen from the map on page 73, shewing the areas subject to average annual rainfalls lying between certain limits. The areas enjoying varying quantities of rainfall determined from the latest available information are shewn in the following table:—

DISTRIBUTION OF AVERAGE RAINFALL.

Average Annual Rainfall.	N.S.W.	Victoria.	Queensland.	South Aust.	Northe'n Territ'y.	Western Aust.	Tasmania. *	Commonwealth. *
	sqr. mls.	sqr. mls.	sqr. mls.	sqr. mls.	sqr. mls.	sqr. mls.	sqr. mls.	sqr. mls.
Under 10 inches	44,997	nil	91,012	317,600	138,190	513,653	nil	1,105,452
10—15 ,,	77,268	19,912	87,489	33,405	141,570	232,815	nil	592,459
15—20 ,,	57,639	12,626	112,738	14,190	62,920	89,922	937	350,972
20—30 ,,	77,202	29,317	213,779	13,827	93,470	95,404	7,559	530,558
30—40 ,,	30,700	14,029	69,880	984	40,690	40,750	4,588	201,621
Over 40 ,,	22,566	12,000	95,602	64	46,780	3,376	10,101	190,489
Total area ...	310,372	87,884	670,500	380,070	523,620	975,920	26,215	2,974,581

* Over 3030 square miles no records available.

Referring first to the capital cities, the complete records of which are given on the following page, it is seen that Sydney with a normal rainfall of 48.28 inches occupies the chief place, Brisbane, Perth, Melbourne, Hobart and Adelaide following in that order, Adelaide with 20.95 inches being the driest. The extreme range from the wettest to the driest year is greatest at Brisbane (72.09 inches) and least at Adelaide (19.48 inches).

In order to shew how the rainfall is distributed throughout the year in various parts of the continent, the figures of representative towns have been selected. (See map on page 74.) Darwin, typical of the Northern Territory, shews that in that region nearly the whole of the rainfall occurs in the summer months, while little or nothing falls in the middle of the year. The figures of Perth, as representing the south-western part of the continent, are the reverse, for while the summer months are dry, the winter ones are very wet. In Melbourne and Hobart the rain is fairly well distributed throughout the twelve months, with a maximum in October in the former, and in November in the latter. The records at Alice Springs and Daly Waters indicate that in the central parts of Australia the wettest months are in the summer and autumn. In Queensland, as in the Northern Territory, the heaviest rains fall in the summer months, but good averages are also maintained during the other seasons.

On the coast of New South Wales, the first six months of the year are the wettest, with slight excesses in April and July; the averages during the last six months are fair and moderately uniform. In general it may be said that one-fourth of the area of the continent, principally in the eastern and northern parts, enjoys an annual average rainfall of from 20 to 50 inches, the remaining three-fourths receiving generally from about 10 to 15 inches.

(v.) *Curves of Rainfall and Evaporation.* The relative amounts of rainfall and evaporation at different times through the year are best seen by referring to the graphs for a number of characteristic places. (See page 68.) It will be recognised at once how large is the evaporation when water is fully exposed to the direct rays of the sun, and to wind.

(vi.) *Tables of Rainfall.* The table of rainfall for a long period of years for each of the various Australian capitals affords information as to the variability of the fall in successive years, and the list of the more remarkable falls furnishes information as to what may be expected on particular occasions.

RAINFALL AT THE AUSTRALIAN CAPITALS, 1840 to 1916.

Year.	Perth. Amount.	Perth. No. of Days.	Perth. 10 Years' Means.	Adelaide. Amount.	Adelaide. No. of Days.	Adelaide. 10 Years' Means.	Brisbane. Amount.	Brisbane. No. of Days.	Brisbane. 10 Years' Means.	Sydney. Amount.	Sydney. No. of Days.	Sydney. 10 Years' Means.	Melbourne. Amount.	Melbourne. No. of Days.	Melbourne. 10 Years' Means.	Hobart. Amount.	Hobart. No. of Days.	Hobart. 10 Years' Means.
	in.		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.		in.
1840	...	...	...	24.23	99	...	29.32	...	...	58.52	150	...	22.57	...	...	...	...	...
1	...	...	...	17.96	93	...	49.31	...	...	76.31	142	...	30.18	...	...	13.95	74	...
2	...	...	...	20.32	122	...	28.81	...	...	48.32	138	...	31.16	...	...	23.60	88	...
3	...	...	...	17.19	104	...	51.67	...	...	62.78	168	...	21.54	...	...	13.43	87	...
4	...	...	...	16.88	136	...	63.20	...	...	70.66	156	...	30.74	...	...	26.25	94	...
5	...	...	...	18.83	125	...	39.09	...	...	62.01	133	...	23.93	...	...	16.68	76	...
6	...	...	...	26.89	114	...	31.41	...	41.83	43.83	139	...	30.53	...	...	21.96	99	...
7	...	...	...	27.61	109	...	...	...	(7 yr.)	42.81	142	...	30.18	...	...	13.86	89	...
8	...	...	...	19.74	114	21.07	42.59	...	...	59.17	155	58.27	33.15	...	28.22	23.62	115	19.24
9	...	...	...	25.44	110	(9 yr.)	...	...	...	21.49	140	(9 yr.)	44.25	...	(9 yr.)	33.52	103	(8 yr.)
1850	...	...	...	19.56	84	...	...	...	...	44.88	157	...	26.98	...	...	14.51	70	...
1	...	...	...	30.86	128	...	...	...	...	35.14	142	...	...	...	...	17.98	107	...
2	...	...	...	27.44	118	...	...	...	...	43.79	143	...	...	...	...	23.62	119	...
3	...	...	...	27.08	128	...	...	...	...	46.12	130	...	...	...	...	14.52	113	...
4	...	...	...	15.35	105	...	...	...	...	29.29	136	...	...	...	...	30.54	109	...
5	...	...	...	23.15	124	...	...	...	...	52.86	138	...	28.21	...	...	18.25	131	...
6	...	...	...	24.93	118	...	...	...	...	43.31	116	...	29.76	134	...	22.73	152	...
7	...	...	...	22.15	105	...	...	...	...	50.95	135	...	28.90	138	...	17.14	113	...
8	...	...	...	21.55	107	23.75	43.00	...	...	39.60	129	40.75	26.01	158	...	33.07	129	22.59
9	...	...	...	14.85	95	...	35.00	...	...	42.01	137	...	21.82	156	...	23.31	159	...
1860	...	...	...	19.67	119	...	54.63	144	...	82.76	180	...	25.38	133	...	21.05	142	...
1	...	...	...	24.04	147	...	69.45	155	...	59.36	157	...	29.16	159	...	28.19	167	...
2	...	...	...	21.85	119	...	28.27	98	...	23.99	108	...	22.08	139	...	21.72	148	...
3	...	...	...	23.68	145	...	68.83	146	...	47.08	152	...	36.42	165	...	40.67	163	...
4	...	...	...	19.75	121	...	47.00	114	...	69.12	185	...	27.40	144	...	28.11	142	...
5	...	...	...	15.51	108	...	24.11	52	...	36.15	140	...	15.94	119	...	23.07	146	...
6	...	...	...	20.11	116	...	51.18	142	...	36.91	156	...	22.41	107	...	23.55	127	...
7	...	...	...	19.05	112	...	61.04	112	...	59.56	140	...	25.79	133	...	22.27	139	...
8	...	...	...	19.99	113	19.85	35.98	110	47.55	42.98	161	49.99	18.27	120	24.47	18.08	112	25.00
9	...	...	...	14.74	117	...	54.39	114	...	48.00	150	...	24.58	129	...	23.87	131	...
1870	...	...	...	23.84	119	...	79.06	154	...	64.47	179	...	33.77	129	...	27.53	123	...
1	...	...	...	23.25	137	...	45.45	119	...	52.27	141	...	30.17	125	...	18.25	131	...
2	...	...	...	22.66	146	...	49.22	131	...	37.12	161	...	32.52	136	...	31.76	160	...
3	...	...	...	21.00	139	...	62.02	138	...	73.40	176	...	25.61	134	...	23.43	157	...
4	...	...	...	17.23	127	...	38.71	135	...	63.60	173	...	28.10	134	...	24.09	138	...
5	...	...	...	29.21	157	...	67.03	162	...	46.25	153	...	32.87	158	...	29.25	182	...
6	28.73	100	...	13.43	110	...	53.42	130	...	45.69	156	...	24.04	134	...	23.63	173	...
7	20.48	103	...	24.95	135	...	30.28	119	...	59.66	147	...	24.10	124	...	20.82	165	...
8	39.72	143	29.64	22.08	112	21.24	56.33	134	53.59	49.77	129	54.03	25.36	116	28.11	29.76	183	25.24
9	41.34	106	(3 yr.)	20.69	130	...	67.30	157	...	63.19	167	...	19.28	127	...	21.07	210	...
1880	31.79	116	...	22.48	142	...	49.12	134	...	29.51	142	...	28.48	147	...	...	...	...
1	24.78	101	...	18.02	135	...	29.39	117	...	40.99	163	...	24.08	134	...	...	...	...
2	35.68	109	...	15.70	134	...	42.62	121	...	42.28	112	...	22.40	131	...	30.69	...	...
3	39.65	122	...	26.76	161	...	32.22	114	...	46.92	157	...	23.71	130	...	24.05	161	...
4	31.96	92	...	18.74	138	...	43.49	136	...	44.04	159	...	25.85	128	...	21.55	171	...
5	33.44	110	...	15.89	133	...	26.85	112	...	39.91	145	...	26.94	123	...	28.29	176	...
6	28.90	89	...	14.42	141	...	53.66	152	...	39.43	152	...	24.00	128	...	21.39	189	...
7	37.52	105	...	25.70	164	...	81.54	242	...	60.16	190	...	32.39	153	...	24.21	174	...
8	27.83	117	33.29	14.55	131	19.30	33.08	143	45.93	23.01	132	42.94	19.42	123	24.66	18.45	151	23.71
9	39.96	123	...	30.87	143	...	49.36	155	...	57.16	186	...	27.14	125	...	30.80	180	(8 yr.)
1890	46.73	126	...	25.78	139	...	73.02	162	...	81.42	184	...	24.24	140	...	27.51	173	...
1	30.33	93	...	14.01	113	...	41.68	143	...	55.30	200	...	26.73	126	...	23.25	160	...
2	31.23	122	...	21.53	137	...	64.98	146	...	69.26	189	...	24.96	124	...	18.62	120	...
3	40.12	145	...	21.49	129	...	88.26	147	...	49.90	209	...	26.80	140	...	27.46	146	...
4	23.72	103	...	20.78	134	...	44.02	143	...	38.22	188	...	22.60	138	...	27.39	141	...
5	33.01	123	...	21.28	130	...	59.11	105	...	31.86	170	...	17.04	131	...	25.40	121	...
6	31.50	103	...	15.17	121	...	44.97	121	...	42.40	157	...	25.16	124	...	21.61	135	...
7	27.17	106	...	15.42	119	...	42.53	115	...	42.52	136	...	25.85	117	...	20.45	153	...
8	31.76	118	33.55	20.75	116	20.71	60.06	131	56.80	43.17	143	51.12	15.61	102	23.61	20.40	164	24.29
9	32.40	107	...	18.84	119	...	38.85	141	...	55.90	174	...	28.87	116	...	20.68	170	...
1900	36.61	124	...	21.68	133	...	34.41	110	...	66.54	170	...	28.09	139	...	19.14	135	...
1	36.75	122	...	18.01	124	...	38.48	110	...	40.10	149	...	27.45	113	...	25.11	149	...
2	27.06	93	...	16.02	123	...	16.17	87	...	43.07	180	...	23.08	102	...	21.85	150	...
3	35.69	140	...	25.47	134	...	49.27	136	...	38.62	173	...	28.43	130	...	25.86	139	...
4	34.35	125	...	20.31	117	...	33.23	124	...	45.93	158	...	29.72	128	...	22.41	139	...
5	34.61	116	...	22.28	131	...	36.76	108	...	35.03	145	...	25.64	129	...	32.09	168	...
6	32.37	121	...	26.51	127	...	42.85	125	...	31.89	160	...	22.29	114	...	23.31	155	...
7	40.12	132	...	17.78	125	...	31.46	119	...	31.32	132	...	22.26	102	...	25.92	166	...
8	30.52	106	34.05	24.56	125	21.15	44.01	125	36.55	45.65	167	43.41	17.72	130	25.36	16.50	148	23.29
9	39.11	107	...	27.69	138	...	34.06	111	...	32.45	177	...	25.86	171	...	27.29	170	...
1910	37.02	135	...	24.62	116	...	49.00	133	...	46.91	160	...	24.61	167	...	25.22	205	...
1	23.38	108	...	15.99	127	...	35.21	128	...	50.24	155	...	36.61	168	...	26.78	193	...
2	27.85	123	...	19.57	116	...	41.30	114	...	47.51	172	...	20.37	157	...	23.14	181	...
3	38.28	141	...	18.16	102	...	40.81	115	...	57.70	141	...	21.17	157	...	19.36	165	...
4	20.21	128	...	11.39	91	...	33.99	141	...	56.42	149	...	18.57	129	...	15.42	154	...
15	43.61	164	...	19.38	117	...	25.66	93	...	34.83	117	...	20.95	167	...	20.91	196	...
16	35.16	128	...	28.16	142	...	52.80	136	...	44.91	161	...	38.04	170	...	43.39	203	...
Aver.	...	...	33.23	...	...	20.95	...	...	46.20	...	...	48.28	...	...	26.11	...	...	23.63
No. of Yrs.			(41)			(78)			(67)			(77)			(73)			(74)

NOTE.—The above average Rainfall figures for Brisbane, Sydnev, and Melbourne differ slightly from the mean annual falls given in the Climatological Tables on pp. 77-79, which are for a less number of years.

9. **Remarkable Falls of Rain.**—The following are the more remarkable falls of rain in the States of New South Wales, Queensland, Western Australia, and South Australia, which have occurred within a period of twenty-four hours :—

HEAVY RAINFALLS, NEW SOUTH WALES, UP TO 1916, INCLUSIVE.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Anthony ...	28 Mar., 1887	17.14	Maitland W.	9 Mar., 1893	14.79
,, ...	15 Jan., 1890	13.13	Major's Creek	14 Feb., 1898	12.32
Araluen ...	15 Feb., 1898	13.36	Marrickville	9 Mar., 1913	10.40
Berry ...	13 Jan., 1911	12.05	Morpeth ...	9 ,, 1893	21.52
Billambil ...	14 Mar., 1894	12.94	Mount Kembla	13 Jan., 1911	18.25
Bomaderry...	13 Jan., 1911	13.03	Mt. Pleasant	24 Mar., 1914	10.30
Broger's Creek	14 Feb., 1898	20.05	Nepean Tunnel	14 Feb., 1898	12.30
,, ,,	19 July, 1910	12.22	Nowra ...	13 Jan., 1911	13.00
,, ,,	13 Jan., 1911	20.83	Padstow Park	9 Mar., 1913	10.64
Bulli Mountain	13 Feb., 1898	17.14	Prospect ...	28 May, 1889	12.37
Camden Haven	22 Jan., 1895	12.23	Richmond	28 ,, ,,	12.18
Castle Hill...	28 May, 1889	13.49	Rosemount	23 Mar., 1914	12.62
Colombo Lyttleton	5 Mar., 1893	12.17	Rooty Hill	27 May, 1889	11.85
Comboyne ...	18 May, 1914	10.68	Taree ...	28 Feb., 1892	12.24
Condong ...	27 Mar., 1887	18.66	Terara ...	26 ,, 1873	12.57
Cordeaux River	14 Feb., 1898	22.58	Tomago ...	9 Mar., 1893	13.76
,, ,,	13 Jan., 1911	14.52	Tongarra Farm	14 Feb., 1898	15.12
Dapto West	14 Feb., 1898	12.05	Towamba ...	5 Mar., 1893	20.00
Dunheved ...	28 May, 1889	12.40	The Hill (Shell Harb.)	24 Mar., 1914	12.00
Holy Flat ...	12 Mar., 1887	12.00	Sherwood ...	17 June, 1914	10.00
,, ,, ...	28 Feb., 1892	12.24	Stockyard Mt.	24 Mar., 1914	10.72
Jamberoo ...	23 Mar., 1914	10.22	South Head		
,, ...	24 ,, ,,	11.28	(near Sydney)	29 Apr., 1841	20.12
Katoomba ...	7 Apr., 1913	10.50	,, ,,	16 Oct., 1844	20.41
Kembla Heights	13 Jan., 1911	17.46	Unanderra	24 Mar., 1914	11.68
Leconfield ...	9 Mar., 1893	14.53	Wollongong	24 ,, ,,	12 50
Madden's Creek	13 Jan., 1911	18.68			

HEAVY RAINFALLS, QUEENSLAND, UP TO 1916, INCLUSIVE.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Allomba (Cairns)	30 Jan., 1913	13.50	Burnett Head		
Anglesey ...	26 Dec., 1909	18.20	(Bundaberg)	16 Jan., 1913	15.22
,, ...	10 Feb., 1915	12.00	Burpengary	10 Feb,, 1915	11.11
Atherton (Cairns)	31 Jan., 1913	16.69	Bustard Head	17 Jan., 1913	14.93
Ayr ...	20 Sep., 1890	14.58	Cairns ...	11 Feb., 1889	14.74
Babinda (Cairns)	31 Jan., 1913	12.79	,, ...	21 Apr., ,,	12.40
,, ,,	1 Feb., 1913	20.51	,, ...	5 ,, 1891	14.08
,, ,,	24 Jan., 1916	22.30	,, ...	11 Feb., 1911	15.17
,, ,,	25 ,, 1916	13.45	,, ...	2 Apr., ,,	20.16
Banyan (Cardwell)	31 ,, 1913	13.79	,, ...	31 Jan., 1913	13.94
Barrine (Cairns)	31 ,, 1913	13.34	,, ...	24 ,, 1916	12.28
Batheaston	27 Dec., 1916	10.00	Calliope ...	9 Feb., 1915	12.09
Bloomsbury	14 Feb., 1893	17.40	Cape Grafton	5 Mar., 1896	13.37
,,	10 Jan., 1901	16.62	Cardwell ...	30 Dec., 1889	12.00
Bowen ...	13 Feb., 1893	14.65	,, ...	23 Mar., 1890	12.00
Boynedale ...	9 ,, 1915	11.20	,, ...	18 ,, 1904	18.24
Bracewell ...	9 ,, 1915	11.59	,, ...	3 Apr., 1911	12.84
Brisbane ...	21 Jan., 1887	18.31	Clare ...	26 Jan., 1896	15.30
Bromby Park (Bowen)	14 Feb., 1893	13.28	Clermont ...	28 Dec., 1916	12.28
Brookfield	14 Mar., 1908	14.95	Coen ...	17 Feb., 1914	12.03
Buderim Mountain	11 Jan., 1898	26.20	Collaroy ...	30 Jan., 1896	14.25
Bundaberg	16 ,, 1913	16.94	,, ...	28 Dec., 1916	12.79
Burketown	15 ,, 1891	13.58	Cooktown ...	22 Jan., 1903	12.49
,, ...	12 Mar., 1903	14.52	,, ...	23 ,, 1914	13.98

HEAVY RAINFALLS, QUEENSLAND—Continued.

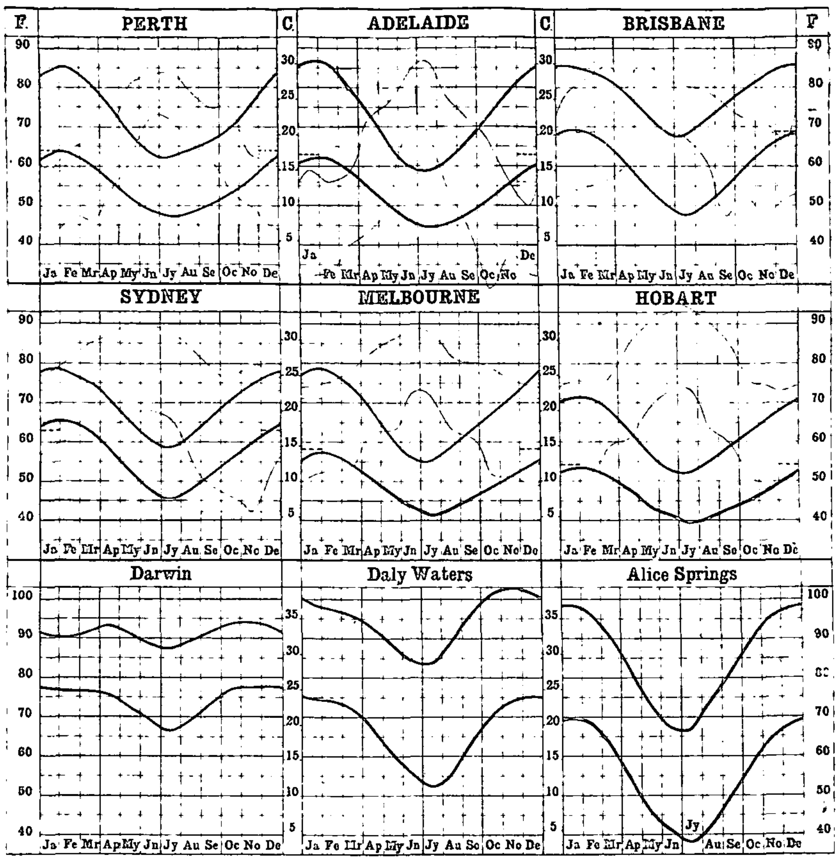
Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Cooran	1 Feb., 1893	13.62	Halifax	5 Feb., 1899	15.37
"	26 Dec., 1908	14.08	"	6 Jan., 1901	15.68
Cooroy	9 June, 1893	13.60	"	8 Apr., 1912	12.75
"	10 Jan., 1898	13.50	Hambledon Mill ...	13 Jan., 1909	13.80
Crohamhurst			" " ...	2 " 1911	18.61
(Blackall Range)	2 Feb., 1893	35.71	" " ...	10 Feb., "	13.97
" " ...	9 June, "	13.31	" " ...	30 Mar., "	13.04
" " ...	9 Jan., 1898	19.55	" " ...	31 " "	14.95
" " ...	6 Mar. "	16.01	" " ...	1 Apr., "	19.62
" " ...	26 Dec., 1909	13.85	" " ...	30 Jan., 1913	17.32
" " ...	10 Feb., 1915	12.98	Harvey Creek ...	8 Mar., 1899	17.72
Crow's Nest ...	2 Aug., 1908	11.17	" " ...	25 Jan., 1900	12.53
Croydon	29 Jan., 1908	15.00	" " ...	25 May, 1901	14.00
Cryna (Beaudesert) ...	21 " 1887	14.00	" " ...	14 Mar., 1903	12.10
Dungeness ...	16 Mar., 1893	22.17	" " ...	11 Jan., 1905	16.96
"	17 Apr., 1894	14.00	" " ...	28 " 1906	12.29
Dunira	9 Jan., 1898	18.45	" " ...	14 " 1909	14.40
"	6 Mar., "	15.95	" " ...	3 " 1911	27.75
Eddington (Cloncurry)	23 Jan., 1891	10.33	" " ...	11 Feb., "	12.88
Emscote Farm ...	10 Feb., 1915	13.22	" " ...	1 Apr., "	13.61
Emu Park	18 Jan., 1913	12.75	" " ...	2 " "	16.46
Enoggera Railway ...	14 Mar., 1908	12.14	" " ...	31 Jan., 1913	24.72
Ernest Junction ...	" "	13.00	" " ...	24 " 1916	13.17
Fairymead Plantation			Haughton Valley ...	26 Jan., 1896	18.10
(Bundaberg) ...	16 Jan., 1913	15.32	Herberton ...	31 Jan., 1913	14.00
Flat Top Island ...	22 Dec., 1909	12.96	Hillcrest (Mooloolah)	26 Dec., 1909	13.35
Floraville	6 Jan., 1897	10.79	Holmwood (Woodf'd)	2 Feb., 1893	16.19
"	11 Mar., 1903	12.86	" "	10 Jan., 1898	12.40
Flying Fish Point ...	7 Apr., 1912	16.06	Homebush ...	3 Feb., "	12.04
" " ...	31 Jan., 1913	16.10	Howard	15 Jan., 1905	19.55
Gatcombe Head			Huntley	27 Dec., 1916	18.94
(Gladstone) ...	18 Jan., 1913	12.88	Ingham	18 Jan., 1894	12.60
Gin Gin	16 " 1905	13.61	"	6 " 1901	13.59
"	16 " 1913	12.27	"	25 Dec., 1903	12.30
Gladstone	18 Feb., 1888	12.37	Inkerman	21 Sep., 1890	12.93
"	31 Jan., 1893	14.62	Inneshowen		
"	4 Feb., 1911	18.83	(Johnstone River)	30 Dec., 1889	14.01
"	9 " 1915	10.10	Innisfail (formerly		
Glen Boughton ...	5 Apr., 1894	18.50	Geraldton) ...	11 Feb., 1889	17.13
" " ...	31 Jan., 1913	14.92	" " ...	31 Dec., "	12.45
" " ...	24 " 1916	14.02	" " ...	6 Apr., 1894	16.02
Glen Prairie ...	18 Apr., 1904	12.18	" " ...	18 " 1899	13.20
Gold Creek Reservoir	14 Mar., 1908	12.50	" " ...	24 Jan., 1900	15.22
Goldsborough (Cairns)	31 Jan., 1913	19.92	" " ...	29 Dec., 1903	21.22
" "	1 Feb., 1913	12.22	" " ...	11 Feb., 1911	14.48
Goodwood (Bund'berg)	16 Jan., 1913	13.07	" " ...	1 Apr., 1911	12.35
Goondi Mill (Innisfail)	6 Apr., 1894	15.69	" " ...	2 " "	15.00
" "	18 Apr., 1899	14.78	" " ...	7 " 1912	20.50
" "	24 Jan., 1900	13.30	" " ...	8 " "	12.15
" "	29 Dec., 1903	17.83	" " ...	31 Jan., 1913	20.91
" "	10 Feb., 1911	17.68	Invicta (Kolan R.) ...	16 Jan., 1913	14.58
" "	31 Mar., "	12.38	Isis Junction ...	6 Mar., 1898	13.60
" "	1 Apr., "	13.60	Kamerunga (Cairns)	20 Jan., 1892	13.61
" "	6 Apr., 1912	15.55	" " ...	6 Apr., 1894	14.04
Goondi	30 Jan., 1913	24.10	" " ...	5 " 1895	12.31
Granada (formerly			" " ...	11 Feb., 1911	13.07
Donaldson) ...	27 Jan., 1891	11.29	" " ...	1 Apr., "	14.20
" " ...	8 " 1911	13.50	" " ...	2 " "	21.00
" " ...	9 " "	14.30	" " ...	31 Jan., 1913	16.00

HEAVY RAINFALLS, QUEENSLAND—Continued.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Kulara (Cairns)	31 Jan., 1913	12.69	Nerang	15 June 1892	12.35
Kuranda (Cairns)	6 Mar., 1899	14.12	North Kolan		
,, ,,	20 Apr., 1903	14.16	(Bundaberg)	6 Jan., 1913	12.90
,, ,,	14 Jan., 1909	12.37	North Pine	16 Feb., 1893	14.97
,, ,,	11 Feb., 1911	16.30	Nundah	14 Mar., 1908	12.00
,, ,,	17 Mar., ,,	15.10	Oxenford	14 Mar., 1908	15.65
,, ,,	31 ,, ,,	18.60	Palmwoods	4 Feb., 1893	12.30
,, ,,	1 Apr., ,,	24.30	,,	10 Jan., 1898	15.85
,, ,,	2 ,, ,,	28.80	,,	7 Mar., 1898	13.02
,, ,,	31 Jan., 1913	16.34	,,	25 Dec., 1909	17.75
Lake Nash	10 Jan., 1895	10.25	Peachester	26 ,, ,,	14.91
,,	20 Mar., 1901	10.02	Pialba (Maryborough)	16 Jan., 1913	17.22
Landsborough	2 Feb., 1893	15.15	Pittsworth	11 Mar., 1890	14.68
,,	9 June, ,,	12.80	Plane Creek (Mackay)	26 Feb., 1913	27.73
,,	26 Dec., 1909	14.00	Point Archer	23 Jan., 1914	13.47
Low Island	10 Mar., 1904	15.07	Port Douglas	5 Mar., 1887	13.00
,,	31 ,, 1911	14.70	,, ,,	10 ,, 1904	16.34
,,	1 Apr., ,,	15.30	,, ,,	11 Jan., 1905	14.68
Lucinda	17 Feb., 1906	13.35	,, ,,	17 Mar., 1911	16.10
,,	10 Mar., 1906	14.60	,, ,,	1 Apr., ,,	31.53
Lytton	21 Jan., 1887	12.85	Ravenswood	24 Mar., 1890	17.00
Mackay	23 Dec., 1909	13.96	Redcliffe	21 Jan., 1887	14.00
Sugar Experimental			,,	16 Feb., 1893	17.35
Farm, Mackay	23 Dec., 1909	12.00	Rosedale	6 Mar., 1898	12.60
Macnade Mill	18 Jan., 1894	12.56	,,	16 Jan., 1913	18.90
,,	17 Apr., ,,	14.26	Sandgate	16 Feb., 1893	14.03
,,	5 Feb., 1899	15.20	Somerset	28 Jan., 1903	12.02
,,	6 Jan., 1901	23.33	St. Helens (Mackay)	24 Feb., 1888	12.00
,,	7 Mar., 1914	12.44	St. Lawrence	17 Feb., 1888	12.10
,,	4 ,, 1915	22.00	,, ,,	30 Jan., 1896	15.00
Maleny	26 Dec., 1909	14.76	Tewantin	30 Mar., 1904	12.30
Mapleton	14 Mar., 1908	14.29	The Hollow (Mackay)	23 Feb., 1888	15.12
,,	26 Dec., 1909	15.72	Thornborough	20 Apr., 1903	18.07
,,	10 Feb., 1915	12.75	Townsville	24 Jan., 1892	19.20
Marlborough	17 ,, 1888	14.24	,,	28 Dec., 1903	15.00
Milton	14 Mar., 1908	12.24	Victoria Mill	6 Jan., 1901	16.67
,,	9 Feb., 1915	10.15	Walsh River	1 Apr., 1911	13.70
Mirani	12 Jan., 1901	16.59	Woodford	2 Feb., 1893	14.93
MiriamVale(B'd'berg)	17 ,, 1913	15.80	Woodlands (Yeppoon)	25 Mar., 1890	14.25
,, ,,	9 Feb., 1915	10.22	,, ,,	31 Jan., 1893	23.07
Mt. Molloy	31 Mar., 1911	20.00	,, ,,	9 Feb., 1896	13.97
,,	1 Apr., ,,	20.00	,, ,,	7 Jan., 1898	14.50
,,	2 ,, ,,	20.00	Woody Island	16 ,, 1913	12.66
Mt. Mee	10 Feb., 1915	12.00	Woombye	26 Dec., 1909	13.42
Mooloolah	13 Mar., 1892	21.53	Wootha	10 Feb., 1915	15.93
,,	2 Feb., 1893	19.11	Yandina	1 ,, 1893	20.08
,,	6 Mar., 1898	14.43	,,	9 June, ,,	12.70
Mount Crosby	14 Mar., 1908	14.00	,,	9 Jan., 1898	19.25
Mount Cuthbert	8 Jan., 1911	18.00	,,	7 Mar., ,,	13.52
Mourilyan	14 Jan., 1909	13.00	,,	28 Dec., 1909	15.80
,,	3 ,, 1911	12.70	Yarrabah	11 Feb., 1911	12.00
,,	11 Feb., ,,	17.40	,,	2 Apr., ,,	30.65
,,	1 Apr., ,,	13.20	,,	24 Jan., 1916	27.20
,,	7 ,, 1912	18.97	,,	25 ,, 1916	18.60
,,	31 Jan., 1913	15.05	Yeppoon	31 ,, 1893	20.05
Mundoolun	21 Jan., 1887	17.95	,,	8 ,, 1898	18.05
Musgrave	6 Apr., 1894	13.71	,,	3 Feb., 1906	14.90
Nambour	9 Jan., 1898	21.00	,,	,, 1911	14.92
,,	7 Mar., ,,	13.28	,,	18 Jan., 1913	13.00
,,	27 Dec., 1909	16.80	,,	8 Oct., 1914	21.70

NOTE.—In Queensland falls of 12 or more inches on coast or 10 or more inches inland are taken.

GRAPHS SHEWING ANNUAL FLUCTUATIONS OF MEAN MAXIMUM AND MINIMUM TEMPERATURE AND HUMIDITY IN SEVERAL PARTS OF THE COMMONWEALTH OF AUSTRALIA.



Explanation of the Graphs of Temperature and Humidity.—In the above graphs, in which the heavy lines denote 'temperature' and the thin lines 'humidity,' the fluctuations of mean temperature and mean humidity are shewn throughout the year. These curves are plotted from the data given in the Climatological Tables hereinafter. The temperatures are shewn in degrees Fahrenheit, the inner columns giving the corresponding values in Centigrade degrees. Humidities have not been obtained for Darwin, Daly Waters, and Alice Springs.

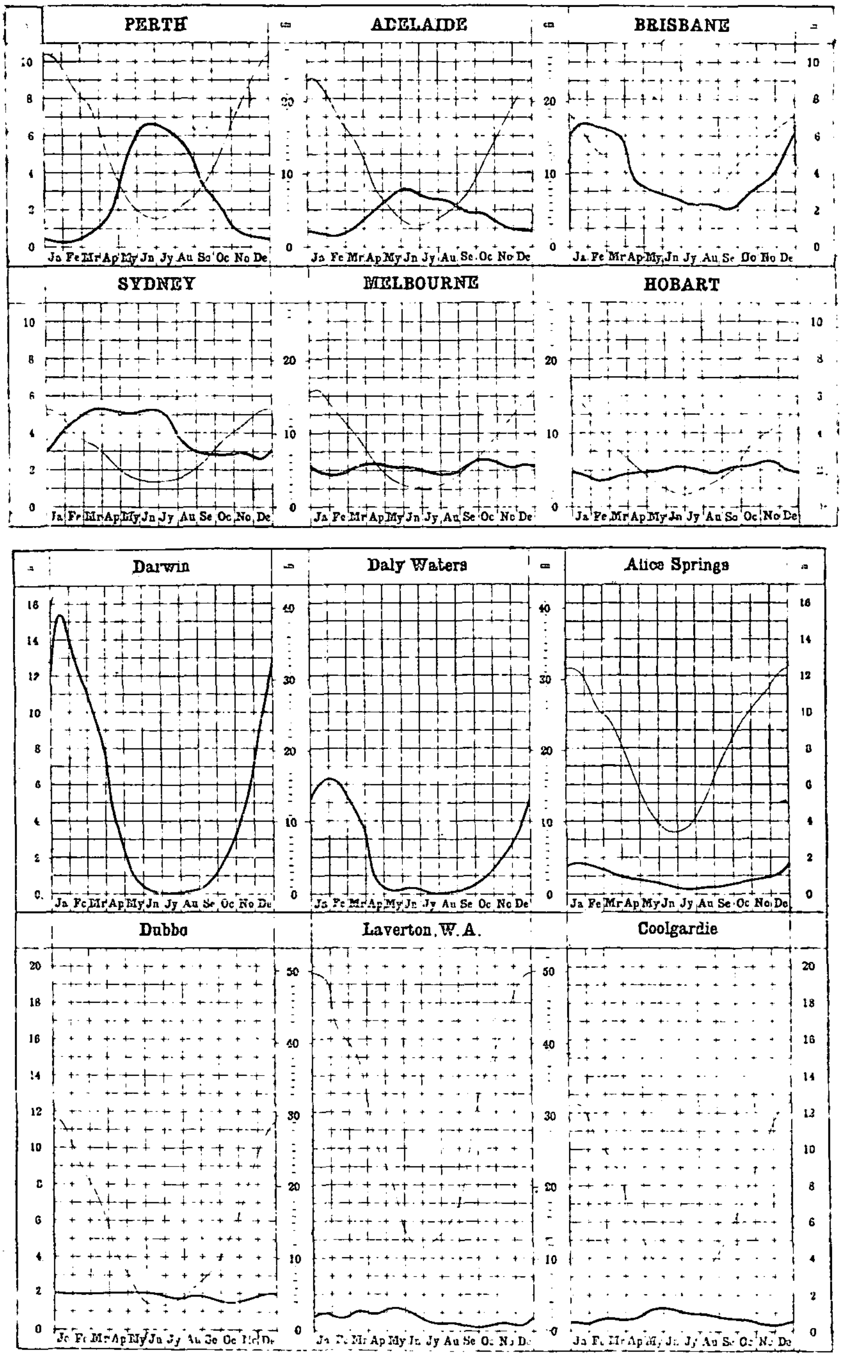
For the thin lines the degree numbers represent relative humidities, or the percentages of actual saturation (absolute saturation = 100).

The upper temperature line represents the mean of the maximum, and the lower line the mean of the minimum results; thus the curves also shew the progression of the range between maximum and minimum temperatures throughout the year. The humidity curves shew the highest and lowest values of the mean monthly humidity at 9 a.m. recorded during a series of years.

Interpretation of the Graphs.—The curves denote mean monthly values. Thus, taking for example, the temperature graphs for Perth, the mean readings of the maximum and minimum temperatures for a number of years on 1st January would give respectively about 83° Fahr. and 62° Fahr. Thus the mean range of temperature on that date is the difference, viz., 21°. Similarly, observations about 1st June would give respectively about 66° Fahr. and 51° Fahr., or a range of 15°.

In a similar manner it will be seen that the greatest mean humidity, say for March, is about 66° and the least mean humidity for the month 46°; in other words, at Perth, the degree of saturation of the atmosphere by aqueous vapour for the month of March ranges between 66 % and 46%.

GRAPHS SHEWING ANNUAL FLUCTUATIONS OF MEAN RAINFALL AND MEAN EVAPORATION IN SEVERAL PARTS OF THE COMMONWEALTH OF AUSTRALIA.



(For Explanation see next page.)

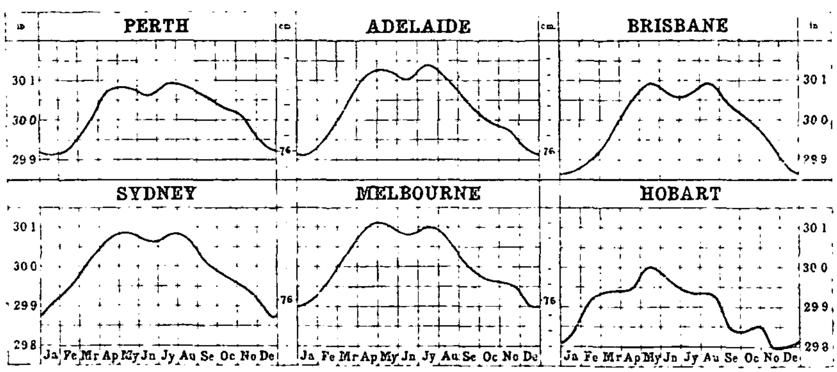
EXPLANATION OF THE GRAPHS OF RAINFALL AND EVAPORATION.—On the preceding graphs thick lines denote rainfall and thin lines evaporation, and shew the fluctuation of the mean rate of fall *per month* throughout the year. The results, plotted from the Climatological Tables hereinafter. are shewn in inches (see the outer columns), and the corresponding metric scale (centimetres) is shewn in the two inner columns. The evaporation is not given for Darwin and Daly Waters.

INTERPRETATION OF THE GRAPHS.—The distance for any date from the zero line to the curve, represents the average number of inches, reckoned as per month, of rainfall at that date. Thus, taking the curves for Adelaide, on the 1st January the rain falls on the average at the rate of about four-fifths of an inch per month, or, say, at the rate of about 9⅗ inches per year. In the middle of June it falls at the rate of nearly 3 inches per month, or, say, at the rate of about 36 inches per year. At Dubbo the evaporation is at the rate of nearly 11¼ inches per month about the middle of January, and only about 1⅔ inches at the middle of June.

TABLE SHEWING MEAN ANNUAL RAINFALL AND EVAPORATION IN INCHES OF THE PLACES SHEWN ON PRECEDING PAGE, AND REPRESENTED BY THE GRAPHS.

—	Rainfall.	Evaporation.	—	Rainfall.	Evaporation.
Perth	33.23	66.37	Darwin...	61.36	—
Adelaide	20.95	54.42	Daly Waters ...	26.35	—
Brisbane	46.42	51.04	Alice Springs...	10.77	95.72
Sydney	48.01	37.32	Dubbo	22.37	—
Melbourne	25.46	38.68	Laverton, W.A.	9.32	145.55
Hobart	23.63	33.29	Coolgardie	9.68	85.75

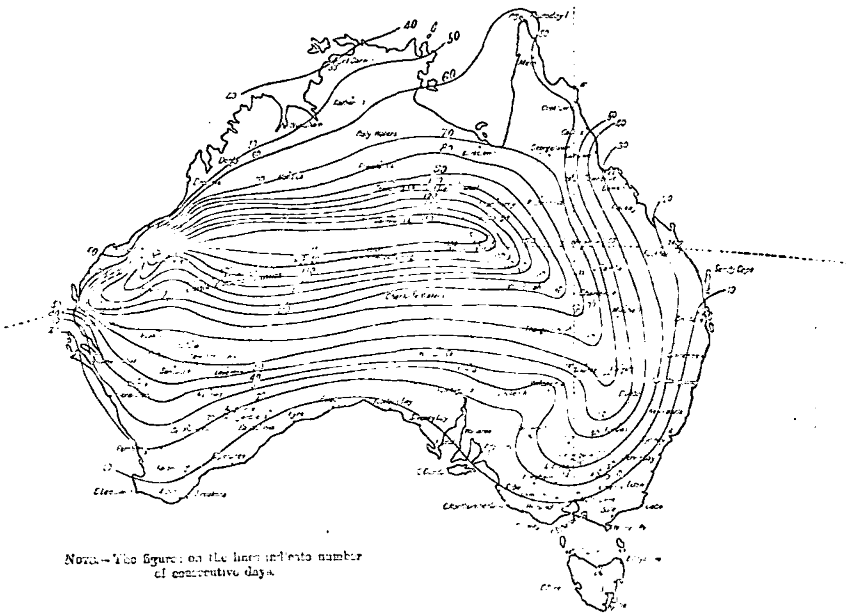
GRAPHS SHEWING ANNUAL FLUCTUATIONS OF MEAN BAROMETRIC PRESSURE FOR THE CAPITALS OF THE SEVERAL STATES OF THE COMMONWEALTH OF AUSTRALIA.



EXPLANATION OF THE GRAPHS OF BAROMETRIC PRESSURE.—On the above graphs the lines representing the yearly fluctuation of barometric pressure at the State capital cities are means for long periods, and are plotted from the Climatological Tables given hereinafter. The pressures are shewn in inches on about 2¼ times the natural scale, and the corresponding pressures in centimetres are also shewn in the two inner columns, in which each division represents one millimetre.

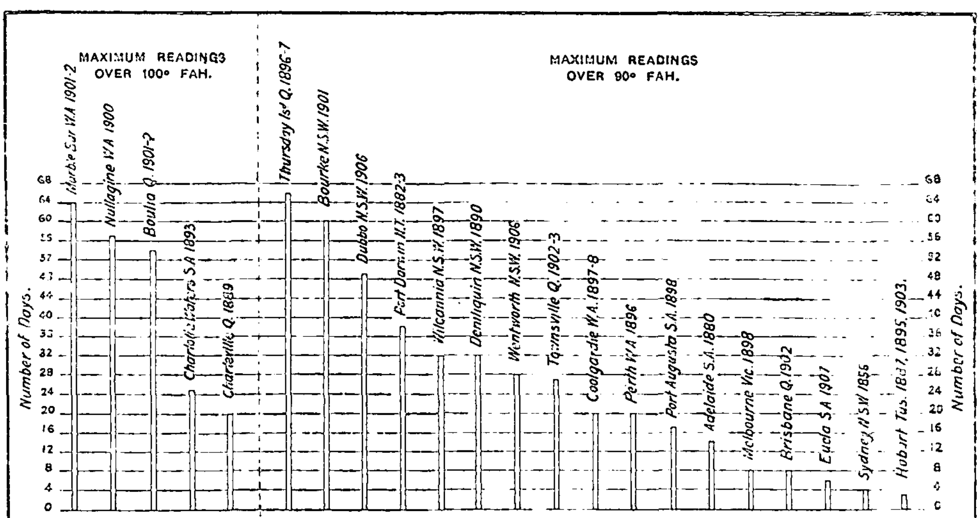
INTERPRETATION OF THE BAROMETRIC GRAPHS.—Taking the Brisbane graph for purposes of illustration, it will be seen that the mean pressure on 1st January is about 29.87 inches, and there are maxima in the middle of May and August of about 30.09 inches.

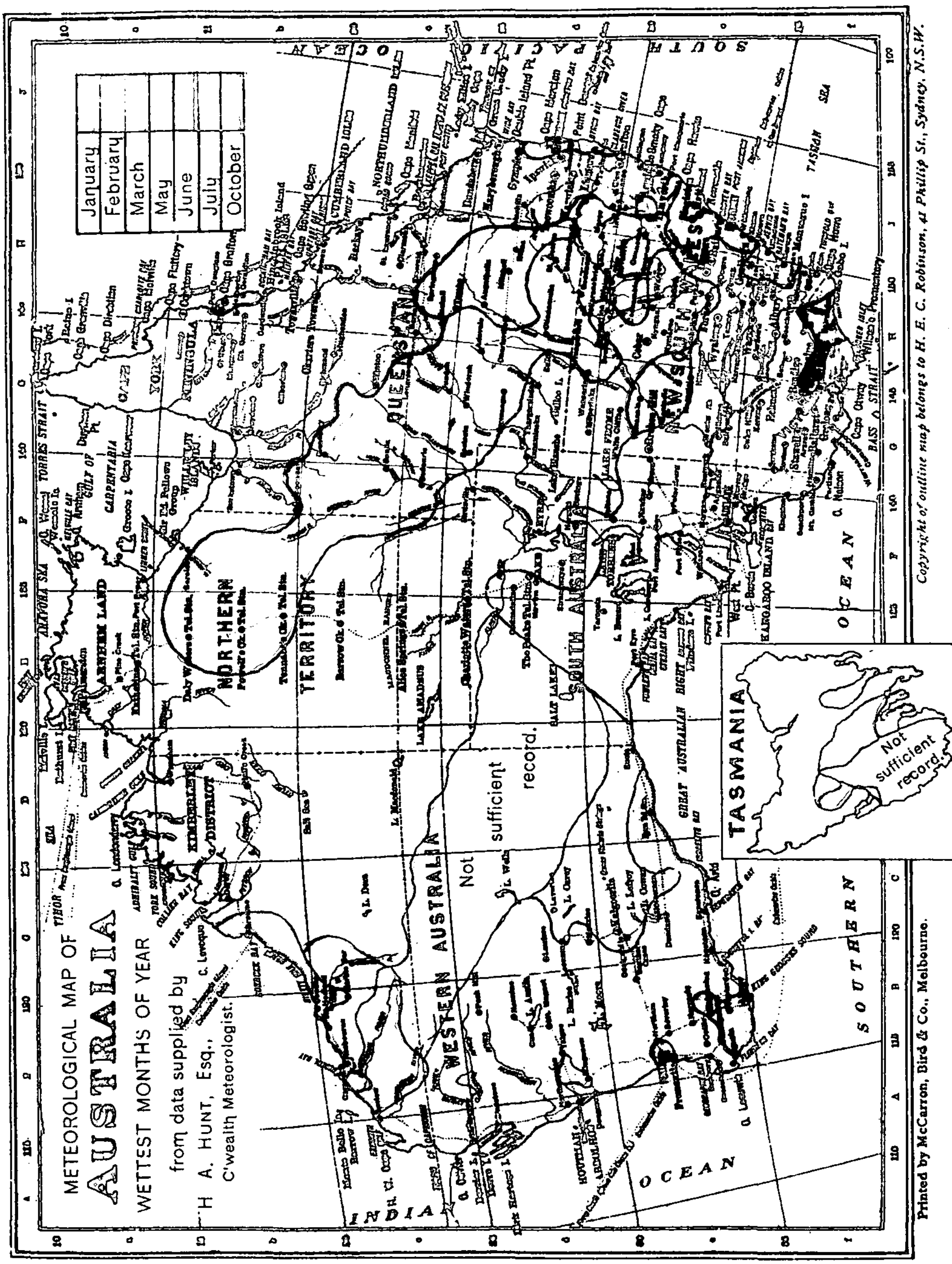
Chart indicating the area affected and period of duration of the Longest Heat Waves when the Maximum Temperature for consecutive 24 hours reached or exceeded 90° Fah.



Note.—The figures on the lines indicate number of consecutive days.

Diagram showing the greatest number of consecutive days on which the Temperature in the shade was over 100° and also over 90° at the places indicated.





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METEOROLOGICAL SUB-DIVISIONS.

West Australia.

No.
1. East Kimberley.
2. West Kimberley.
3. North-West.
4. Gascoyne.
5. South-West.
6. Eucla.
7. Eastern.

South Australia.

8. Northern Territory.
9. Far North and N.W.
10. West.

No.
11. Upper North.
12. North-East.
13. Lower North.
14. Central.
15. Murray Valley.
16. South-East.

Queensland.

17. Peninsular.
18. Gulf.
19. Far West.
20. Central.
21. Nth-East Coast.

No.
22. Central Coast.
23. South-East Coast.
24. Darling Downs.
25. Maranoa.
26. South-West.

New South Wales.

27. Western.
28. North-West Plain.
29. North-West Slope.
30. Northern Tableland
31. North Coast.
32. Hunter & Manning.

No.
33. Central Tableland.
33a. Metropolitan.
34. Cent. Westn. Slope.
35. Cent. Westn. Plain.
36. Riverina.
37. South-West Slope.
38. Southern Tableland
39. South Coast.

Victoria.

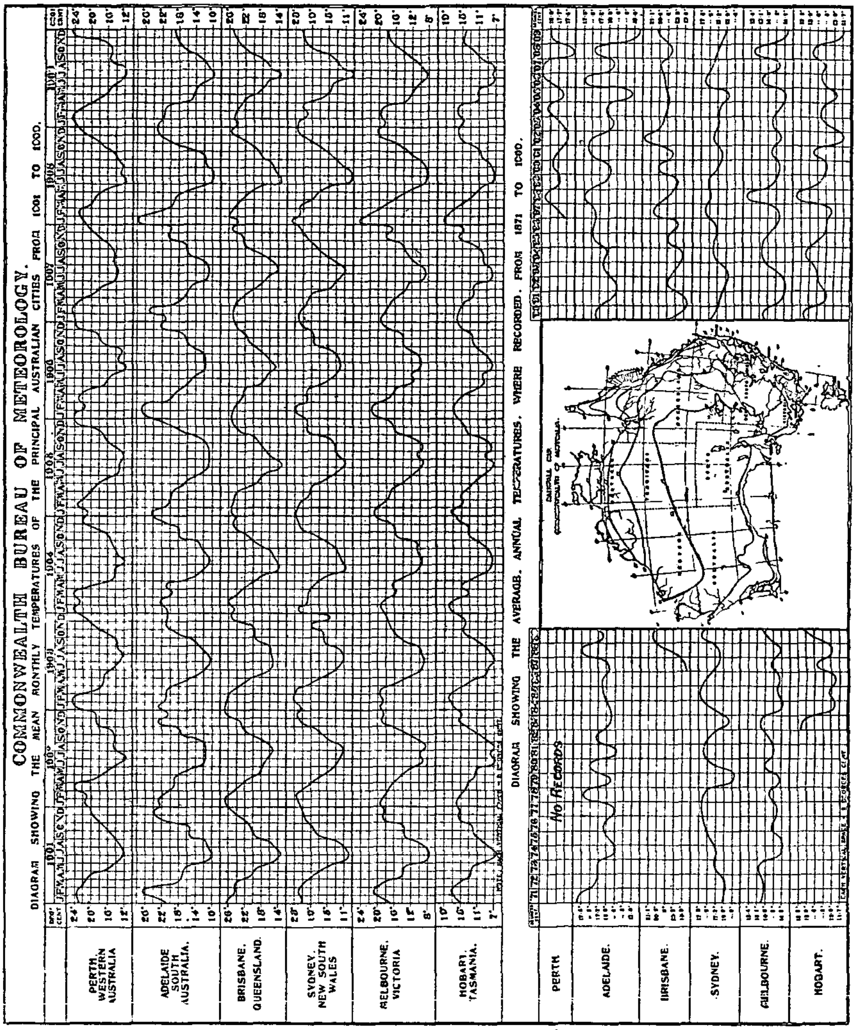
40. Gippsland.
41. North-East.
42. Central.

No.
43. North Central.
44. Northern Country.
45. Mallee.
46. Wimmera.
47. Western.

Tasmania.

48. Northern.
49. W.Coast Mt.Region
50. Central Plateau.
51. Midland.
52. East Coast.
53. Derwent.
54. South-Eastern.

The above are the meteorological sub-divisions adopted by H. A. Hunt, Esq., C'wealth. Meteorologist.

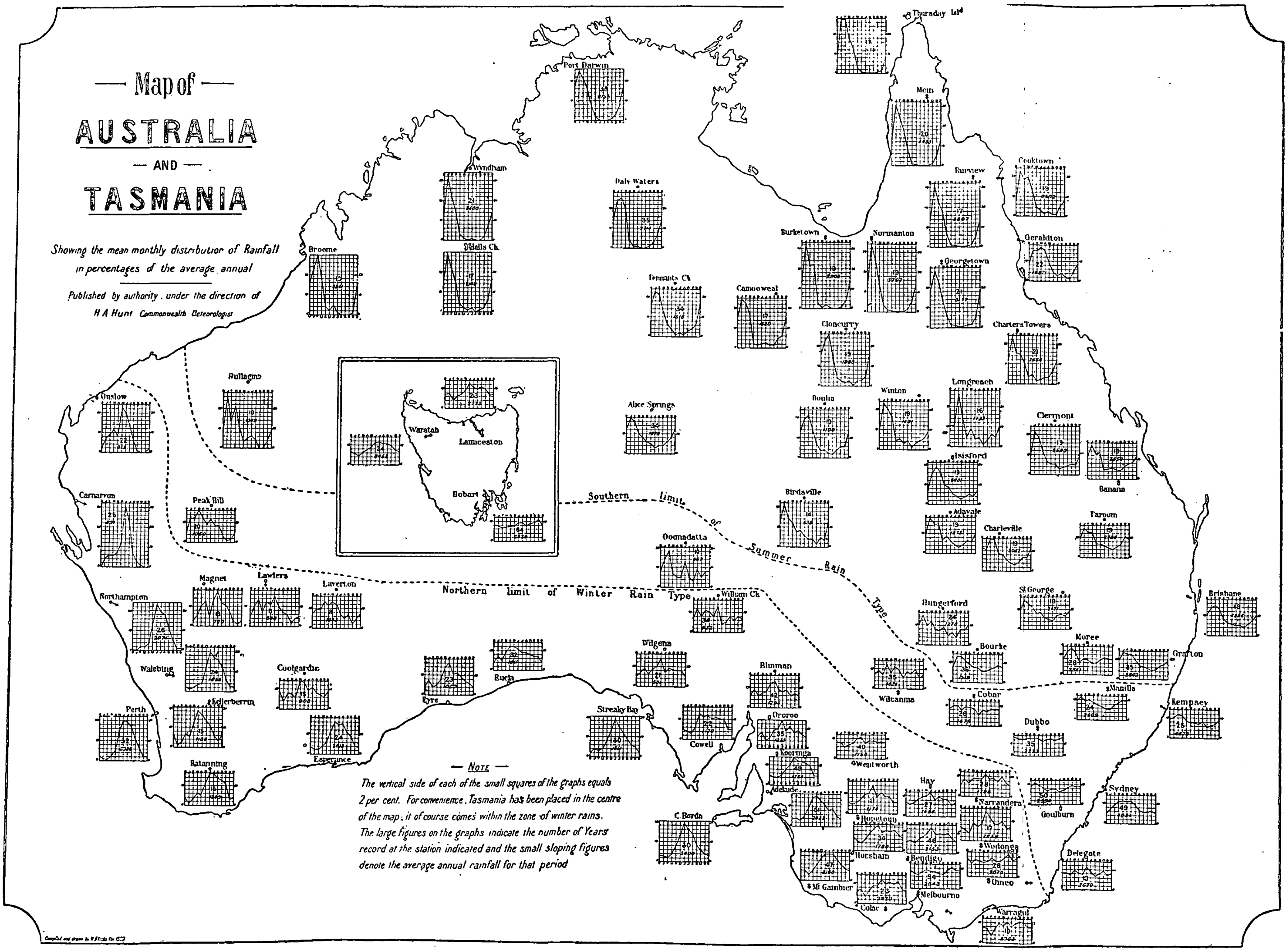


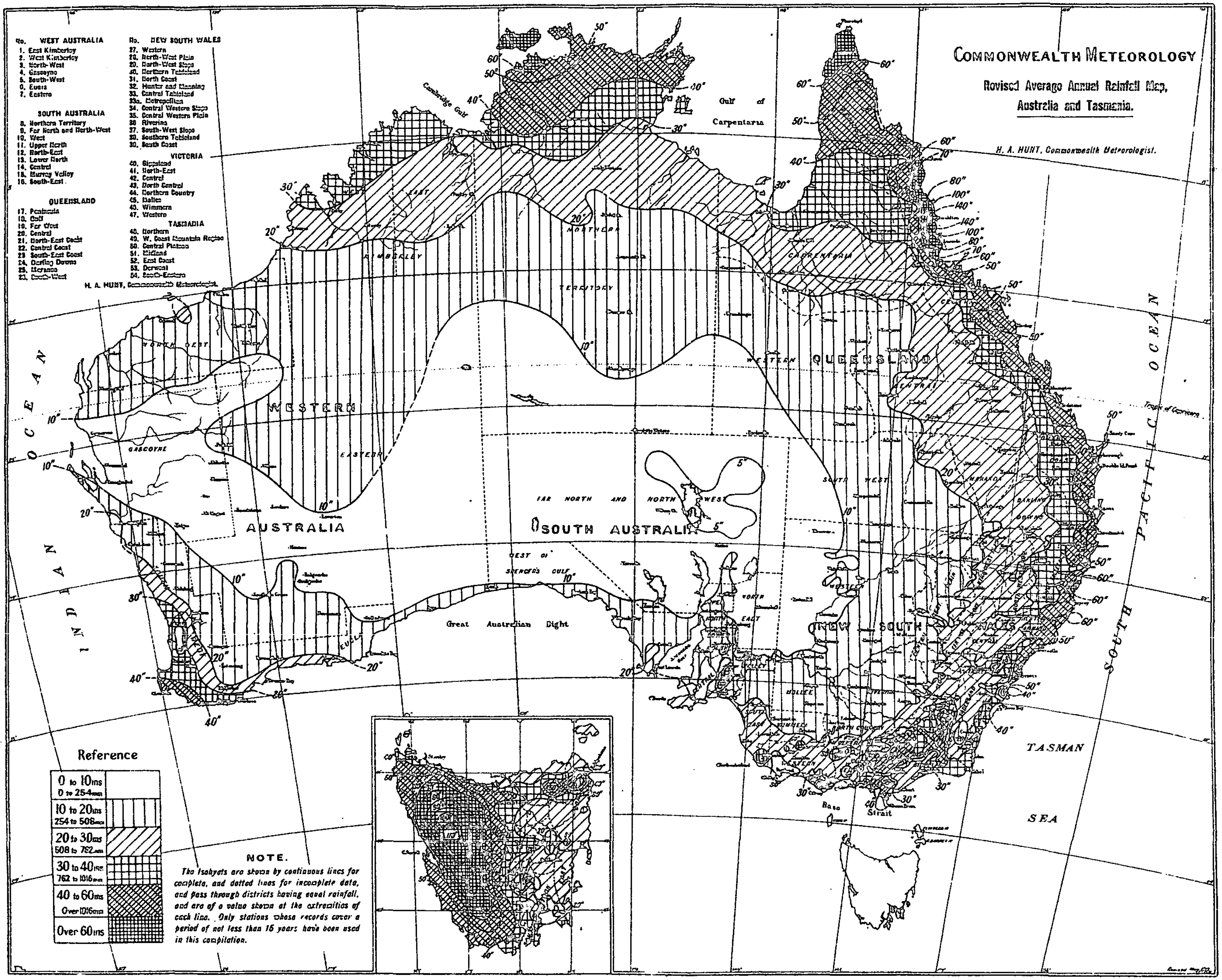
EXPLANATION OF GRAPH.

The six continuous curves on the upper part of the diagram shew the fluctuations of mean monthly temperatures of the Australian capitals from 1901 to 1909. The base of each small square denotes one month, and the vertical side 2° Centigrade or 3.6° Fahrenheit.

The six curves in lower portion of the diagram similarly shew the fluctuations of the mean annual temperatures, from 1871 in the case of Adelaide, Sydney and Melbourne, from 1883, 1887 and 1897 in the case respectively of Hobart, Brisbane and Perth. The base of each rectangle represents one year, and the vertical side 0.3° Centigrade or 0.54° Fahrenheit.

The map shews the areas affected by given amounts of annual rainfall, and is elsewhere given.


Map of
AUSTRALIA
AND
TASMANIA
Showing the mean monthly distribution of Rainfall in percentages of the average annual
Published by authority, under the direction of H A Hunt Commonwealth Meteorologist
Southern limit of Summer Rain Type
Northern limit of Winter Rain Type
NOTE
The vertical side of each of the small squares of the graphs equals 2 per cent. For convenience, Tasmania has been placed in the centre of the map; it of course comes within the zone of winter rains.
The large figures on the graphs indicate the number of Years' record at the station indicated and the small sloping figures denote the average annual rainfall for that period
Thursday Isld
Port Darwin
Mein
Wyndham
Daly Waters
Cooktown
Fairview
Halls Ck
Broome
Burketown
Normanton
Georgetown
Geraldton
Tennants Ck
Camooweal
Cloncurry
Charters Towers
Nullagine
Onslow
Waratah
Launceston
Hobart
Alice Springs
Boulia
Winton
Longreach
Clermont
Isisford
Banana
Carnarvon
Peak Hill
Birdsville
Adavale
Charleville
Taroom
Oodnadatta
Magnet
Lawlers
Laverton
Northampton
William Ck
Hungerford
St George
Brisbane
Walebing
Coolgardie
Wilgena
Bourke
Moree
Grafton
Eucla
Eyre
Blinman
Wilcannia
Cobar
Manilla
Kellerberrin
Perth
Streaky Bay
Cowell
Ororoo
Kempsey
Dubbo
Katanning
Esperance
Wentworth
Kooringa
Adelaide
Hay
Narrandera
Goulburn
Sydney
C. Borda
Hopetoun
Horsham
Bendigo
Wodonga
Omeo
Delegate
Mt Gambier
Colac
Melbourne
Warragul



By authority, McCarron, Bird & Co., Printers, Melbourne.

HEAVY RAINFALLS, WESTERN AUSTRALIA, UP TO 1916, INCLUSIVE.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Alice Downs ...	20 Jan., 1914	8.12	Point Torment ...	17 Dec., 1906	11.86
" ...	21 " "	5.33	Port George, W. ...	17 Jan., 1915	11.24
" ...	22 " "	4.04	Thangoo	17-19 Feb.'96	24.18
Balla Balla ...	21 Mar., 1899	14.40	Whim Creek ...	2 Apr., 1898	7.08
Boodarie	21 " "	14.53	"	3 " "	29.41
Cossack	3 Apr., 1898	12.82	"	20 Mar., 1899	8.89
"	16 " 1900	13.23	"	21 " "	18.17
Croydon	3 Mar., 1903	12.00	Woodstock ...	21 " 1912	13.00
Cocos Island ...	29 Nov., "	14.38			
Derby	29 Dec., 1898	13.09	Wyndham ...	27 Jan., 1890	11.60
"	30 Dec., "	7.14	"	11 " 1903	9.98
Fortescue	3 May, 1890	23.36	"	12 " "	6.64
Frazier Downs ...	3 Mar., 1916	11.25	"	13 " "	4.20
Kerdiadary ...	7 Feb., 1901	12.00	Yeeda	28 Dec., 1898	8.42
Meda	9 Jan., 1914	2.87	"	29 " "	6.88
"	10 " "	8.72	"	30 " "	6.12
"	2 Mar., 1916	10.55	"	2 Mar., 1916	10.70
Obagama	28 Feb., 1910	12.00	"	3 " "	4.80

HEAVY RAINFALLS, NORTHERN TERRITORY, UP TO 1916, INCLUSIVE.

		ins.			ins.
Bonrook	24 Dec., 1915	10.60	Cosmopolitan Gold Mine	24 Dec., 1915	10.60
Borroloola... ...	14 Mar., 1899	14.00	Lake Nash ...	21 Mar., 1901	10.25
Brock's Creek ...	4 Jan., 1914	10.68	Pine Creek ...	8 Jan., 1897	10.35
" " ...	24 Dec., 1915	14.33	Darwin	7 Jan., 1897	11.67
Burrundie ...	4 Jan., 1914	11.61			

HEAVY RAINFALLS, TASMANIA, UP TO 1916 INCLUSIVE.

		ins.			ins.
The Springs ...	30 Jan., 1916	9.72	The Springs ...	31 Jan., 1916	1.03

10. **Snowfall.**—Light snow has been known to fall even as far north, occasionally, as latitude 31° S., and from the western to the eastern shores of the continent. During exceptional seasons it has fallen simultaneously over two-thirds of the State of New South Wales, and has extended at times along the whole of the Great Dividing Range, from its southern extremity in Victoria as far north as Toowoomba in Queensland. During the winter snow covers the ground to a great extent on the Australian Alps for several months, where also the temperature falls below zero Fahrenheit during the night, and in the ravines around Kosciusko and similar localities the snow never entirely disappears.

The antarctic "V"-shaped disturbances are always associated with our most pronounced and extensive snowfalls. The depressions on such occasions are very steep in the vertical area, and the apexes are unusually sharp-pointed and protrude into very low latitudes, sometimes even to the tropics.

11. **Hail.**—*Hail falls throughout Australia most frequently along the southern shores* of the continent in the winter, and over south-eastern Australia during the summer months. The size of the hailstones generally increases with distance from the coast, a fact which lends strong support to the theory that hail is brought about by ascending

currents. Rarely does a summer pass without some station experiencing a fall of stones exceeding in size an ordinary hen-egg, and many riddled sheets of light-gauge galvanised iron bear evidence of the weight and penetrating power of the stones.

Hail storms occur most frequently in Australia when the barometric readings indicate a flat and unstable condition of pressure. They are almost invariably associated with tornadoes or tornadic tendencies, and on the east coast the clouds from which the stones fall are generally of a remarkable sepia-coloured tint.

12. **Barometric Pressures.**—The mean annual barometric pressure (corrected to sea-level and standard gravity) in Australia varies from 29.80 inches on the north coast to 29.92 inches over the central and 30.03 inches in the southern parts of the continent. In January the mean pressure ranges from 29.70 inches in the northern and central areas to 29.91 inches in the southern. The July mean pressure ranges from 29.90 inches at Darwin to 30.12 inches at Alice Springs. Barometer readings, corrected to mean sea-level, have, under anticyclonic conditions in the interior of the continent, ranged from 30.81 inches to as low as 28.44 inches. This lowest record was registered at Townsville during a hurricane on the 9th March, 1903. The mean annual fluctuations of barometric pressure for the capitals of Australia are shewn on page 69.

13. **Wind.**—Notes on the distinctive wind currents in Australia were given in preceding Year Books (see No. 6, page 83) and are here omitted to save space.

14. **Cyclones and Storms.**—The "elements" in Australia are ordinarily peaceful, and although severe cyclones have visited various parts, more especially coastal areas, such visitations are rare, and may be properly described as erratic.

During the winter months the southern shores of the continent are subject to cyclonic storms, evolved from the V-shaped depressions of the southern low-pressure belt. They are felt most severely over the south-western parts of Western Australia, to the south-east of South Australia, in Bass Straits, including the coast line of Victoria, and on the west coast of Tasmania. Apparently the more violent wind pressures from these cyclones are experienced in their northern half, that is, in that part of them which has a north-westerly to a south-westerly circulation.

Occasionally the north-east coast of Queensland is visited by hurricanes from the north-east tropics. During the first three months of the year these hurricanes appear to have their origin in the neighbourhood of the South Pacific Islands, their path being a parabolic curve of south-westerly direction. Only a small percentage, however, reach Australia, the majority recurving in their path to the east of New Caledonia.

Very severe cyclones, popularly known as "Willy Willies," are peculiar to the north-west coast of Western Australia from the months of December to March inclusive. They apparently originate in the ocean, in the vicinity of Cambridge Gulf, and travel in a south-westerly direction with continually increasing force, displaying their greatest energy near Cossack and Onslow, between latitudes 20° and 22° South. The winds in these storms, like those from the north-east tropics, are very violent and destructive, causing great havoc amongst the pearl-fishers. The greatest velocities are usually to be found in the south-eastern quadrant of the cyclones, with north-east to east winds. After leaving the north-west coast, these storms either travel southwards, following the coast-line, or cross the continent to the Great Australian Bight. When they take the latter course their track is marked by torrential rains, as much as 29.41 inches, for example, being recorded in 24 hours at Whim Creek from one such occurrence. Falls of 10 inches and over have frequently been recorded in the northern interior of Western Australia from similar storms.

Some further notes on severe cyclones and on "Southerly Bursters," a characteristic feature of the eastern part of Australia, will be found in previous issues of the Year Book (see No. 6, pp. 84, 85, 86).

15. **Influences affecting Australian Climate.**—Australian history does not cover a sufficient period, nor is the country sufficiently occupied, to ascertain whether or not the advance of settlement has materially affected the climate as a whole. Local changes therein, however, have taken place, a fact which suggests that settlement and the treatment of the land have a distinct effect on local conditions. For example, the mean temperature of Sydney shews a rise of two-tenths of a degree during the last twenty years, a change probably brought about by the great growth of residential and manufacturing buildings within the city and in the surrounding suburbs during that period. Again, low-lying lands on the north coast of New South Wales, that originally were seldom subject to frosts, have, with the denudation of the surrounding hills from forests, experienced annual visitations, the probable explanation being that, through the absence of trees, the cold air of the high lands now flows, unchecked and untempered, down the sides of the hills to the valleys and lower lands.

(i.) *Influences of Forests on Climate*. As already indicated, forests doubtless exercise a great influence on local climate, and hence, to the extent that forestal undertakings will allow, the weather can be controlled by human agency. The direct action of forests is an equalising one; thus, especially in equatorial regions and during the warmest portion of the year, they considerably reduce the mean temperature of the air. They also reduce the diurnal extremes of their shade temperatures, by altering the extent of radiating surface, by evaporation, and by checking the movement of air. While decreasing evaporation from the ground, they increase the relative humidity. Vegetation greatly diminishes the rate of flow-off of rain, and the washing away of surface soil. Thus, when a region is protected by trees, steadier water supply is ensured, and the rainfall is better conserved. In regions of snowfall the supply of water to rivers is similarly regulated, and without this and the sheltering influence of ravines and "gullies," watercourses supplied mainly by melting snow would be subject to alternate periods of flooding and dryness. This is borne out in the inland rivers. Thus, the River Murray, which has never been known to run dry, derives its steadiness of flow mainly through the causes above indicated.

(ii.) *Direct Influences of Forest on Rainfall*. Whether forests have a direct influence on rainfall is a debatable question, some authorities alleging that precipitation is undoubtedly induced by forests, while others contend the opposite.

Sufficient evidence exists, however, to establish that, even if the rainfall has not increased, the beneficial effect of forest lands in tempering the effects of the climate is more than sufficient to disclose the importance of their protection and extension.

It is the rapid rate of evaporation, induced by both hot and cold winds, which injures crops and makes life uncomfortable on the plains. Whether the forest aids in increasing precipitation there may be doubt, but nobody can say that it does not check the winds and the rapid evaporation due to them.

Trees as wind-breaks have been successfully planted in central parts of the United States, and there is no reason why similar experiments should not be successful in many parts of our treeless interior. The belts should be planted at right angles to the direction of the prevailing parching winds, and if not more than half a mile apart will afford shelter to the enclosed areas.

In previous issues some notes on observations made in other countries were added (see Year Book No. 6, pp. 86 and 95).

16. **Comparison of Rainfalls and Temperatures.**—For the purpose of comparison the following lists of rainfalls and temperatures are given for various important cities throughout the world, for the site of the Federal capital, and for the capitals of the Australian States :—

COMPARISONS OF RAINFALLS AND TEMPERATURES OF CITIES OF THE WORLD WITH THOSE OF AUSTRALIA.

Place.	Height above M.S.L.	Annual Rainfall. Average.	Annual Rainfall. Highest.	Annual Rainfall. Lowest.	Temperature. *Mean Summer.	Temperature. †Mean Winter.	Temperature. Highest on Record.	Temperature. Lowest on Record.	Temperature. Average Hottest Month.	Temperature. Average Coldest Month.
	Ft.	Ins.	Ins.	Ins.	Fahr.	Fahr.	Fahr.	Fahr.	Fahr.	Fahr.
Amsterdam ...	6	27.29	40.59	17.60	63.2	36.8	90.0	4.1	64.4	35.4
Auckland ...	125	43.31	63.72	26.32	66.1	52.5	91.0	31.9	67.2	51.8
Athens	351	15.48	33.32	4.55	79.2	49.1	106.5	19.6	81.1	47.5
Bergen	146	89.10	102.80	73.50	56.8	34.5	88.5	4.8	57.9	33.6
Berlin	115	22.95	30.04	14.25	64.7	32.2	98.6	—13.0	66.0	30.0
Berne	1,877	36.30	58.23	24.69	62.2	30.1	91.4	— 3.6	64.4	28.0
Bombay	37	71.15	114.89	33.41	83.5	75.1	100.0	55.9	84 8	74.2
Breslau	482	22.00	28.01	16.45	63.9	30.0	100.0	—23.4	65.5	29.3
Brussels	328	28.35	41.18	17.73	62.6	36.0	95 5	— 4.4	63.7	34.5
Budapest... ...	500	25.20	35.28	16.79	68.6	30.2	98.6	— 5.1	70.4	28.2
Buenos Ayres ...	72	36.82	80.73	21.53	73.2	51.5	103.1	25.9	74.2	50.5
Calcutta	21	61.98	89.32	39.38	84.9	67.1	108.2	44.2	85.4	65.5
Capetown ...	40	25.50	36.72	17.71	68.1	54.7	102.0	34.0	68.8	53.9
Caracas	3,420	30.03	47.36	23.70	68.3	65.3	87.8	48.2	69.2	63.7
Chicago	823	33.54	45.86	24.52	69.2	25.4	103.0	—23.0	72.3	24.0
Christchurch ...	25	25.45	35.30	13.54	61.1	43.4	95.7	21.3	61.6	42.4
Christiania ...	82	22.52	31.73	16.26	61.0	24.4	95.0	—21.1	62.6	23.9
Colombo... ...	40	83.83	139.70	51.60	81.5	79.9	95.8	65.0	82.6	79.1
Constantinople ...	245	28.75	42.74	14.78	74.0	43.5	103.6	13.0	75.7	42.0
Copenhagen ...	46	22.33	28.78	13.94	60.7	32.1	90.5	—13.0	62.2	31.4
Dresden	115	26.80	34.49	17.72	62.9	32.4	93.4	—15.3	64.4	31.6
Dublin	47	27.66	35.56	16.60	59.4	42.0	87.2	13.3	60.5	41.7
Dunedin	300	37.06	53.90	22.15	57.3	43.1	94.0	23.0	57.9	42.0
Durban	260	40.79	71.27	27.24	75.6	64.4	110.6	41.1	76.7	63.8
Edinburgh ...	441	25.21	32.05	16.44	55.8	38.8	87.7	5.0	57.2	38.3
Geneva	1,328	33.48	46.89	21.14	64.4	33.7	...	...	66.2	32.2
Genoa	157	51.29	108.22	28.21	73.8	46.8	94.5	16.7	75.4	45.5
Glasgow	184	38.49	56.18	29.05	52.7	41.0	84.9	6.6	58.0	38.4
Greenwich ...	159	24.12	35.54	16.38	61.3	39.3	100.0	4.0	62.7	38.6
Hong Kong ...	110	84.10	119.72	45.83	81.3	60.3	97.0	32.0	81.8	58.1
Johannesburg ...	5,750	31.63	50.00	21.66	65.4	54.4	94.0	23.3	68.2	48.9
Leipzig	384	24.69	31.37	17.10	63.1	31.5	97.3	—14.8	64.8	30.6
Lisbon	312	29.18	52.79	17.32	69.6	51.3	94.1	32.5	70.2	49.3
London	18	24.04	38.20	18.23	61.2	39.3	100.0	9.4	62.8	38.7
Madras	22	49.06	88.41	18.45	86.7	76.0	113.0	57.5	87.6	75.3
Madrid	2,149	16.23	27.48	9.13	73.0	41.2	107.1	10.5	75.7	39.7
Marseilles ...	246	21.88	43.04	12.28	70.3	45.3	100.4	11.5	72.1	43.3
Moscow	526	18.94	29.28	12.07	63.4	14.7	99.5	—44.5	66.1	11.9
Naples	489	34.00	56.58	21.75	73.6	48.0	99.1	23.9	75.4	46.8
New York ...	314	42.47	59.68	28.78	72.1	31.7	100.0	— 6.0	74.5	30.3
Ottawa	294	33.40	44.44	26.36	67.2	14.1	98.5	—33.0	69.7	12.0
Paris	165	21.92	29.56	16.44	63.5	37.1	101.1	—14.1	65.8	36.1
Pekin	143	24.40	36.00	18.00	77.7	26.6	114.0	— 5.0	79.2	23.6
Quebec	296	40.46	47.57	32.12	63.5	12.4	95.5	—34.3	66.3	10.1
Rome	166	32.57	57.89	12.72	74.3	46.0	104.2	17.2	76.1	44.6
San Francisco ...	155	22.83	38.82	9.31	59.0	51.0	101.0	29.0	61.0	50.0
Shanghai ...	14	44.13	62.52	27.91	77.4	39.4	102.9	10.2	79.7	37.4
Singapore ...	8	91.99	158.68	32.71	81.2	78.6	94.2	63.4	81.5	78.3
Stockholm ...	146	18.31	25.46	11.78	59.7	27.0	91.8	—22.0	62.1	25.7
Petrograd ...	16	21.30	29.52	13.75	61.1	17.4	97.0	—38.2	63.7	15.2
Tokio	70	59.17	77.10	45.72	73.9	38.9	97.9	15.4	77.7	37.1
Trieste	85	42.94	63.14	26.57	73.9	41.3	99.5	14.0	76.3	39.9
Vienna	663	24.50	33.90	16.50	65.7	30.4	97.7	— 8.0	67.1	28.0
Vladivostock ...	55	19.54	33.60	9.39	63.9	11.0	95.7	—21.8	69.4	6.1
Washington ...	75	43.80	61.33	18.79	74.7	34.5	104.0	—15.0	76 8	32.9
Wellington (N.Z.)	110	49.70	67.68	30.02	61.7	48.4	88.0	30.0	62.4	47.5
Zurich	1,542	45.15	78.27	29.02	63.3	31.3	94.1	— 0.8	65.1	29.5
FEDERAL CAPITAL SITE.					*	†				
Canberra (Dist.) Queanbeyan ...	2,000 to 2,900	22.36	41.29	10.45	68.5	44.0	101.0	20.0	70.6	43.1
THE STATE CAPITALS.					*	†				
Perth	197	33.23	46.73	20.21	72.9	55.8	107.9	34.2	74.1	54.9
Adelaide	140	20.95	30.87	11.39	73.1	53.0	116.3	32.0	74.1	51.6
Brisbane	137	46.20	88.26	16.17	76.7	59.6	108.9	36.1	77.2	58.2
Sydney	146	48.28	82.76	21.49	71.0	53.9	108.5	35.9	71.7	52.4
Melbourne ...	115	26.11	44.25	15.61	66.5	50.0	111.2	27.0	67.4	48.5
Hobart	177	23.63	43.39	13.43	61.3	46.6	105.2	27.0	62.3	45.3

* Mean of the three hottest months. † Mean of the three coldest months.

17. **Climatological Tables.**—The means, averages, extremes, totals, etc., for a number of climatological elements have been determined from long series of observations at the Australian capitals up to and including the year 1916. These are given in the following tables:—

CLIMATOLOGICAL DATA FOR PERTH, W.A.

LAT. 31° 57′ S., LONG. 115° 50′ E. HEIGHT ABOVE M.S.L. 197 FT.

BAROMETER, WIND, EVAPORATION, LIGHTNING, CLOUDS, AND CLEAR DAYS.

Month.	Bar. corrected to 32° F. Mn. Sea Level and Standard Gravity from 9 a.m. & 3 p.m. readings.	Wind. Greatest Number of Miles in one day.		Wind. Mean Hourly Pressure. (lbs.)	Wind. Total Miles.	Wind. Prevailing Direction.	Mean Amount of Evaporation.	No. of Days Lightning.	Mean Amount of Clouds, 9 a.m. & 3 p.m.	No. of Clear Days.
No. of yrs. over which observation extends	32	19		19	19	19	18	19	20	20
January	29.910	797	27/98	0.70	11,321	S	10.45	1.7	2.8	13.9
February	29.926	650	6/08	0.65	9,981	S S E	8.70	1.1	3.0	11.4
March	29.990	651	6/13	0.55	10,173	S S E	7.75	1.1	3.3	12.0
April	30.076	955	25/00	0.42	8,594	S E	4.82	0.8	4.6	7.2
May	30.086	768	5/12	0.35	8,050	E N E	2.78	1.9	5.4	5.4
June	30.064	861	27/10	0.37	7,993	E	1.73	1.9	6.1	3.2
July	30.094	949	11/99	0.40	8,478	N N E	1.64	2.7	5.6	4.9
August	30.085	966	15/03	0.43	8,928	W	2.38	1.5	5.6	4.8
September	30.062	864	11/05	0.48	9,153	S W	3.36	1.5	5.3	5.4
October	30.030	809	6/16	0.54	9,999	S S W	5.25	1.2	5.3	5.4
November	29.990	777	18/97	0.60	10,265	S	7.66	1.1	4.0	8.0
December	29.929	672	31/98	0.66	11,037	S	9.85	1.5	3.1	11.8
Year { Totals ...	—	—		—	—	—	66.37	18.0	4.5	93.4
Year { Averages ...	30.020	—		0.51	9,503	S	—	—	—	—
Year { Extremes ...	—	966*		—	—	—	—	—	—	—

* August 15, 1903.

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature. Mean Max.	Mean Temperature. Mean Min.	Mean Temperature. Mean	Extreme Shade Temperature. Highest.		Extreme Shade Temperature. Lowest.		Greatest Range.	Extreme Temperature. Highest in Sun.		Extreme Temperature. Lowest on Grass.		Mean Hours of Sunshine.
No. of yrs. over which observation extends.	20	20	20	20		20		20	19		18		19
January	84.3	63.1	73.7	107.0	16/97	50.6	25/01	56.4	177.3	22/14	42.4	25/02	324.0
February	84.8	63.3	74.1	107.3	12/15	47.7	1/02	59.6	169.0	4/99	39.8	1/13	271.7
March	81.3	60.6	71.0	106.1	6/14	45.8	8/03	60.3	164.0	6/14	36.7	8/03	270.7
April	75.8	56.8	66.3	99.7	9/10	39.3	20/14	60.4	157.0	8/16	31.0	20/14	217.5
May	68.7	52.4	60.6	90.4	2/07	34.3	11/14	56.1	139.1	7/14	25.3	11/14	182.4
June	63.7	49.2	56.4	81.7	2/14	36.3	29/14	45.4	135.5	9/14	29.0	20/16	146.7
July	62.4	47.4	54.9	73.8	24/99	34.2	7/16	39.6	133.2	13/15	25.2	6,7/16	167.0
August	63.9	48.2	56.0	81.0	12/14	35.3	31/08	45.7	139.1	21/13	27.9	10/11	186.1
September	66.2	50.2	58.2	86.7	30/13	38.9	17/13	47.8	153.6	29/16	29.2	21/16	203.0
October	69.4	52.8	61.1	93.4	17/06	41.2	10/03	52.2	154.0	29/14	33.4	1/10	235.7
November	75.1	56.3	65.7	104.6	24/13	42.0	1/04	62.6	166.6	23/15	35.5	*	292.0
December	80.9	60.6	70.8	107.9	20/04	48.0	2/10	59.9	168.7	25/15	39.1	2/10	327.5
Year { Averages ...	73.0	55.1	64.0	—		—		—	—		—		2827.3 †
Year { Extremes ...	—	—	—	107.9	20/12/1904	34.2	7/7/1916	73.7	177.3	22/1/1914	25.2	6,7/7/1916	—

* 6/10 and 14/12. † Total for year.

HUMIDITY, RAINFALL, AND DEW.

Month.	Humidity. Mean 9 a.m.	Humidity. Highest Mean.	Humidity. Lowest Mean.	Rainfall. Mean Monthly.	Rainfall. Mean No. of Days Rain.	Rainfall. Greatest Monthly.		Rainfall. Least Monthly.		Rainfall. Greatest in One Day.		Dew. Mean Amount of Dew.	Dew. Mean No. days Dew.
No of yrs. over which observation extends	20	20	20	41	41	41		41		41		—	20
January	53	61	42	0.35	3	2.17	1879	nil.	*	1.74	28/79	—	2.0
February	55	65	46	0.42	3	2.98	1915	nil.	†	1.63	26/15	—	2.8
March	57	66	46	0.70	4	4.50	1896	nil.	‡	1.53	17/76	—	5.0
April	63	72	53	1.60	7	4.97	1882	0.05	‖	2.62	30/04	—	8.0
May	73	81	61	4.72	14	12.13	1879	0.98	1903	2.80	20/79	—	12.6
June	78	83	72	6.61	16	12.11	1890	2.16	1877	2.65	16/00	—	12.0
July	79	84	72	6.47	17	10.90	1902	2.42	1876	3.00	4/91	—	13.0
August	74	79	67	5.64	18	10.33	1882	0.46	1902	2.79	7/03	—	11.1
September	68	75	62	3.26	14	7.72	1903	0.34	1916	1.73	23/09	—	8.9
October	62	75	54	2.09	11	7.87	1890	0.49	1892	1.38	15/10	—	6.0
November	55	63	49	0.82	6	2.78	1916	nil.	1891	1.11	30/03	—	4.5
December	52	62	44	0.55	4	3.05	1888	nil.	1886	1.72	1/88	—	3.1
Year { Totals ...	—	—	—	—	—	—		—		—		—	89.0
Year { Averages ...	62	—	—	33.23	117	—		—		—		—	—
Year { Extremes ...	—	84	42	—	—	12.13	5/79	nil.	§	3.00	4/7/91	—	—

* 1888, 1894, 1897, 1911. † 1885, 1891, 1896, 1903, 1913. ‡ 1877, 1884, 1886. ‖ 1890, 1894.
§ Various years.

CLIMATOLOGICAL DATA FOR ADELAIDE, S.A.

LAT. 34° 56′ S., LONG. 138° 35′ E. HEIGHT ABOVE M.S.L. 140 FT.

BAROMETER, WIND, EVAPORATION, LIGHTNING, CLOUDS, AND CLEAR DAYS.

Month.	Bar. corrected to 32° F. Mn. Sea Level and Standard Gravity from 9 a.m. & 3 p.m. readings.	Wind. Greatest Number of Miles in one day.	Wind. Mean Hourly Pressure. (lbs.)	Wind. Total Miles.	Wind. Prevailing Direction.	Mean Amount of Evaporation.	No. of Days Lightning.	Mean Amount of Clouds, 9 a.m. 3 p.m. & 9 p.m.	No. of Clear Days.
No. of yrs. over which observation extends	60	39	39	39	39	47	45	49	35
January	29.916	758 19/99	0.35	7,983	S x W	8.97	2.3	3.5	7.7
February	29.952	691 22/96	0.30	6,842	S	7.34	2.0	3.4	7.1
March	30.036	628 9/12	0.25	6,803	S x W	5.79	2.3	3.9	6.6
April	30.117	773 10/96	0.22	6,236	S W x S	3.38	1.7	5.0	3.8
May	30.129	760 9/80	0.21	6,188	N N E	2.00	1.7	5.7	1.8
June	30.100	750 12/78	0.25	6,632	N x E	1.23	2.2	6.2	1.3
July	30.131	674 25/82	0.25	6,804	N x W	1.29	1.6	5.8	1.6
August	30.098	773 31/97	0.28	7,234	N N W	1.87	2.3	5.6	2.0
September	30.040	720 2/87	0.32	7,405	W S W	2.84	2.4	5.2	2.9
October	29.999	768 28/98	0.34	7,988	S W x W	4.78	3.4	4.9	3.9
November	29.973	677 2/04	0.34	7,675	S S W	6.51	3.8	4.6	5.1
December	29.919	675 12/91	0.35	8,024	S S W	8.42	2.8	3.8	7.1
Year { Totals ...	—	—	—	—	—	54.42	28.5	—	50.9
Year { Averages ...	30.034	—	0.29	7,151	S W x S	—	—	4.8	—
Year { Extremes ...	—	773*	—	—	—	—	—	—	—

* 10/4/96 and 31/8/97.

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature. Mean Max.	Mean Temperature. Mean Min.	Mean Temperature. Mean	Extreme Shade Temperature. Highest.	Extreme Shade Temperature. Lowest.	Greatest Range.	Extreme Temperature. Highest in Sun.	Extreme Temperature. Lowest on Grass.	Mean Hours of Sunshine.
No. of yrs. over which observation extends	60	60	60	60	60	60	39	56	35
January	86.5	61.6	74.1	116.3 26/58	45.1 21/84	71.2	180.0 18/82	36.5 14/79	308.1
February	86.2	62.1	74.1	113.6 12/99	46.4 13/05	67.2	170.5 10/00	36.7 24/78	264.2
March	80.8	58.9	69.9	108.0 12/61	44.8 –/57	63.2	174.0 17/83	33.8 27/80	237.8
April	73.2	54.6	63.9	98.0 10/66	39.6 15/59	58.4	155.0 1/83	30.3 27/08	176.2
May	65.4	50.0	57.7	88.3 5/66	36.9 †	51.4	148.2 12/79	25.9 10/91	149.8
June	60.2	46.6	53.4	76.0 23/65	32.5 27/76	43.5	138.8 18/79	22.9 12/13	119.9
July	58.7	44.5	51.6	74.0 11/06	32.0 24/08	42.0	134.5 26/90	23.3 25/11	137.8
August	62.0	45.9	53.9	85.0 31/11	32.3 17/59	52.7	140.0 31/92	23.5 7/88	161.3
September	66.2	47.8	57.0	90.7 23/82	32.7 4/58	58.0	160.5 23/82	26.2 15/08	182.7
October	72.5	51.4	62.0	102.2 24/14	36.0 –/57	66.2	158.8 19/82	28.5 7/96	229.3
November	78.6	55.3	67.0	113.5 21/65	40.8 2/09	72.7	166.9 20/78	31.5 2/09	261.4
December	83.4	58.9	71.1	114.2 14/76	43.0 ‡	71.2	175.7 7/99	32.5 4/84	303.0
Year { Averages ...	72.8	53.1	63.0	—	—	—	—	—	2531.5†
Year { Extremes ...	—	—	—	116.3 26/1/58	32.0 24/7/08	84.3	180.0 18/1/82	22.9 12/6/13	—

† 26/1895 and 24/1904. ‡ 16/61 and 4/06. † Total for year.

HUMIDITY, RAINFALL, AND DEW.

Month.	Humidity. Mean 9 a.m.	Humidity. Highest Mean.	Humidity. Lowest Mean.	Rainfall. Mean Monthly.	Rainfall. Mean No. of Days Rain.	Rainfall. Greatest Monthly.	Rainfall. Least Monthly.	Rainfall. Greatest in One Day.	Dew. Mean Amount of Dew.	Dew. Mean No. days Dew
No. of yrs. over which observation extends	49	49	49	78	78	78	78	78	—	45
January	38	59	30	0.72	4	4.00 1850	nil. *	2.30 2/89	—	4
February	41	56	33	0.61	4	2.67 1858	nil. †	2.24 14/13	—	5
March	47	58	36	1.04	6	4.60 1878	nil. ‡	3.50 5/78	—	11
April	57	72	44	1.86	9	6.78 1853	0.06 1910	3.15 5/60	—	14
May	68	76	49	2.68	14	7.75 1875	0.20 1891	2.75 1/53	—	16
June	77	84	69	3.11	15	8.58 1916	0.42 1886	1.97 26/16	—	16
July	76	87	69	2.63	17	5.38 1865	0.36 1889	1.75 10/65	—	17
August	69	77	54	2.49	16	6.24 1852	0.35 1914	2.23 19/51	—	16
September	61	72	44	1.96	14	4.64 1840	0.45 1896	1.42 25/93	—	15
October	51	67	29	1.72	11	3.83 1870	0.17 1914	2.24 16/08	—	12
November	43	57	37	1.17	8	3.55 1851	0.04 1885	1.88 28/58	—	7
December	39	50	33	0.96	6	3.98 1861	nil. 1904	2.42 23/13	—	5
Year { Totals ...	—	—	—	20.95	124	—	—	—	—	138
Year { Averages ...	53	—	—	—	—	—	—	—	—	—
Year { Extremes ...	—	87	29	—	—	8.58 6/16	nil. §	3.50 5/3/78	—	—

* 1848, etc. † 1848, etc. ‡ 1859, etc.
§ January, February, March and December, various years.

CLIMATOLOGICAL DATA FOR BRISBANE, QUEENSLAND.

LAT. 27° 28′ S., LONG. 153° 2′ E. HEIGHT ABOVE M.S.L. 137 FT.

BAROMETER, WIND, EVAPORATION, LIGHTNING, CLOUDS, AND CLEAR DAYS.

Month.	Bar. corrected to 32° F. Mn. Sea Level and Standard Gravity from 9 a.m. & 3 p.m. readings.	Wind. Greatest Number of Miles in one day.	Wind. Total Miles.	Wind. Mean Hourly Pressure. (lbs.)	Wind. Prevailing Direction.	Mean Amount of Evaporation.	No. of Days Lightning.	Mean Amount of Clouds, 9 a.m. & 3 p.m.	No. of Clear Days.
No. of yrs. over which observation extends	30	6	6	6	30	8	30	30	8
January	29.871	315 24/14	3,667	0.07	E	6.699§	5.1	6.2	3.6
February	29.893	268 26/14	3,568	0.08	S E	5.104	5.1	6.2	1.9
March	29.951	305 29/16	2,916	0.05	S	4.632	4.0	5.9	4.3
April	30.041	215 8/16	2,799	0.05	S	3.651	3.2	5.0	8.6
May	30.091	180 19/20/15	2,545*	0.03	S	2.841	2.8	4.9	8.9
June	30.059	307 23/16	2,742‡	0.04	S	2.081	1.9	4.4	8.1
July	30.064	200 1/16	2,524‡	0.03	S	2.186	2.2	3.9	11.0
August	30.086	215 5/16	2,871	0.05	S	2.755	3.6	3.8	11.5
September	30.027	205 28/16	2,730	0.04	S	3.671	5.3	3.9	11.5
October	30.003	308 19/15	3,469	0.07	N E	4.992	6.8	4.5	7.9
November	29.950	265† 27/14	3,708	0.08	E & N E	5.950	8.0	5.1	6.5
December	29.882	295 21/13	3,912	0.08	E & N E	6.482	8.3	5.7	3.1
Year — Totals ...	—	—	—	—	—	51.044	56.3	—	86.9
Year — Averages ...	29.993	—	3,121	0.06	S'ly.	—	—	5.0	—
Year — Extremes ...	—	315 24/1/14	—	—	—	—	—	—	—

* Mean for 4 years. † 28 days. ‡ Mean for 5 years. § Mean for 6 years.

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature. Mean Max	Mean Temperature. Mean Min.	Mean Temperature. Mean	Extreme Shade Temperature. Highest.	Extreme Shade Temperature. Lowest.	Greatest Range.	Extreme Temperature. Highest in Sun.	Extreme Temperature. Lowest on Grass.	Mean Hours of Sunshine.
No. of yrs. over which observation extends.	30	30	30	30	30	30	30	30	8
January	85.5	68.9	77.2	108.9 14/02	58.8 4/93	50.1	164.4 2/13	49.9 4/93	220.8
February	84.6	68.5	76.6	101.9 11/04	58.7 *	43.2	165.2 6/02	49.3 9/89	202.3
March	82.4	66.4	74.4	96.8 16/88	52.4 29/13	44.4	160.0 1/87	45.4 29/13	198.2
April	79.2	61.7	70.5	95.2 †	48.6 17/00	46.6	152.3 10/14	37.0 17/00	208.8
May	73.5	55.4	64.5	88.8 18/97	41.3 24/99	47.5	147.0 1/10	29.8 8/97	194.3
June	69.3	50.8	60.1	83.2 28/15	36.3 29/08	46.9	133.9 6/06	25.4 23/88	156.1
July	68.2	48.2	58.2	83.4 28/98	36.1 ‡	47.3	146.1 20/15	23.9 11/90	181.4
August	71.3	49.8	60.6	87.5 28/07	37.4 6/87	50.1	140.7 30/88	27.1 9/99	219.9
September	76.0	54.7	65.4	95.2 16/12	40.7 1/96	54.5	155.5 26/03	30.4 1/89	229.5
October	79.8	59.8	69.8	101.4 18/93	43.3 3/99	58.1	156.5 31/89	34.9 8/89	245.3
November	83.1	64.1	73.6	106.1 18/13	48.5 2/05	57.6	162.3 7/89	38.8 1/05	237.6
December	85.4	67.4	76.4	105.9 26/93	56.4 13/12	49.5	159.5 23/89	49.1 8/94	239.7
Year — Averages ...	78.2	59.6	68.9	—	—	—	—	—	¶2533.9
Year — Extremes ...	—	—	—	108.9 14/1/02	36.1 ‖	72.8	165 2 6/2/02	23.9 11/7/90	—

* 10-11/04. † 9/96 and 5/03. ‡ 12/94 and 2/96. ‖ 12/7/94 and 2/7/96. ¶ Total for year.

HUMIDITY, RAINFALL, AND DEW.

Month.	Humidity. Mean 9 a.m.	Humidity. Highest Mean.	Humidity. Lowest Mean.	Rainfall. Mean Monthly.	Rainfall. Mean No. of Days Rain.	Rainfall. Greatest Monthly.	Rainfall. Least Monthly.	Rainfall. Greatest in One Day.	Dew. Mean Amount of Dew.	Dew. Mean No. days Dew
No. of yrs. over which observation extends	30	30	30	65	57	63	63	46	—	30
January	65	79	53	6.45	14	27.72 1895	0.61 1882	18.31 21/87	—	3.5
February	69	82	55	6.71	14	40.39 1893	0.77 1904	8.36 16/93	—	3.7
March	72	85	56	6.01	15	34.04 1870	0.58 1868	11.18 14/08	—	6.6
April	72	79	60	3.70	12	15.28 1867	0.04 1897	4.47 13/16	—	9.9
May	74	85	64	2.94	10	13.85 1876	0.00 1846	5.62 9/79	—	10.6
June	75	82	67	2.66	8	14.03 1873	0.00 1847	6.01 9/93	—	8.1
July	74	81	67	2.31	8	8.46 1889	0.00 1841	3.54 ‡	—	9.7
August	71	80	61	2.26	7	14.67 1879	0.00 *	4.89 12/87	—	7.5
September	65	76	47	2.04	9	5.43 1886	0.10 1907	2.46 2/94	—	7.3
October	62	72	52	2.72	10	9.99 1882	0.14 1900	1.95 20/89	—	5.3
November	59	71	46	3.60	10	10.43 1846	0.00 1842	4.46 16/86	—	2.6
December	61	67	52	5.02	12	13.99 1910	0.35 1865	6.60 28/71	—	2.0
Year — Totals ...	—	—	—	46.42	129	—	—	—	—	76.8
Year — Averages ...	68.3	—	—	—	—	—	—	—	—	—
Year — Extremes ...	—	85	46	—	—	40.39 2/1893	0.00 †	18.31 21/1/87	—	—

— signifies no record kept.

* 1862, 1869, 1880. † 5/1846, 7/1841, 8/1862, 1869, 1880, 11/1842. ‡ 15/76, 16/89.

CLIMATOLOGICAL DATA FOR SYDNEY, N.S.W.

LAT. 33° 52′ S., LONG. 151° 12′ E. HEIGHT ABOVE M.S.L. 146 FT.

BAROMETER, WIND, EVAPORATION, LIGHTNING, CLOUDS, AND CLEAR DAYS.

Month.	Bar. corrected to 32° F. Mn. Sea Level and Standard Gravity from 24 hourly readings.	Wind. Greatest Number of Miles in one day.		Wind. Mean Hourly Pressure. (lbs.)	Wind. Total Miles.	Wind. Prevailing Direction.	Mean Amount of Evaporation.	No. of Days Lightning.	Mean Amount of Clouds, 9 a.m. 3 p.m. & 9 p.m.	No. of Clear Days.
No. of yrs. over which observation extends.	57	49		49	49	57	37	56	54	52
January	29.902	721	1/71	0.37	8,253	N E	5.18	4.7	5.8	1.9
February	29.943	871	12/69	0.33	7,080	N E	4.02	4.3	6.1	1.2
March	30.012	943	20/70	0.25	6,841	N E	3.43	4.2	5.6	1.7
April	30.071	803	6/82	0.23	6,248	N E	2.45	3.8	5.0	2.5
May	30.084	758	6/98	0.22	6,422	W	1.65	3.4	4.9	2.9
June	30.061	712	7/00	0.29	7,085	W	1.35	2.2	4.9	3.2
July	30.079	930	17/79	0.28	7,187	W	1.43	2.5	4.5	3.9
August	30.068	756	22/72	0.27	6,974	W	1.78	3.3	4.1	4.2
September	30.005	964	6/74	0.30	7,228	W	2.59	4.1	4.4	4.0
October	29.971	926	4/72	0.33	7,847	N E	3.70	4.9	5.0	2.2
November	29.936	720	13/68	0.34	7,708	N E	4.48	5.4	5.5	1.6
December	29.882	938	3/84	0.36	8,114	N E	5.26	5.6	5.7	1.8
Year Totals ...	—	—		—	—	—	37.32	48.4	—	31.1
Year Averages ...	30.001	—		0.30	7,249	N E	—	—	5.1	—
Year Extremes ...	—	964	6/9/74	—	—	—	—	—	—	—

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature. Mean Max.	Mean Temperature. Mean Min.	Mean Temperature. Mean	Extreme Shade Temperature. Highest.		Extreme Shade Temperature. Lowest.		Greatest Range.	Extreme Temperature. Highest in Sun.		Extreme Temperature. Lowest on Grass.		Mean Hours of Sunshine.
No. of yrs. over which observation extends.	58	56	58	58		58		58	57		57		6
January	78.4	64.9	71.7	108.5	13/96	51.2	14/65	57.3	164.3	26/15	44.2	18/97	204.6
February	77.4	64.9	71.2	101.0	19/66	49.3	28/63	51.7	162.1	16/98	43.4	25/91	166 3
March	75.5	63.0	69.3	102.6	3/69	48.8	14/86	53.8	172.3	4/89	39.9	17/13	186.0
April	71.1	58.0	64.6	89.0	4/09	44.6	27/64	44.4	144.1	10/77	33.3	24/09	150.0
May	65.0	52.1	58.5	83.5	1/59	40.2	22/59	43.3	129.7	1/96	30.1	5/09	111.6
June	60.5	48.2	54.4	74.7	24/72	38.1	29/62	36.6	123.0	14/78	28.1	24/11	93 0
July	59.0	45.8	52.4	74.9	17/71	35.9	12/90	38.9	144.3	15/98	24.0	4/93	105.4
August	62.3	47.6	55.0	82.0	31/84	36.8	3/72	45.2	149.0	30/78	26.1	4/09	164.3
September	66.5	51.4	59.0	91.1	24/07	40.8	18/64	50.3	142.2	12/78	30.1	17/05	174.0
October	71.1	55.9	63.5	99.7	19/98	43.3	2/99	56.4	151.9	*	32.7	9/05	195.3
November	74.4	59.6	67.1	102.7	21/78	45.8	1/05	56.9	158.5	28/99	36.0	6/06	192.0
December	77.2	62.9	70.0	107.5	31/04	49.3	2/59	58.2	171.5	4/88	41.5	6/09	192.2
Year Averages ...	69.9	56.2	63.1	—		—		—	—		—		1934.7†
Year Extremes ...	—	—	—	108.5	13/1/96	35.9	12/7/90	72.6	172.3	4/3/89	24.0	4/7/93	

* 30 and 31/14. † Total for year.

HUMIDITY, RAINFALL, AND DEW.

Month.	Humidity. Mean 9 a.m.	Humidity. Highest Mean.	Humidity. Lowest Mean.	Rainfall. Mean Monthly.	Rainfall. Mean No. of Days Rain.	Rainfall. Greatest Monthly.		Rainfall. Least Monthly.		Rainfall. Greatest in One Day.		Dew. Mean Amount of Dew.	Dew. Mean No. days Dew
No. of yrs. over which observation extends	58	58	58	58	58	58		58		58		58	58
January	69	78	58	3.44	13.9	15.26	1911	0.42	1888	7.08	13/11	0.002	1.3
February	72	81	60	4.53	14.2	18.56	1873	0.34	1902	8.90	25/73	0.004	2.1
March	75	85	63	5.23	15.1	18.70	1870	0.42	1876	6.52	9/13	0.008	3.4
April	77	87	63	5.36	13.2	24.49	1861	0.06	1868	7.52	29/60	0.016	5.6
May	76	90	66	5.01	15.3	20.87	1889	0.21	1885	8.36	28/89	0.022	6.3
June	79	89	68	5.12	12.9	16.30	1885	0.19	1902	5.17	16/84	0.017	5.3
July	77	88	66	4.89	12.7	13.21	1900	0.12	1862	5.72	28/08	0.016	5.4
August	73	84	56	3.15	11.4	14.89	1899	0.04	1885	5.33	2/60	0.014	4.9
September	69	79	49	2.87	12.0	14.05	1879	0.08	1882	5.69	10/79	0.008	3.5
October	67	77	47	2.95	12.7	11.14	1916	0.21	1867	6.37	13/02	0.007	3.1
November	66	79	42	2.81	12.4	9.88	1865	0.19	1910	4.23	19/00	0.004	2.2
December	68	77	52	2.65	12.9	8.47	1910	0.23	1913	4.75	13/10	0.003	1.5
Year Totals ...	—	—	—	48.01	158.7	—		—		—		0.121	44.6
Year Averages ...	72	—	—	—	—	—		—		—		—	—
Year Extremes ...	—	90	42	—	—	24.49	April/61	0.04	Aug./85	8.90	25/2/73	—	—

CLIMATOLOGICAL DATA FOR MELBOURNE, VICTORIA.

LAT. 37° 49′ S., LONG. 144° 58′ E. HEIGHT ABOVE M.S.L. 115 FT.

BAROMETER, WIND, EVAPORATION, LIGHTNING, CLOUDS, AND CLEAR DAYS.

Month.	Bar. corrected to 32°F. Mn. Sea Level and Standard Gravity hourly means.	Wind. Greatest Number of Miles in one day.	Wind. Mean Hourly Pressure. (lbs.)	Wind. Total Miles.	Wind. Prevailing Direction.	Mean Amount of Evaporation.	No. of Days Lightning.	Mean Amount of Clouds, 9a.m. 3 p.m. & 9 p.m.	No. of Clear Days.
No. of yrs. over which observation extends	* 59	48	48	48	48	44	9	59	9
January	29.913	583 10/97	0.29	7,301	S W, S E	6.40	1.9	5.1	8.1
February	29.961	566 8/68	0.26	6,347	S W, S E	5.04	2.6	5.1	7.5
March	30.033	677 9/81	0.22	6,313	S W, S E	3.94	1.6	5.5	5.8
April	30.100	597 7/68	0.19	5,697	S W, N W	2.36	1.0	5.8	4.1
May	30.108	693 12/65	0.19	5,894	N W, N E	1.46	0.3	6.5	2.9
June	30.079	761 13/76	0.24	6,387	N W, N E	1.10	1.0	6.7	1.9
July	30.098	755 8/74	0.22	6,350	N W, N E	1.05	0.9	6.3	3.7
August	30.065	637 14/75	0.25	6,813	N W, N E	1.48	1.0	6.3	2.0
September	29.993	617 11/72	0.28	6,993	N W, S W	2.27	1.6	6.1	2.6
October	29.968	899 5/66	0.29	7,277	S W, N W	3.32	2.1	5.9	5.0
November	29.948	734 13/66	0.28	7,000	S W, S E	4.52	2.8	5.9	3.4
December	29.896	655 1/75	0.30	7,439	S W, S E	5.74	2.1	5.5	4.2
Year { Totals ...	—	—	—	—	—	38.68	18.9	—	51.4
Year { Averages ...	30.014	—	0.25	6,651	S W, N W	—	—	5.9	—
Year { Extremes ...	—	899 5/10/66	—	—	—	—	—	—	—

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature. Mean Max.	Mean Temperature. Mean Min.	Mean Temperature. Mean	Extreme Shade Temperature. Highest.	Extreme Shade Temperature. Lowest.	Greatest Range.	Extreme Temperature. Highest in Sun.	Extreme Temperature. Lowest on Grass.	Mean Hours of Sunshine.
No. of yrs. over which observation extends	61	61	61	61	61	61	57	56	35
January	78.2	56.7	67.4	111.2 14/62	42.0 28/85	69.0	178.5 14/62	30.2 28/85	247.5
February	77.9	56.9	67.4	109.5 7/01	40.3 9/65	69.2	167.5 15/70	30.9 6/91	210.2
March	74.5	54.7	64.6	105.5 2/93	37.1 17/84	68.4	164.5 1/68	28.9 *	174.1
April	68.4	50.7	59.5	94.0 6/65	34.8 24/88	59.2	152.0 8/61	25.0 23/97	137.2
May	61.4	46.6	54.0	83.7 7/05	29.9 29/16	53.8	142.6 2/59	21.1 26/16	108.1
June	56.8	44.0	50.4	72.2 1/07	28.0 11/66	44.2	129.0 11/61	20.4 17/95	84.5
July	55.5	41.6	48.5	68.4 24/78	27.0 21/69	41.4	125.8 27/80	20.5 12/03	100.6
August	58.8	43.3	51.0	77.0 20/85	28.3 11/63	48.7	137.4 29/69	21.3 14/02	123.8
September	62.5	45.5	54.0	82.3 30/07	31.1 16/08	51.2	142.1 20/67	24.7 13/07	143.7
October	67.0	48.1	57.6	98.4 24/14	32.1 3/71	66.3	154.3 28/68	25.9 3/71	178.2
November	71.4	51.1	61.3	105.7 27/94	36.5 2/96	69.2	159.6 29/65	24.6 2/96	210.8
December	75.3	54.0	64.6	110.7 15/76	40.0 4/70	70.7	170.3 20/69	33.2 1/04	233.9
Year { Averages ...	67.3	49.4	58.4	—	—	—	—	—	1952.6†
Year { Extremes ...	—	—	—	111.2 14/1/62	27.0 21/7/69	84.2	178.5 14/1/62	20.4 17/6/95	—

* 17/84 and 20/97. † Total for year

HUMIDITY, RAINFALL, AND DEW.

Month.	Humidity. Mean Daily.	Humidity. Highest Mean.	Humidity. Lowest Mean.	Rainfall. Mean Monthly.	Rainfall. Mean No. of Days Rain.	Rainfall. Greatest Monthly.	Rainfall. Least Monthly.	Rainfall. Greatest in One Day.	Dew. Mean Amount of Dew.	Dew. Mean No. days Dew
No. of yrs. over which observation extends	60	60	60	61	61	61	61	61	—	9
January	60	74	52	1.86	7	5.68 1904	0.04 1878	2.97 9/97	—	1.5
February	61	75	52	1.70	7	6.24 1904	0.03 1870	2.14 7/04	—	2.5
March	65	78	53	2.17	9	7.50 1911	0.18 1859	3.05 15/78	—	6.9
April	70	83	62	2.29	11	6.71 1901	0.33 1908	2.28 22/01	—	8.0
May	76	86	62	2.18	13	4.31 1862	0.45 1901	1.85 7/91	—	7.4
June	78	88	72	2.08	14	4.51 1859	0.73 1877	1.74 21/04	—	8.6
July	78	88	72	1.83	13	7.02 1891	0.57 1902	2.71 12/91	—	11.5
August	72	81	63	1.80	14	3.59 1909	0.48 1903	1.87 17/81	—	8.6
September	69	81	61	2.41	14	7.93 1916	0.52 1907	2.62 12/80	—	6.6
October	67	79	52	2.59	13	7.61 1869	0.29 1914	3.00 17/69	—	8.0
November	63	75	52	2.24	10	6.71 1916	0.25 1895	2.57 16/76	—	2.0
December	60	75	49	2.31	9	7.18 1863	0.11 1904	2.62 28/07	—	1.5
Year { Totals ...	—	—	—	25.46	134	—	—	—	—	73.1
Year { Averages ...	68	—	—	—	—	—	—	—	—	—
Year { Extremes ...	—	88	49	—	—	7.93 9/16	0/03 2/70	3.05 15/3/78	—	—

CLIMATOLOGICAL DATA FOR HOBART, TASMANIA.

LAT. 42° 53′ S., LONG. 147° 20′ E. HEIGHT ABOVE M.S.L. 177 FT.

BAROMETER, WIND, EVAPORATION, LIGHTNING, CLOUDS, AND CLEAR DAYS.

Month.	Bar. corrected to 32° F. Mn. Sea Level and Standard Gravity from 9 a.m. & 3 p.m. readings.	Wind. Greatest Number of Miles in one day.		Wind. Mean Hourly Pressure. (lbs.)	Wind. Total Miles.	Wind. Prevailing Direction.	Mean Amount of Evaporation.	No. of Days Lightning.	Mean Am't. of Clouds, 9 a.m. 3 p.m. & 9 p.m.	No. of Clear Days.
No. of yrs. over which observation extends	32	6		6	6	12	6	9	54	10
January	29.826	500	30/16	0.19	5,999	N W & S E	5.764	0.6	6.0	3.4
February	29.919	393	19/13	0.12	4,269	S E & N	4.108	1.3	6.0	2.8
March	29.939	406	8/15	0.12	4,670	N & S E	3.134	0.9	5.9	1.8
April	29.945	413	9/11	0.14	4,965	N to N W	2.077	0.9	6.0	1.9
May	29.995	411	3/16	0.12	4,643	N to N W	1.346	0.4	6.0	1.9
June	29.954	415	17/12	0.11	4,309	N to N W	0.740	0.9	6.0	1.9
July	29.938	396	17/11	0.10	4,371	N to N W	0.867	0.3	5.8	3.1
August	29.926	459	30/11	0.13	4,922	N to N W	1.281	1.0	6.0	2.2
September	29.843	516	26/15	0.20	5,813	N to N W	2.013	0.7	6.1	1.8
October	29.841	461	8/12	0.18	5,796	N	3.400	1.1	6.2	1.6
November	29.790	508	18/15	0.20	5,855	N & S E	3.937	0.8	6.3	1.7
December	29.807	375	21/16	0.17	5,679	N W & S E	4.625	1.8	6.2	1.1
Year Totals ...	—	—		—	—	—	33.292	10.7	—	25.4
Year Averages ...	29.894	—		0.15	5,108	N	—	—	6.0	—
Year Extremes ...	—	516	26/9/15	—	—	—	—	—	—	—

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature. Mean Max.	Mean Temperature. Mean Min.	Mean Temperature. Mean	Extreme Shade Temperature. Highest.		Extreme Shade Temperature. Lowest.		Greatest Range.	Extreme Temperature. Highest in Sun.		Extreme Temperature. Lowest on Grass.		Mean Hours of Sunshine.
No. of yrs. over which observation extends	46	46	46	70		70		70	29		50		22
January	71.5	53.0	62.3	105.0	1/00	40.3	*	64.7	160.0	†	30.6	19/97	211.1
February	71.5	53.1	62.3	104.4	12/99	39.0	20/87	65.4	165.0	24/98	28.3	–/87	178.2
March	68.1	50.7	59.4	98.8	5/46	36.0	31/05	62.8	150.0	3/05	27.5	30/02	169.2
April	62.7	47.6	55.2	90.0	2/56	30.0	25/56	60.0	142.0	18/93	25.0	–/86	136.7
May	57.3	43.5	50.4	77.5	1/41	29.2	20/02	48.3	128.0	‡	20.0	19/02	129.1
June	52.7	40.9	46.8	75.0	7/74	28.0	22/79	47.0	122.0	12/94	21.0	6/87	101.5
July	51.7	39.0	45.3	72.0	22/77	27.0	18/66	45.0	118.7	19/96	18.7	16/86	125.1
August	54.9	40.9	47.8	77.0	3/76	30.0	10/73	47.0	129.0	1887	20.1	7/09	140.4
September	58.6	42.9	50.8	80.0	9/72	30.0	12/41	50.0	138.0	23/93	22.7	–/86	137.8
October	62.8	45.3	54.0	92.0	24/14	32.0	12/89	60.0	156.0	9/93	23.8	§	162.7
November	66.2	48.2	57.2	98.0	20/88	35.2	5/13	62.8	154.0	19/92	26.0	1/08	192.5
December	69.5	51.1	60.3	105.2	30/97	38.0	3/06	67.2	156.0	18/05	27.2	–/86	187.7
Year Averages ...	62.3	46.3	54.3	—		—		—	—		—		1872.0¶
Year Extremes ...	—	—	—	105.2	30/12/97	27.0	18/7/66	78.2	165.0	24/2/98	18.7	16/7/86	—

* 3/72 and 2/06. † 5/86 and 13/05. ‡ 1888 and 1892. § 1/86, 1899. ¶ Total for year.

HUMIDITY, RAINFALL, AND DEW.

Month.	Humidity. Mean 9 a.m.	Humidity. Highest Mean.	Humidity. Lowest Mean.	Rainfall. Mean Monthly.	Rainfall. Mean No. of Days Rain.	Rainfall. Greatest Monthly.		Rainfall. Least Monthly.		Rainfall. Greatest in One Day.		Dew. Mean Amount of Dew.	Dew. Mean No. days Dew.
No. of yrs. over which observation extends	37	37	37	74	73	74		74		50		—	7
January	64	75	51	1.80	9	5.91	1893	0.03	1841	2.96	30/16	—	1.0
February	65	76	51	1.44	8	9.15	1854	0.07	1847	4.50*	25/54	—	2.1
March	70	76	59	1.64	10	7.60	1854	0.02	1843	2.06	14/11	—	4.3
April	74	85	60	1.87	11	6.50	1909	0.07	1904	5.02	20/09	—	9.1
May	79	90	68	1.87	13	6.37	1905	0.10	1843	3.22	14/58	—	12.2
June	83	94	73	2.17	13	8.15	1889	0.22	1852	4.11	14/89	—	5.6
July	82	97	74	2.11	14	5.98	1849	0.30	1850	2.00	27/78	—	7.3
August	78	92	64	1.82	13	10.16	1858	0.23	1854	4.35	12/58	—	6.1
September	72	87	60	2.12	14	7.14	1844	0.39	1847	3.50	29/44	—	2.9
October	68	75	51	2.23	15	6.67	1906	0.26	1850	2.58	4/06	—	3.0
November	64	74	50	2.57	14	8.92	1849	0.16	1868	3.97	6/49	—	1.0
December	63	73	51	1.99	11	9.00	1875	0.11	1842	2.48	13/16	—	1.1
Year Totals ...	—	—	—	23.63	145	—		—		—		—	55.7
Year Averages ...	72	—	—	—	—	—		—		—		—	—
Year Extremes ...	—	97	50	—	—	10.16	8/1858	0/02	3/1843	5.02	20/4/09	—	—

* 4.18, 26/54 also.

§ 7. Australian Eucalyptus Timbers.*

1. **Historical.**—As shewn by early records, the first conception of the utility of Australian eucalyptus timbers was not at all satisfactory or complimentary, for a certain Major of Engineers in a letter home, containing his impressions of the newly occupied country, writes very disparagingly of matters generally, and particularises the timber resources of Australia as practically *nil*, for he states in this connection, "even the trees (Eucalyptus) are worthless, for not only after they fall, but even whilst standing they are turned into *sand*."

Australians, of course, quite understand the reason for this statement, and it is interesting to compare it with the generally accepted verdict to-day—that in regard to hardwoods and decorative timbers the Australian eucalyptus holds its own in the timber markets of the world.

In the early days of Colonial history, when freights were of course scarce, evidence shews that eucalyptus timber was one of the first raw products to be exported to England, where it was used in the Naval dockyards for ship building.

The value of these timbers has from time to time been brought under the notice of the outside world by the collections exhibited at the various exhibitions held in London in 1851 and 1862, and in Paris and other International Exhibition centres.

As population grew, and trade increased, more attention was paid to timber resources; the early researches of Col. Ward Laslett, and more recently those of Professor Warren and G. A. Julius, adding considerably to our knowledge.

The early nomenclature applied to the various eucalyptus species was, naturally, imperfect, and while it possesses a certain value, nevertheless it renders the task of comparison with modern results a somewhat laborious one.

2. **Nomenclature.**—The vernacular naming of the eucalyptus trees has unfortunately been one of the bugbears of the Australian trade since its inception. The prime cause of the trouble was the giving of common English names to Australian trees, having a fancied or supposed resemblance to the English product. This practice was frequently responsible for the most ludicrous results. For example, the name "Apple tree" was applied to some species of eucalyptus which have absolutely nothing in common with their English namesake. Many similar instances could be given. Again, the same common name is sometimes bestowed upon half-a-dozen different species.

As the result of concerted action on the part of the respective State Forestry Departments, immediate action is, however, to be taken to introduce order into the present chaos.

There is, moreover, such a wealth of timber in Australia, that there are not enough common names amongst those so far used to cover each species. This difficulty could, nevertheless, be overcome by employing the specific portion of the scientific names as trade terms. Objection would of course be raised that business people could not use these names, but this objection may be countered by pointing out that in connection with the trade in the essential oils of the eucalyptus no difficulty has been experienced in regard to the adoption of the correct scientific appellation.

The Technological Museum, by suppressing the common name and species synonyms, and using scientific names only from the start, has assisted the perfumery, pharmaceutical and other industrial enterprises in overcoming the difficulty, so that to-day all these various industries give orders for oils under the scientific names, and will have nothing to do with the common names. A guarantee is thus assured of the true origin of the article which is being purchased. It is really remarkable how quickly Australian bushmen familiarise themselves with the scientific terms, and there is hardly a distillery working in Australia to-day, either in the city or the "back blocks," where the worker cannot give the scientific names of the leaves being distilled.

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* Contributed by R. T. Baker, Esquire, F.L.S., etc., Curator and Econ. Botanist, Technological Museum: Lecturer on Timbers, Sydney University.

Further, since no one is allowed to sell margarine for butter, a customer ordering ironbark should not be supplied with a timber that is not an ironbark, but really a mountain ash, the former name being applied only in one particular State, and that where the true ironbark does not grow.

The subject of nomenclature is mentioned because it is of the very greatest importance in the timber export trade, and also because serious attention is being given to it by the respective State Forestry Departments, who look to the co-operation of the timber trade to assist in the removal of so serious a handicap to their best interests.

3. **Classification.**—(i.) *General.* The first practical classification of Australian eucalypts was cortical, *i.e.*, founded on the appearance of the bark, and was adopted by the first settlers at Port Jackson in 1788, and such grouping has lasted to this day. The earliest botanist soon recognised that the bushmen could differentiate his trees in the field very much better than the systematist could in the herbarium, working on the morphology of his material. The principal groups of Eucalypts commercially are :—Ironbarks, gums, tallowwood, stringybarks, ashes, blackbutts, mahoganies, boxes, bloodwoods and peppermints.

These groups are satisfactory so far as they go, but they do not go far enough, for the trade difficulty is to discriminate between the *species* coming into the groups, since they are all classed as hardwoods. This term covers a multitude of timber characteristics, no regard being paid to such distinguishing features as colour, weight, durability, etc., all being placed in one class, simply because they possess one character in common, viz., hardness. Consequently, in buildings, wood pavings, and other constructions there is a medley of timbers.

Few, if any, timber yards or mills are prepared to sell a line of any particular timber such as mahogany, blackbutt, stringybark. They will execute an order for hardwood, and the purchaser has to make the selection from the consignment. A few varieties, such as spotted gum, tallowwood, ironbark (4 spp.) are, however, very often specified, and can be obtained true to name, and a few others outside eucalypts might be mentioned, *i.e.*, teak, myall, etc.

This state of affairs is a great disadvantage in many industries. Thus, in wood blocking, as many as half-a-dozen species of timber will be used each with its own special powers of atmospheric and attrition resistance. Consequently, instead of having the evenness of surface during the life of a road which would obtain if wood of the same kind throughout were used, the variation in the breaking down of each kind produces an irregular surface for the traffic, and thus hastens the disintegration of the best wood, and seriously impairs the life of the road.

The disadvantage can, of course, be overcome by stocking large quantities, from which can be selected the quantity and kind required.

There is perhaps something to be said on behalf of the mill owner, since his action is really governed by nature, which in this continent has not produced forests of specific trees, as is the case in the Northern Hemisphere. There are found entire forests of beech, oak, elm, pine, etc., but here species are met with growing indiscriminately.

In any classification of Australian timbers, Eucalyptus hardwoods are given pride of place, as they embrace by far the largest forest area, but the quantity and value of the ornamental timbers, other than hardwoods, are by no means to be despised. It is only recently, moreover, that it has been shewn that a number of our eucalyptus hardwoods may also be placed in the category of cabinet timbers.

(ii.) IRONBARKS. The ironbarks are the most noted of the eucalypts for durability, hardness, weight, and closeness of texture. The species are limited in number and vary in quality of timber, their respective suitability for any particular work being a matter of choice with the various trades.

It may be mentioned that these timbers are restricted in their geographical distribution, the marketable varieties practically being found in New South Wales only. Two are recorded from Queensland, but these are not appreciated for their timbers. All the ironbarks have very hard, firm, thick, deeply furrowed bark, more or less impregnated with kino, this portion of the tree being much in demand by wheelwrights or blacksmiths for heating tires.

The weight or specific gravity of ironbarks is due to the great predominance of very thick walled wood fibres in the timber structure.

The principal Ironbarks are :—

(*a*) The broad-leaved Ironbark, *E. siderophloia*, which is one of the best owing to its great strength and its superiority over iron and steel girders, inasmuch as it will not buckle when subjected to heat. This timber is used for beams, girders, and columns, wharf and bridge decking, heavy carriage work, etc.

(*b*) Grey Ironbark, *E. paniculata. Sm.* This is another excellent timber, the tree being separated in the field from other Ironbarks by its hard, compact, corky bark—with less kino than obtains in the others—and its paniculate inflorescence. The wood is grey or chocolate in colour, very hard, compact, and, when interlocked, almost impossible to split. It is chiefly used for purposes similar to the Red Ironbark.

(*c*) Narrow-leaved Ironbark, *E. crebra. F. v. M.* This tree has a much wider geographical range than the other species, being found in the coast district of New South Wales, in the coastal ranges, and almost to the interior. It is not considered of equal merit to its congeners.

The Red Flowering Ironbark, *E. sideroxylon* and the Citron Scented Ironbark, are not appreciated for their timber.

(iii.) GUMS. On a timber classification these are divided naturally into two classes :—(*a*) Pale coloured woods, and (*b*) Red coloured woods.

These constitute the largest section of the Eucalypts, and have the widest distribution, since representatives are found in all the States. They are recognised in the field broadly by their smooth white bark. Various common names have been bestowed upon the different species by the settlers, timber getters, and sawyers, the appellation having reference to individual peculiarities of the trees, such as : (1) nature and colour of timber, (2) nature and colour of bark, (3) locality of growth, (4) chemical and physical properties of the several parts of the tree, or growth of the tree.

(*a*) *Pale Timbers.* Some of the best known trees throughout the world belong to this group, one name especially having gained more notoriety than the rest, viz., *E. globulus*, this being due to the wide distribution of its seed half a century ago.

As a timber it has been extensively exported from Tasmania for wharf piles, and decking, and such uses form about the limit of its employment to-day, as it is one of the most difficult to season. It is for this reason that *E. globulus* is no longer planted or sown for its timber.

Spotted Gum. E. maculata. Hook. One of the best known of this group of trees and very extensively used where resilience and lightness combined with strength are the desiderata, such as in coach building and other industries. It has recently been used in the furniture trade with much acceptance, as the colour somewhat resembles that of Oak (Quercus).

Care should be taken to see that all the sapwood is removed, as it is most liable to borer attacks, and this defect has often caused great trouble and expense in large buildings where the wood has been used for joists in error for tallow wood.

Giant Gum. E. regnans. F. v. M. One of the monarchs of the forests of Victoria and Tasmania, having a timber much approaching in texture and colour that of *E. Delegatensis,* but perhaps more fissile. It might be ranked as an ash, and is a splendid timber for work requiring similar qualities. It is a rapid grower and therefore one of the best for afforestation.

Salmon Gum. E. salmonophloia. F. v. M. Not a large tree, but the timber is hard, strong and durable, and extensively used in mines in West Australia. It has also been used in piles, and with great success in bridges and culverts. The name is derived from the colour of the bark.

Manna or Ribbony Gum. E. viminalis. Labill. This timber is regarded by some as poor in quality, but others again speak very highly of it.

Brown Gum. E. Muelleri. F. B. Moore. A very tall Tasmanian tree attaining a height of 200 ft., having a very pale pink or whitish timber, tough, of medium hardness, and might be classed as an ash, as it much resembles that group of trees.

Mountain Gum. E. goniocalyx. F. v. M. A forest tree producing one of the finest pale hardwoods in the world. It is close grained, hard, tough, interlocked, and useful in constructional works of all kinds, heavy carriage work, and similar structures.

York Gum. E. loxophleba. Benth. A good average forest tree of West Australia, yielding a very hard, durable, tough, red coloured timber, and one of the best for heavy carriage work, building construction, mining, etc.

A *Blue Gum. E. Maideni. F. v. M.* A fine forest tree of restricted area, yielding a superior pale-coloured hard timber, equal in qualities to *E. goniocalyx*.

(*b*) *Red Coloured Timbers.* In this section are to be found some of the finest timbers in Australia, and possibly in the world. The timbers here enumerated are all of excellent quality, and are highly valued both outside and in Australia for brightness of colour, easy working, and durability, while for general utility they are equal to any other timbers grown. They specially appeal to the forester for re-afforestation, and few more magnificent and valuable forest trees could now be grown.

Murray Red Gum. E. rostrata. Schl. A beautiful forest tree found growing in the neighbourhood of all inland rivers and their tributaries and billabongs. It has deservedly received perhaps more attention at the hands of foresters than any of the other gums, and the red gum timber reserves of the river Murray are now famous. The timber is hard, durable, close, straight grained, but sometimes interlocked, dresses well and is very decorative from its red colour. It is one of our most valuable timbers for bridge decking, construction works, wood blocks, and heavy carriage work.

Sydney Blue Gum. E. saligna. Sm. Next to its variety Flooded Gum, it is one of the lightest in weight of the red gums, but it is probably more extensively used than any other in the group, being in specially great demand for wheelwrights' work, although its suitability for other forms of wood work have yet to be recognised. Its light red colour particularly adapts it for some forms of cabinet work. It is open in the grain, free working, rarely if ever affected with gum veins, and is a splendid timber for general purposes.

Forest Red Gum. E. tereticornis. Sm. One of the finest forest trees of Australia, yielding an excellent red wood. It very closely resembles the Murray red gum in texture, weight, and colour, and it is often cult to differentiate their timber specimens. Forest red gum is a close, compact wood, although it dresses easily, but it is not a specially heavy wood. Its field of utilisation is worthy of great extension.

A *Grey Gum. E. propinqua. H. D. et J. H. M.* This is a superior red timber, but is rather restricted in its geographical distribution, being found only in the North coast district of New South Wales. It is worthy of re-afforestation, for it is a splendid forest tree. The timber is harder and heavier than its congener the blue gum, *E. saligna*, being of a closer texture, the fibres having thicker walls while there are fewer pores. It is a splendid timber, useful for many purposes, and will no doubt be much appreciated when better known.

Flooded Gum. E. saligna, var. pallidivalvis. R. T. B. et H. G. S. A well-known variety in the Sydney markets, used for many purposes, but not much valued for use as wood blocks. It is lighter in colour than its type, but more open in the grain, and considered less durable, still it is a useful timber and capable of being used in many ways.

Grey Gum. E. punctata. D. C. A well-known timber in the Sydney market, used extensively for railway sleepers. It is a particularly hard, durable, close grained, interlocked timber, and is often very difficult to distinguish from red ironbark.

South Australian Blue Gum. E. leucoxylon. F. v. M. A fine forest tree attaining a height of over 100 feet, often 50 or 60 feet without a branch. The timber is pale yellowish or pink in colour, hard, strong, and durable, and one of the best of South Australian timbers. It is used for railway sleepers, piles, jetty planking, naves and felloes, waggon shafts, telegraph poles, axe handles, and building construction.

Slaty Gum. E. Dawsoni. R. T. B. A very fine forest tree, with a tall straight white stem, and only a small head of branchlets and leaves. The timber is one of the finest, being hard, close grained, heavy, and equal in every way to ironbark, from which it is difficult to distinguish. It is a splendid timber for heavy constructional works, and, in fact, can be used wherever great strength is required.

Morrell. E. longicornis. F. v. M. Not a very large tree but has a very hard, heavy, close grained, interlocked red coloured timber, and one exhibiting great strength, especially suitable for heavy constructional work of all kinds.

Wandoo. E. redunca. Schau. A red coloured timber, lighter in weight than morrell, but otherwise possessing all the qualities of that timber for specific applications, suitable for naves, cart and buggy shafts, and railway truck construction.

(iv.) TALLOW-WOOD. A quite limited but excellent group of eucalyptus hardwoods comes under the category of tallow-woods, viz., *E. microcorys* and *E. planchoniana*. The former is extensively used in heavy carriage and construction work, and is especially adapted for the latter, being a timber never attacked by the borers.

(v.) STRINGYBARKS. This group includes numerous species, but for some reason or other the timber has not received the appreciation it has deserved, probably due to the high value set upon ironbark and a few other excellent woods. Nevertheless these timbers are very valuable as hardwoods, and, as decorative timbers, their use within the last year or two has come as a revelation to the cabinet maker, and few more ornamental timbers have been introduced into the trade. The figure is often unique, and in colour the timber might readily pass as exotic satin wood. This figure must not be confounded with that produced by pronounced rays, such as occur in oaks, etc. (*e.g. Quercus, Proteaceæ,* and *Casuarinae*), but it is due to the undulating disposition of the fibres, which is so frequently found in Australian woods.

The handicap of weight is overcome by using it as veneer on lighter timber, and some very handsome furniture made in this way has recently been exhibited in Melbourne and Adelaide. There is a great future in the cabinet-making trade for the figured eucalyptus hardwoods, especially stringybark and blackbutt.

The majority of these timbers are employed in house building, but a future awaits them in constructional works, and coach work, being durable, hard, fissile, interlocked, and less heavy than ironbark. They are easily distinguished in the bush by their stringy bark, which well describes the nature or character of the cortex.

The principal stringybarks, together with their uses and characters, are:—

White Stringybark. E. eugenioides. Sm. In New South Wales this is considered the best of the group, although not restricted to that State. The wood is close, straight-grained, hard, durable, of a pale grey colour when fresh cut, and on exposure tones down to a rich oak tint. It is used as a general all round timber, but some specimens have recently been tested for their carving qualities, and in this field of applied art white stringybark is shewn to be one of the best, surpassing even English oak. As the more restricted species, such as ironbarks, are cut out, there can be no doubt that many new avenues of utilisation will be found for this splendid wood.

Yellow Stringybark. E. Muelleriana. A.W.H. One of the most prized stringybarks in Gippsland, Victoria, where it appears to be restricted in its geographical location. It is hard, close grained, with a yellowish tinge running through it.

A Stringybark. E. obliqua. L. Her. An historical tree, for this eucalypt was the first one to be described. It is found in Tasmania, South Australia, Victoria, New South Wales and probably in Queensland, The timber is extensively used in the first mentioned State and largely exported for use in general purposes, but it figures now in a new role, in the furniture trade, passing under the name of Tasmanian oak. In natural colour it certainly much resembles that timber, but of course has not the silver grain of oaks produced by the rays, which in the case of all eucalypts are microscopical, but beautiful figures are nevertheless frequently found, due, as stated above, to the peculiar twisting or undulating of the fibres.

Silver Top Stringybark. E. laevopinea. R.T.B. At present this very fine forest tree is only known from one district in New South Wales, but as it closely resembles other stringybarks in morphological characters, it is very probably being passed over as another species, although bushmen were the first to shew the field differences between it and its congeners, such as *E. macrorhyncha* and *E. eugenioides.*

A Stringybark. E. dextropinea. R. T. B. An average forest tree producing a fairly serviceable timber, but not so much appreciated as the previous species.

Red Stringybark. E. macrorhyncha. F. v. M. One of the most widely distributed of the stringybarks, being found in all the eastern states.

(vi.) ASHES. *Mountain Ash or Tasmanian Oak. E. Delegatensis. R. T. B.* When first described it was thought that the species was limited in its distribution, but it has since transpired that it occurs in Victoria and Tasmania as well as in New South Wales, and to-day is one of the best known and most easily procurable of all Australian timbers. It is a very fine wood and quite worthy of its local name Ash, for it possesses all the qualities of the *Fraxinus* (Ash) of other parts of the world, and for which it forms an excellent substitute, being light in colour and comparatively so in weight. The timber is straight-grained, free from knots or gum veins, obtainable in long lengths, and planes and dresses easily. It is, however, of no use for carpentry work in exposed positions, and although settlers have used it for fencing it soon rots away at the ground line.

Ash. E. fraxinoides. H. D. et J. H. M. A splendid timber possessing all the qualities of the best foreign ashes (*Fraxinus*) and for which it is a fine substitute. It is not found in the market, being rather restricted in its geographical distribution, but it is well worthy of cultivation. For casks it appears particularly suited, and its qualities will be more appreciated when the timber is better known.

Mountain Ash. E. Sieberiana. F. v. M. Placed here under the ashes, but only tentatively until the revised nomenclature now being prepared by the State Forestry

Department is published. This should never have been placed in the ash class as the timber is harder, closer grained, and different in colour to the species of that group. In Tasmania it is vernacularly known as "Ironbark."

Smooth Bark Mountain Ash. E. oreades. R. T. B. This tree with its tall, white, smooth-barked stem is one of the features of the Blue Mountain gullies. It is occasionally found, however, in the levels and slopes above the gullies, as at Katoomba, but this is exceptional, for it is essentially a gully tree. The timber is not so white as the other ashes, nor quite so fissile, and is more liable to gum veins from which the others are specially exempt, otherwise it can be utilised in the same way as the other species of the group.

(vii.) BLACKBUTTS. Very few species are classed under this common name, and yet the two here mentioned are well known and appreciated in the trade for the quality of their timber.

E. pilularis is the blackbutt of the east coast, and its timber is highly valued for its durability in the soil. It is pale coloured, hard, close grained, with occasional narrow gum veins, by which it is generally identified. It is used principally in building construction, carriage works, bridges, wood blocks, and recently in cabinet work.

E. patens. Benth. A fair sized tree, with a light-coloured, tough, durable timber, suitable for carriage work and general building construction.

(viii.) MAHOGANIES. This group includes some well defined forest trees famous for their timbers, which are divided into two groups, pale and red.

The local application of the common name was due to the supposed resemblance of the red mahogany to the commercial article, Honduras mahogany, familiar no doubt to many of the first settlers. The colour (red) is perhaps the only common character, the Australian wood being much heavier and harder and a deeper red, and subject to gum veins. However, it was used in the early days for cabinet work, but not to any great extent, the discovery of Red Cedar (*Cedrela Toona*) soon superseding it in this direction. The pale timber resembling its prototype in hardness and texture was called white mahogany.

(*a*) Pale. "*White Mahogany.*" *E. acmenioides. Schau.* A good average forest tree yielding one of the best pale timbers. The timber is hard, close grained, and interlocked. It works well and is a very durable wood, being specially suited for sleepers, constructional works, bridging and heavy work requiring a strong white timber.

A "*White Mahogany.*" *E. umbra. R. T. B.* A tree much resembling its congener *E. acmenioides*, but the timber is not so good in all round qualities.

(*b*) Red. "*Red Mahogany.*" *E. resinifera. Sm.* It is a hard, close grained timber, darkening in colour with age, and is used for general purposes, but rarely used now for cabinet work. Its chief defect is the presence of borers, and it is not a lasting timber in closed damp positions, such as flooring joists. It is more durable in the light, and is extensively used for rusticated weather boards.

Jarrah. E. marginata. Sm. Although not known on the market as a red mahogany, yet it more resembles this class of timber than any other section. It is a splendid substitute for the Honduras mahogany, so largely used in other parts of the world in the cabinet trade. It is medium in weight, of a good fresh red colour, works up well and easily, takes a good polish, and is a beautiful timber for office fittings and furniture. It is, however, largely used for other purposes, such as constructional works and carriage work of all kinds.

(ix.) BOX TIMBERS. These are a well defined group of Eucalypts, with numerous species well distributed throughout the States. They may be divided into two classes of timber, pale and red. In other respects, such as in texture, grain, weight, durability, and hardness, there is a close resemblance. These timbers are particularly well adapted for heavy constructional work, carriage building, bridge decking, fencing, etc. Being interior species they are rarely found on the export trade market.

The principal boxes with Pale coloured timbers are :—

White box, *E. albens, Miq.*; Apple-top box, *E. angophoroides, R. T. B.*; Black box, *E. Boormani, D. & J. H. M.*; Grey box, *E. hemiphloia, F. v. M.*; Swamp box, *E. microtheca, F. v. M.*; Coolabah, *E. Ravertiana, F. v. M.*; Thozet's box, *E. Stowena*; Mallee box, *E. Woollsiana, R.T.B.*; Black or Flooded box, *E. bicolor, A. Cunn.*; Lignum vitæ, *E. Fletcheri, R.T.B.*; Tuart, *E. gomphocephala, D.C.*; Fuzzy box, *E. conica, D. & J. H. M.*; Yellow box, *E. melliodora, A. Cunn.*

Red :—

Coast Red box, *E. Rudderi, J. H. M.*; A Red box, *E. polyanthema, Schauer*; South Coast Red box, *E. Bosistoana, F. v. M.*; Poplar-leaved box, *E. populifolia, Hook*; Ironbark box, *E. affinis, D. & J. H. M.*; A Red box, *E. pendula, A. Cunn.*

(x.) BLOODWOODS. These trees form a very distinct group from their congeners, their morphological characters being well defined, while their timbers are also *sui generis*. The species are not numerous, but they extend from Western Australia in a northerly direction round to the East coast as far South as the Victorian border. They can be detected in the field at once by the leaf venation alone. The timbers are hard, heavy, open in the grain, some having a large figure, but are very prone to gum (kino) veins, hence their utilisation is limited. They are nevertheless strong and very durable in the ground, this quality being due probably to the tan in the kino. They are very suitable for railway sleepers, posts, bridge decking, etc.

The principal species are :—*E. corymbosa, E. calophylla* (the red gum of Western Australia), *E. eximia*, yellow bloodwood, *E. intermedia, E. terminalis, E. trachyphloia.*

(xi.) PEPPERMINTS. These do not comprise a numerous section of eucalyptus trees. They derived their name originally from the presence of the peppermint odour in the leaves, attention to which was first drawn by the medical officers of the First Fleet. The constituent giving rise to this odour has since been isolated and named Piperitone, and promises to be of considerable value in pharmacy.

The timbers are not generally found on the market, although in the country districts where they occur they are used for many purposes, and some have a reputation for durability in the ground. In recent times the name unfortunately is being applied to trees which have a bark similar to the original peppermint tree, *E. piperita*, but have no trace of Piperitone in the leaves.

§ 8. The Chemical Products of Australian Eucalypts.*

1. **General.**—The important Australian genus, Eucalyptus, is remarkable for the number and diversity of its chemical constituents. It might perhaps appear from a cursory glance that these were distributed throughout the several groups in an irregular manner, but research has shown that this is not so, for a most orderly arrangement is traceable through the various members and groups of the genus, a peculiarity which suggests a predominating influence of evolutionary conditions.

* Contributed by Henry G. Smith, Esquire, F.C.S., Assistant Curator and Economic Chemist, Technological Museum, Sydney.

2. **Inorganic Influences.**—A distinctive selection in location by very many species, growing under natural conditions, has been recognised. Some prefer a siliceous soil, while others select a basic one, and numerous examples of eucalyptus species approaching a common boundary, yet not intermingling, are known. This peculiarity is well demonstrated by the species growing between Sydney and Penrith, and upon the Blue Mountains. The chief controlling factors governing the geographical distribution of most eucalypts seem to be climate, altitude, and soil, and the adaptation to certain localities, shewn by various species, is directly traceable to chemical influences, and more particularly to available inorganic constituents. It is seldom that species are found growing satisfactorily in a situation unconformable with their usual requirements.

The great differences in size between members of the various groups is also traceable largely to chemical influences, and the largest trees growing in Eastern Australia belong to a group, the species of which have much in common, both botanically and chemically. Four of these may be mentioned in illustration, viz., *E. regnans* ("Giant Gum"); *E. Delegatensis* ("Gum-topped Stringybark"); *E. obliqua* ("Stringybark"); *E. pilularis* ("Blackbutt"); the first three being common to both Australia and Tasmania. Eucalyptus trees that attain a great size usually grow in soils comparatively poor in mineral constituents, and trees of large dimension, so placed, do not store mineral matter in their timbers, except in very small amounts. *E. regnans*, for instance, sometimes exceeds 70 feet in circumference, and reaches a height of over 300 feet, yet it secretes only about 0.05 per cent. of inorganic chemical constituents in its timber (calculated on the anhydrous wood). The other species mentioned above shew the same peculiarity; *E. Delegatensis* about 0.04 per cent.; *E. obliqua* about 0.03 per cent.; and *E. pilularis* about 0.05 per cent. Although the amount of ash constituents in the woody portions of these and allied species is so small, yet a much larger quantity is present in the leaves, buds, petioles, seed-cases and seeds from the same tree. The leaves of *E. pilularis*, for instance, contain about 2.9 per cent. of ash; the buds with petioles about 3.8 per cent.; the seed-cases or fruits about 2.9 per cent., and the seeds 1 per cent. The inorganic material in these portions of the tree would obviously be available for repeated use, but not so if deposited in corresponding amount in the timber.

A striking peculiarity in the eucalypts is the relative constancy of the element manganese in the ash of related species. The mean results in the case of the four species above mentioned shew that the manganese present in their timbers represents only one part in about one million parts of anhydrous timber, being practically the same in each. In the five species of "Ironbarks" the manganese is about one part in sixty thousand parts of anhydrous timber.

The actual part manganese plays in plant metabolism is not well known, although during late years considerable work has been undertaken in regard to its relation to plants generally. It seems remarkable that such relative constancy in the amount of manganese should be shown with members of particular groups of eucalypts, especially as it occurs in such exceedingly small quantities. Although the ash contents in the timbers of the "Ironbarks" vary in amount among themselves, yet the manganese is relatively a constant quantity, and is in amount about five times that found in the ash of timbers belonging to the group of which *E. regnans* may be considered the type.

Another peculiarity shewn by the inorganic constituents of the several groups is the changing amounts of calcium and magnesium. In the ashes of the timbers of the typical "Boxes"—"White Box" *E. albens*, for instance—the lime (Ca O) exceeds 50 per cent., while the magnesia (Mg O), is only about 2 per cent. In the ashes of the "Ironbarks" the lime is about 30 per cent., and the magnesia about 7 per cent. In the inorganic portion of the timber of *E. regnans*, the lime is only about 16 per cent., while the magnesia has increased to about 22 per cent. The reason for this is apparent, because in those species in which lime is the chief constituent, oxalic acid is a characteristic product of metabolism, and Nature usually disposes of an excess of this substance in plants by combining it with calcium to form the insoluble calcium oxalate. In some eucalypts the calcium oxalate is present in such abundance that at times as much as one-sixth of the entire air-dried bark consists of crystallised calcium oxalate. It is not difficult to separate these crystals as such, and if the smooth barks of certain species are finely powdered, boiled in water until the crystals float out of the cells, they will collect on the top of the water. The crystals from the barks of all the species which contain them are similar in shape, and have the peculiarity of often forming geniculate twins. The crystals are about 0.017 mm. in length and about 0.007 mm. in breadth; they make excellent objects for observation under the microscope.

With the big trees belonging to other groups, oxalic acid is not formed to the same extent, consequently calcium is not in such request, and it is in these trees that the magnesium is at times in excess. The amount of each element is, however, small, the lime in *E. regnans*, for instance, representing about one 15,000th part of the weight of the moisture-free timber, and the magnesia about one 10,000th part. Oxalic acid might be obtained economically from certain eucalypts, because the tannin in those barks which contain it is of very good quality for tanning purposes. The cost of collection and preparation would be borne by the tannin extract so prepared, and the oxalic acid obtained as a by-product. *E. salubris* of West Australia is a species which might be so treated. Already large quantities of the bark of an allied species, the "Mallet," *E. occidentalis*, have been used for tanning purposes, and a considerable trade has been done with it in Western Australia.

3. **Eucalyptus Tannins.**—It would be well perhaps at this stage to refer generally to the tannins of the eucalypts because of the great diversity in the properties of these substances as derived from members of the several groups. The astringent exudations, or kinos, may be taken as illustrating the particular tannin present in the tree, and this is often associated with well defined chemical bodies such as aromadendrin and eudesmin.

All the exudations of the earlier members of the genus, as well as those of the closely related genus Angophora, contain the crystallisable body aromadendrin *alone*, eudesmin not being present in any degree. As the genus evolved, eudesmin, which is a beautifully crystallised body, makes its appearance, and continues to increase in amount until it reaches a maximum in the exudations of the typical "Boxes," (*E. hemiphloia, E. albens, etc.*), where it occurs to the extent of about 10 per cent. Although the quantity of eudesmin increases so greatly, yet the aromadendrin has not been entirely eliminated, so that while aromadendrin occurs without eudesmin in some eucalyptus kinos, the reverse is not the case. These two substances can be readily separated from each other, and they give entirely reverse colour reactions with strong sulphuric and nitric acids. As the genus further evolved both these bodies ceased to be formed, and the exudations of the "Stringybarks," the "Peppermints," the "Ashes," and in fact all the more recent groups of the genus do not contain either body. Economically this is of importance because the tannins in those species which contain eudesmin and aromadendrin in their kinos can be utilised for tanning purposes, if sufficiently abundant. Their affinity for hide substance is excellent, but this is not the case with the tannins in which these bodies are absent. Although the kinos of the "Stringybarks," and the "Peppermints," appear to the taste the most astringent of all, and the potassium permanganate test certainly supports this, yet the affinity of these tannins for hide substance is very low indeed, and they are therefore unsuitable as tanning agents.

This peculiarity also accounts for the "sluggishness" in tanning properties of the barks of the "Ironbarks," *E. sideroxylon* for example. But, while the tannin in the exudations of the "Ironbarks" is similar to that in the "Stringybarks," in the former it is combined with a member of the sugar group, so that these exudations consist of a tannin glucoside. This glucoside has been named "Emphloin," and it differs from other eucalyptus exudations in being insoluble in alcohol, although soluble in water. For a long time this substance was thought to be a gum, but gum as such is not present in the eucalypts.

It might be expected that such a diversity in chemical properties would influence the employment of these eucalyptus kinos commercially, and such is the case. Besides being utilised for tanning purposes astringent exudations are employed in pharmacy for the preparation of tincture of kino, but one great objection to them generally has been that after some time the tinctures form a jelly, and thus become spoiled. Eucalyptus kinos have been employed for this purpose, but at times with indifferent success. The reason for this is now easily explained. The kinos of the "Ironbarks" do not go into solution in alcohol, while those of the "Stringybarks" and "Peppermints" quickly form jellies; nevertheless certain very astringent eucalyptus kinos, which are readily soluble in alcohol, do not form jellies, no matter how long the tinctures may be kept. Pharmacists, therefore, need not be troubled further with gelatinized tincture of kino if the proper eucalyptus kinos are used in its manufacture. The exudation of the "Red Gum" of West Australia, *E. calophylla* is, for many reasons, the best of all for this purpose, and the writer has a sample of the tincture of the kino of this species which was prepared over twenty years ago, and is as fluid to-day as it was when first made. The exudation of the "Red Gum" of Eastern Australia, *E. rostrata,* is not so good in many respects, although it makes a very fair tincture, and is now used for this purpose.

4. **Eucalyptus Essential Oils.**—The relative constancy in chemical products derived from a particular species of eucalyptus is a characteristic feature, and as particular chemical constituents can be determined with great accuracy, it follows that considerable assistance can be rendered to botanical diagnosis by this chemical evidence, irrespective of the economic aspect. It is sometimes difficult to place definitely a doubtful species of eucalyptus without a determination of its chemical characteristics. That the changes which have taken place in the genus, both botanically and chemically, have been contemporaneous is shown from the study of the leaf venations in connection with that of the essential oil products. In the earlier members of the genus, the "Bloodwoods" for instance, the venation of the mature lanceolate leaves resembles closely the markings of a feather, the numerous veins being quite obtuse, the midrib thick, and the marginal vein close to the edge of the leaf. The essential oil distilled from species, the leaves of which have this venation, consists largely of the terpene pinene, a substance which has ten carbon atoms and sixteen hydrogen atoms in the molecule. None of the oils from this group is at present of economic value, although a very good turpentine (pinene) is obtainable from species occurring later in the genus. As the genus evolved, the leaf venation became less obtuse, and more open, the marginal vein further removed from the edge, and the midrib less thick. The oil from trees with this leaf venation still has pinene as the chief terpene, but the oxygen-bearing constituent, eucalyptol or cineol ($C_{10}H_{18}O$) occurs in quantity. Eucalyptus oils of this class are now largely in demand for pharmaceutical purposes, and also for the manufacture of pure eucalyptol, so that economically this group is of considerable importance. Those species which occupy the more recent end of the genus, and occur so plentifully on the highlands of the eastern portion of Australia and Tasmania, have again a different leaf venation to those of the other two classes. The midrib is thin, the veins very acute and open, and the marginal vein removed from the edge of the leaf to so great a distance that often a second one has formed. The oil distilled from the leaves of these species consists largely of the terpene phellandrene, a substance also containing ten carbon and sixteen hydrogen atoms, but these are arranged differently in the molecule from those in pinene. This terpene is absent from the oils of the first group, and also from those of distinctive members of the second class. The yield of oil from some species belonging to the third class is very considerable, and it can be cheaply produced. Large quantities are used industrially in the separation, by a flotation process, of metallic sulphides, such as those of lead, zinc, copper, molybdenum, etc.

These cheaper phellandrene eucalyptus oils, moreover, act more satisfactorily in the flotation process than the more expensive eucalyptus oils. The product of the "Broad-leaf Peppermint," *E. dives,* appears to be the best of all essential oils for mineral separation, and a considerable industry should be established in Eastern Australia in the preparation of the essential oil from this and similar species. Many tons of oil per month are at present being distilled in New South Wales and Victoria for flotation work, and systematic effort should largely increase this output. The yield of oil from *E. dives* is about 3 per cent., and the species has a most extensive range in the highlands of New South Wales and Victoria.

Representative species of the first group are not found in Victoria, except at one locality on the border of New South Wales, and are quite absent in Tasmania. The members of the second group have a more extensive range and occur in all the States, including Tasmania, while those of the third group are found mostly in Eastern Australia and Tasmania. There is, however, no well-marked line of demarcation separating one group from the other, and chemically the constituents gradually increase in amount until a maximum is reached in one or more species of the group.

Although some hundreds of distinct species of eucalyptus occur in Australia, yet the number which can be utilised commercially for oil distillation does not exceed perhaps 10 per cent. The two chief factors which govern production are yield of oil and composition. The yields vary considerably, ranging from about 4 per cent. to practically nothing, and it is a remarkable fact that each species not only gives an oil comparatively constant in composition, but secretes the oil in practically a uniform manner. These characteristics, moreover, hold throughout almost the entire range of the species, the known exceptions being very few. The quantity of oil diminishes somewhat during the winter, increasing again in the spring and summer months. Species which yield oils suitable for pharmaceutical purposes vary in amount from about 2 per cent. downwards, a very large number yielding from half to three-quarters per cent. It is of course evident that the least prolific species cannot compete commercially with those which give a greater amount of oil, if the products are of equal quality; but when the oil constituents of the less prolific varieties are of considerable value, such as those used for perfumery purposes, *i.e.*, the alcohol geraniol, and its ester geranyl-acetate, distilled from the leaves of *Eucalyptus Macarthuri*; or the aldehyde citronellal from *E. citriodora*; or the aldehyde citral from *E. Staigeriana*, the extra value of the oil makes up for the smaller yield.

Pharmaceutical eucalyptus oils, when rectified, are either colourless or tinged yellow. This peculiarity appears to be due to the action of the two phenols peculiar to eucalyptus oils; one of these has been named tasmanol, because it occurs more frequently in the oils of the Tasmanian species. It is a liquid phenol, and in the structure of its molecule differs from the other phenol which is crystallisable. This has not yet been named, but it evidently changes to form a coloured substance with a quinone structure, which tasmanol cannot do as it contains a methoxy group.

Another characteristic of the colourless oils which contain the terpene phellandrene, is that often a constituent is present which has a strong peppermint odour, and this is particularly noticeable in the oils of the "Peppermint" group. This constituent is a ketone, and has been named piperitone; it combines with sodium bisulphite, and can therefore be obtained in a pure condition.

The yellow oils, on the other hand, often contain a characteristic constituent known as aromadendral. This is an aromatic aldehyde, and is particularly associated with the oils of the "Boxes" and of the "Mallees," and it can also be prepared in a pure condition. These two bodies do not appear to occur together in the oil of the same species.

Several other constituents have already been isolated from certain eucalyptus oils, but these at present do not appear to have distinctive group characteristics, or to be of economic value; they are thus only of scientific interest. Among these may be mentioned the low boiling alcohols and aldehydes; the low boiling ester butyl-butyrate;

the solid crystalline substance eudesmol; the two solid paraffins—one having a melting point 64° C., the other melting at 55·56° C.; the sesquiterpenes ($C_{15}H_{24}$); and the hydrocarbon cymene ($C_{10}H_{14}$).

The terpene limonene ($C_{10}H_{16}$) which occurs in the oil of *E. Staigeriana* may eventually become of economic importance, as it is associated with the aldehyde citral; this eucalyptus oil is thus in agreement in chief constituents with lemon oil, and could be equally well used for flavouring purposes, besides being more cheaply prepared. The optical rotation of the eucalyptus limonene is, however, to the left, while that in lemon oil rotates the ray to the right. This peculiarity is known as stereo-isomerism, and is physical rather than chemical.

5. **Rubber and Wax.**—The very young leaves and shoots of the earlier species of the genus, the "Bloodwood" group particularly, are coated with an elastic substance which on investigation was found to be a rubber of very good quality, but as it occurs on the exterior of the leaves it is susceptible to alteration under the influences of sun and air, so that it is not found on the older leaves. It has no economic value but is of particular scientific interest, as it does not occur on the leaves of the members of the other groups, and apparently was one of the first chemical constituents to be discarded by nature in the process of evolution.

Another constituent which is found coating the leaves of some species is a vegetable wax, and the pulverulent appearance of their young leaves is due to this substance. It can be easily removed but is not promising economically, as it has a somewhat low melting point, 60° C., and vegetable waxes are known which melt at a much higher temperature.

6. **Eucalyptus Dyes.**—The leaves of some species of eucalyptus are quite yellow when dry. This peculiarity is due to the presence of a dye-material which has been named myrticolorin. This substance is a glucoside of quercetin, and is thus closely allied to quercitron, a material that has long been used for dyeing purposes. Myrticolorin is easily separated as a definite substance by the following process:—The leaves are finely ground, boiled in water, filtered boiling hot, the filtrate allowed to cool when the myrticolorin crystallises out, the tannins and salts remaining in solution. It is then filtered cold, washed and dried. As much as 8½ pounds of myrticolorin from each 100 pounds of ground leaves were obtained from the leaves of the "Red Stringybark," *Eucalyptus macrorhyncha*. It dyes various colours with different mordants; yellow with aluminium, and khaki with potassium bichromate. As the dye is fast to light and to milling it might be utilised for khaki and other dyeing, as it is quite suitable for the purpose, and at present is going to waste.

Some of the eucalyptus exudations could also be utilised for dyeing purposes, and possibly with advantage. It is very necessary, however, that research work be undertaken to decide this point, as well as to determine the value of other probable Australian vegetable dyes.

7. **Carbohydrate.**—Chemical constituents other than those enumerated above are known to occur in the eucalypts, but I shall refer here to one only, viz., the carbohydrate raffinose, which was discovered by Johnston in 1843 in eucalyptus manna.

Most persons in Australia, at all events, have heard of eucalyptus manna, the white sweetish material found at times on the ground beneath certain species, *E. viminalis* particularly. Raffinose is the chief constituent in this substance, but is somewhat sparsely distributed in nature; it has been found in sugar beet and also in cotton seed. When the molecule of raffinose is suitably broken down, the sugars formed are dextrose, lævulose, and galactose, so that raffinose is a more complex substance than cane sugar.

Two distinct organic chemical substances are thus separately circulating, and are obtained as exudations from some eucalyptus species, viz., an astringent one peculiar to the group, and manna. This sweetish exudation is not peculiar to the leaves of the tree, but is sometimes found exuding from the bark, and a fairly good specimen is in the Sydney Technological Museum, showing the manna attached to the bark from which it was exuding, together with some of the pure kino collected at the same time and from the same tree. The species was *E. punctata*.

8. **Economic Advantages of Eucalyptus Cultivation.**—In conclusion, reference may be made to the economic advantage to be derived from the cultivation of those eucalyptus species which show the most promising results for the production of chemical products useful for industrial purposes.

It is, perhaps, difficult to impress the ordinary Australian with the advantages to be derived from the cultivation of the "Gum Trees," yet this will eventually be done, and already the cultivation of one species has been commenced in Victoria. If thousands of acres were planted with the right species for the production of the required products, then priority in supply to the world's markets would be secured. It seems certain that particular species of eucalpytus will eventually be cultivated for the chemical products they afford, and if this is not done in Australia, then the people in other countries will reap the advantage to be gained from such cultivation.