CHAPTER II.

PHYSIOGRAPHY.

§ 1. General Description of Australia.

1. **Geographical Position.**—(i) *General.* 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. 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."

(ii) *Tropical and Temperate Regions.* Of the total area of Australia nearly 40 per cent. lies within the tropics. Assuming, as is usual, that the latitude of the Tropic of Capricorn is 23° 30′ S., its correct value for 1920 is 23° 26′ 58.89″, and it decreases about 0.47″ per annum, the areas within the tropical and temperate zones are approximately as follows :—

AUSTRALIA—AREAS OF TROPICAL AND TEMPERATE REGIONS.

(STATES AND TERRITORY PARTIALLY 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).

2. **Area of Australia compared with Areas of other Countries.**—It is not always realized that the area of Australia is nearly as great as 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 more than three-fourths of the whole area of Europe, and 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. This great area, coupled with a limited population, renders the solution of the problem of Australian development a particularly difficult one. The areas of Australia and of other countries are given in the following table :—

AREA OF AUSTRALIA AND OF OTHER COUNTRIES.

Country.	Area.
Continental Divisions—	Sq. miles.
Europe	3,858,361
Asia	16,705,618
Africa	12,154,812
North and Central America and West Indies	8,601,799
South America	7,366,287
Australasia and Polynesia	3,422,017
Total, exclusive of Arctic and Antarctic Conts.	52,108,894
Europe—	
Russia	1,657,560
France	212,659
Spain	194,783
Germany	183,468
Sweden	173,035
Lithuania	154,491
Finland	149,586
Poland	149,042
Norway	124,964
Rumania	122,282
United Kingdom	121,633
Italy	110,632
Jugo-Slavia	95,628
Czecho-Slovakia	54,264
Greece	41,933
Bulgaria	40,656
Iceland	39,709
Hungary	35,654
Portugal	35,490
Austria	30,766
Latvia	25,000
Esthonia	23,160
Denmark (Exclusive of Iceland)	17,144
Switzerland	15,976
Netherlands	12,582
Belgium	11,744
Albania	11,500
Turkey	10,882
Luxemburg	999
Danzig	709
Andorra	191
Malta	118
Liechtenstein	65
San Marino	38
Monaco	8
Fiume	8
Gibraltar	2
Total, Europe	3,858,361
Asia—	
Russia	5,913,877
China and Dependencies	3,913,560
British India	1,093,074

Country.	Area.
ASIA—*continued.*	Sq. miles.
Independent Arabia	1,000,000
Feudatory Indian States	709,555
Far Eastern Republic	652,740
Persia	628,000
Dutch East Indies	561,661
Turkey	273,202
Japan (and Dependencies)	261,276
Afghanistan	245,000
Siam	198,900
Mesopotamia	143,250
Syria	114,530
Philippine Islands (inclusive of Sulu Archipelago)	114,400
Laos	96,500
Omán	82,000
Bokhara	79,000
British Borneo and Sarawak	73,106
Kurdistan and Turkish Armenia	71,990
Cambodia	57,900
Nepál	54,000
Tonking	40,530
Annam	39,758
Azerbaijan	33,970
Federated Malay States	27,506
Smyrna	25,801
Georgia	25,760
Ceylon	25,481
Khiva	24,000
Malay Protectorate (including Johore)	23,486
Cochin China	22,000
Bhután	20,000
Armenia	15,240
Aden and Dependencies	9,005
Palestine	9,000
Timor, etc. (Portuguese Indian Archipelago)	7,330
Brunei	4,000
Cyprus	3,584
Andaman and Nicobar Islands	2,895
Kiauchau (including Neutral Zone)	2,700
Goa, Damao, and Diu	1,638
Straits Settlement	1,600
Sokotra	1,382
Hong Kong and Dependencies	391
Wei-hai-wei	285
Bahrein Islands	250
French India (Pondicherry, etc.)	196
Kwang Chau Wan	190
Maldive Islands	115
Macao, etc.	4
Total, Asia	16,705,618

AREA OF AUSTRALIA AND OF OTHER COUNTRIES—*continued.*

Country.	Area.	Country.	Area.
Africa—	Sq. miles.	AFRICA—*continued.*	Sq. miles.
French Sahara ..	1,544,000	Réunion	970
Sudan	1,014,400	Ifni	965
French Equatorial Africa	982,049	Fernando Po, etc. ..	814
Belgian Congo	909,654	Mauritius and Dependencies	809
Angola	484,800	St. Thomas and Principe Islands	360
Union of South Africa ..	473,096	Seychelles	156
Rhodesia	440,000	St. Helena	47
Portuguese East Africa ..	428,132	Ascension	34
Tripolitania and Cyrenaica	406,000		
Senegambia and Niger ..	366,700	Total, Africa ..	12,154,812
Tanganyika Territory ..	365,000		
Abyssinia	350,000		
Egypt	350,000		
Territory of the Niger ..	347,400	**North and Central America and West Indies—**	
Mauretania	344,967	Canada	3,729,665
Nigeria and Protectorate	332,000	United States, (exclusive of Alaska, etc.)	3,026,789
South-west Africa ..	322,400	Mexico	767,198
Bechuanaland Protectorate	275,000	Alaska	590,884
Kenya Colony and Protectorate	245,060	Newfoundland and Labrador	162,734
Madagascar	228,000	Nicaragua	49,200
Morocco	223,000	Guatemala	48,290
Algeria (including Algerian Sahara)	222,180	*Greenland	46,740
Kameroon (French) ..	166,489	Honduras	44,275
Upper Volta	154,400	Cuba	44,215
Italian Somaliland ..	139,430	Costa Rica	23,000
Ivory Coast	121,976	Santo Domingo ..	19,332
Uganda Protectorate ..	110,300	Salvador	13,183
Rio de Oro and Adrar ..	109,200	Haiti	10,204
French Guinea	95,218	British Honduras ..	8,592
Gold Coast Protectorate (with Nth. Territories)	80,000	Bahamas	4,404
Senegal	74,112	Jamaica	4,207
British Somaliland ..	68,000	Porto Rico	3,435
Tunis	50,000	Trinidad and Tobago ..	1,977
Eritrea	45,800	Guadeloupe and Dependencies	722
Dahomey	42,460	Leeward Islands ..	715
Liberia	40,000	Windward Islands ..	527
Nyassaland Protectorate	39,573	Curaçao and Dependencies	403
Kameroon (British) ..	31,000	Martinique	385
Sierra Leone and Protectorate	31,000	Turks and Caicos Islands ..	224
Togoland (French) ..	21,893	Barbados	166
Portuguese Guinea ..	13,940	Virgin Islands of U.S.A., late Danish West Indies	132
Togoland (British) ..	12,600	St. Pierre and Miquelon ..	93
Basutoland	11,716	Cayman Islands ..	89
Spanish Guinea (Rio Muni, etc.)..	9,470	Bermudas	19
Spanish Morocco ..	7,700		
Swaziland	6,678	Total, N. and C. America and W. Indies ..	8,601,799
French Somali Coast ..	5,790		
Gambia and Protectorate	4,134	**South America—**	
Cape Verde Islands ..	1,480	Brazil	3,275,510
Comoro Islands, Mayotte, etc.	1,440	Argentine Republic ..	1,153,119
Zanzibar	1,020	Peru	722,461

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

AREA OF AUSTRALIA AND OF OTHER COUNTRIES—*continued.*

Country.	Area.	Country.	Area.
SOUTH AMERICA—*continued.*	Sq. miles.	AUSTRALASIA AND POLYNESIA —*continued.*	Sq. miles.
Bolivia	514,155	British Solomon Islands ..	11,000
Colombia (exclusive of Panama)	440,846	Fiji	7,435
Venezuela	398,594	New Caledonia and Dependencies	7,237
Chile	289,829	Hawaii	6,449
Paraguay	175,673	New Hebrides	5,500
Ecuador	116,000	French Establishments in Oceania	1,520
British Guiana	89,480	Territory of Western Samoa	1,260
Uruguay	72,153	Marianne, Caroline, and Marshall Islands ..	960
Dutch Guiana ..	46,060	Tonga	385
Panama	32,380	Guam	225
French Guiana	32,000	Gilbert and Ellice Islands	208
Falkland Islands ..	6,500	Samoa (U.S.A. part) ..	102
South Georgia	1,000	Norfolk Island	13
Panama Canal Zone ..	527	Nauru Island	12
Total, South America ..	7,366,287	Total, Australasia and Polynesia	3,422,017
Australasia and Polynesia—			
Commonwealth of Australia	2,974,581		
Dutch New Guinea ..	121,339		
New Zealand and Dependencies	103,861		
Papua	90,540		
Territory of New Guinea	89,390	**British Empire**	13,257,584

The figures quoted in the table have been extracted from the Statesman's Year-Book for 1922, but, as several of the boundaries have not yet been finally adjusted since the war, modifications will in some instances be necessary.

3. **Areas of Political Subdivisions.**—As already stated, Australia consists of six States and the Northern and Federal Territories. The areas of these, and their proportions of the total of Australia, are shown in the following table :—

AUSTRALIA—AREA OF STATES AND TERRITORIES.

State or Territory.	Area.	Percentage on Total.
	Sq. miles.	
New South Wales	309,432	10.40
Victoria	87,884	2.96
Queensland	670,500	22.54
South Australia	380,070	12.78
West Australia	975,920	32.81
Tasmania	26,215	0.88
Northern Territory	523,620	17.60
Federal Territory	940	0.03
Total	2,974,581	100.00

4. **Coastal Configuration.**—(i) *General.* 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 Cape 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).

(ii) *Coast-line.* The lengths of coast-line, exclusive of minor indentations, of each State and of the whole continent, and the area per mile of coast-line, are shown in the following table :—

AUSTRALIA—COAST LINE AND AREA PER MILE THEREOF.

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

(*a*) Including Federal Territory. (*b*) Area 2,948,366 square miles.

For the entire Commonwealth of Australia 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.

(iii) *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 of the earlier issues of this Year Book fairly complete information has been given concerning some special geographical element. The nature of this information and its position in the various Year Books can be readily ascertained on reference to the special index following the general index at the end of this work.

6. **Fauna, Flora, Geology, and Seismology of Australia.**—Special articles dealing with these features have appeared in previous Year Books, but limits of space naturally preclude their repetition in each volume. As pointed out in 5 *supra*, however, the nature and position of these articles can be readily ascertained from the special index.

§ 2. Climate and Meteorology of Australia.*

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 organization of the Commonwealth Bureau of Meteorology, and a résumé 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.

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

(iii) Bulletins, Victorian and Interstate, showing pressure, temperature, wind, rain, cloud extent, and weather. Similar publications are also issued from the divisional offices in each of the State Capitals.

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.

In addition, fifteen Bulletins of Climatology have been published, particulars of which are given in preceding issues of the Official Year Book (see No. 12, page 54).

3. **General Description of Australia.**—A considerable portion (0.530) of three divisions of Australia 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 square miles belong to the tropical zone, and 1,020,720 to the temperate zone. The whole area of Australia within the temperate zone, however, is 1,825,261 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 7,300 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.

On the coast, the rainfall is often abundant and the atmosphere moist, but in some portions of the interior it is very limited, and the atmosphere dry. The distribution of forest, therefore, with its climatic influence, is very uneven. In the interior, in places, there are fine belts of trees, but there are large areas also which are treeless, and where the air is hot and parched in summer. Again, on the coast, even so far south as latitude 35°, the vegetation is tropical in its luxuriance, and to some extent also in character. Climatologically, therefore, Australia may be said to present a great variety of features.

4. **Meteorological Divisions.**—(i) *General.* 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., a line 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., a line from Wilcannia along the Darling River to its junction with the Murray; (*d*) between divisions II. and V., a line from the junction of the Darling and Murray Rivers, along the latter to Encounter Bay; (*e*) between divisions III. and IV., a line 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., a line 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*) Tasmania constitutes division V.

The population included within these boundaries at the Census of the 4th April, 1921, was approximately as follows:—

Division	I.	II.	III.	IV.	V.
Population	332,000	500,000	824,000	1,915,000	1,866,000

In these divisions, the order in which the capitals occur is as follows:—(*a*) Perth, (*b*) Adelaide, (*c*) Brisbane, (*d*) Sydney, (*e*) Melbourne, and (*f*) Hobart; and the climatological and meteorological statistics relating to the capital cities are dealt with herein in accordance with that order.

(ii) *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—AUSTRALIA.

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	1,926	23 38	133 37
Sydney ..	133	33 52	151 12	Dubbo ..	870	32 18	148 35
Melbourne ..	115	37 49	144 58	Laverton, W.A.	1,530	28 40	122 23
Hobart ..	177	42 53	147 20	Coolgardie ..	1,389	30 57	121 10

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

The comparison is even more favourable when the Northern Hemisphere is included, for in the United States the 70° isotherm extends in several of the western States so 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 8.2°, and the extreme readings for the year, or the highest maximum in the hottest month and the lowest reading in the coldest month, show a difference of under 50°.

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

(ii) *Hottest and Coldest Parts.* A comparison of the temperatures recorded at coast and inland stations shows 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° continuously for days and weeks. The coldest part of the Commonwealth is the extreme south-east of New South Wales and extreme east of Victoria—the region of the Australian Alps. Here the temperature seldom, if ever, reaches 100°, even in the hottest of seasons.

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

(iii) *Monthly Maximum and Minimum Temperatures.* The normal monthly maximum and minimum temperatures can be best shown by means of graphs, which exhibit the nature of the fluctuation of each for all available years. In the diagram herein for nine representative places in Australia, the upper heavy curves show the mean maximum, and the lower heavy curves the mean minimum temperatures based upon daily observations, while the thin curves show the relative humidities.

6. **Relative Humidity.**—Next after temperature the degree of humidity may be regarded as of outstanding importance as an element of climate. The characteristic differences of relative humidity between the various capitals of Australia call for special remark. For nine representative places the variations of temperature are shown on the graph herein, which gives results based upon daily observations of the dry and wet bulb thermometers for all available years. In the case of the capital cities the curves are accompanied by curves of humidity. Hitherto difficulties have been experienced in many parts of Australia in obtaining satisfactory observations for lengthy continuous periods. 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*, or the percentage of aqueous vapour actually existing on the total possible if the atmosphere were saturated. From the detailed humidity results for the State capitals given in the tables hereinafter, it will be 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. It will be noted also that the *relative humidity* is ordinarily but not invariably great when the temperature is low.

7. **Evaporation.**—(i) *General.* 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"* and dams. The magnitude of the economic loss by evaporation will be appreciated from the tabular records herein, which show that the yearly amount varies from about 33 inches at Hobart to 94 inches at Alice Springs in the centre of the Continent.

(ii) *Monthly Evaporation Curves.* The curves showing the mean monthly evaporation in various parts of the Commonwealth disclose how characteristically different are the amounts for the several months in different localities. The evaporation for characteristic places is shown on the diagram giving also rainfalls.

(iii) *Loss by Evaporation.* In the interior of Australia the possible evaporation is greater than the actual rainfall. Since the loss by evaporation depends largely on the exposed area, tanks and dams so designed that the surface shall be a minimum are advantageous. Further, 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 naturally of more than ordinary concern in the drier districts of Australia.

8. **Rainfall.**—(i) *General.* As even a casual reference to climatological maps indicating the distribution of rainfall and prevailing direction of wind would clearly show, 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, and, 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, where the prevailing winds, blowing from the interior of the continent instead of from the ocean, result in the lightest coastal rain in Australia.

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

The westerly winds, which skirt the southern shores, are responsible for the very reliable, although generally light to moderate, 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.

(ii) *Factors determining Distribution and Intensity of Rainfall.* (iii) *Time of Rainfall.* In Year Book No. 6 (see pp. 72 to 74) some notes were given of the various factors governing the distribution, intensity, and period of Australian rainfall.

(iv) *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 145 and 168 inches. The maximum and minimum falls there are :— Goondi, 241.53 in 1894 and 67.88 inches in 1915, or a range of 173.65 inches ; Innisfail, 211.24 in 1894 and 69.87 inches in 1902, or a range of 141.37 inches ; Harvey's Creek, 254.77 in 1921 and 80.47 inches in 1902, or a range of 174.30 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 29 years.

Harvey's Creek in the shorter period of 23 years has three times exceeded 200 inches, the total for 1921 being 254.77 inches, and at the South Johnstone Sugar Experiment Station, where a gauge has recently been established, 202.52 inches were recorded in 1921.

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 were at one time regarded as the driest part of Australia, but authentic observations in recent years over the settled districts in the east of that State show that the annual average is from 10 to 12 inches.

(v) *Quantities and Distribution of Rainfall.* 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 show. The general distribution is best seen from the rainfall map herein which shows 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 shown in the following table :—

AVERAGE ANNUAL RAINFALL DISTRIBUTION.

Average Annual Rainfall.	N.S.W. (a)	Victoria.	Queensland.	South Australia.	Northern Territory	Western Australia.	Tasmania. (b)	Total. (b)
	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

(a) Including Federal Capital Territory. (b) Over an area of 3,030 square miles no records are available.

Referring first to the capital cities, the complete records of which are given in the next table, it will be seen that Sydney, with a normal rainfall of 48.17 inches, occupies the chief place ; Brisbane, Perth, Melbourne, Hobart and Adelaide following in that order, Adelaide with 21.08 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 show how the rainfall is distributed throughout the year in various parts of the continent, the figures of representative towns have been selected. (See map.)

The figures for Darwin, typical of the Northern Territory, show that nearly the whole of the rainfall occurs there in the summer months, while little or none falls in the middle of the year. The figures for 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 for the former, and in November for 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 a maximum in the autumn; the averages during the last six months are fair, and moderately uniform. Generally it may be said that approximately one-third of the area of the continent, principally in the eastern and northern parts, enjoys an annual average rainfall of from 20 to 50 or more inches, the remaining two-thirds averaging from about 10 to 20 inches.

(vi) *Curves of Rainfall and Evaporation.* The relative amounts of rainfall and evaporation at different times through the year are clearly indicated in the graphs herein. Inspection thereof will show how large is the evaporation when water is fully exposed to the direct rays of the sun and to wind.

(vii) *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. As pointed out in 4 *ante*, the capitals are dealt with in the order in which they occur in the adopted meteorological divisions.

RAINFALL—AUSTRALIAN CAPITAL CITIES, 1901 TO 1922.

Year.	Perth.			Adelaide.			Brisbane.			Sydney.			Melbourne.			Hobart.		
	Amount.	No. of Days.	10 Years' Means.	Amount.	No. of Days.	10 Years' Means.	Amount.	No. of Days.	10 Years' Means.	Amount.	No. of Days.	10 Years' Means.	Amount.	No. of Days.	10 Years' Means.	Amount.	No. of Days.	10 Years' Means.
	in.		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.		in.
1901	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	..
11	23.38	108	..	15.99	127	..	35.21	128	..	50.24	155	..	36.61	168	..	26.78	193	..
12	27.85	123	..	19.57	116	..	41.30	114	..	47.51	172	..	20.37	157	..	23.14	181	..
13	38.28	141	..	18.16	102	..	40.81	115	..	57.70	141	..	21.17	157	..	19.36	165	..
14	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	..
17	45.64	146	..	28.90	153	..	40.92	127	..	52.40	151	..	30.57	171	..	30.62	214	..
18	39.58	138	34.98	17.41	107	21.13	24.95	121	37.87	42.99	149	46.64	27.13	160	26.39	26.04	179	25.82
19	30.66	120	..	17.21	108	..	19.36	96	..	58.71	152	..	24.89	141	..	22.48	153	..
20	40.35	124	..	26.70	119	..	39.72	122	..	43.42	159	..	28.27	162	..	18.00	182	..
21	41.09	135	..	22.64	100	..	54.31	167	..	43.34	140	..	29.76	154	..	18.04	159	..
22	31.86	135	..	23.20	117	..	35.82	109	..	39.35	136	..	25.02	151	..	28.27	189	..
Aver.	..	..	33.86	..	..	21.08	..	..	45.33	..	..	48.17	..	..	26.23	..	..	23.65
No. of Yrs.	..	..	(47)	..	..	(84)	..	..	(73)	..	..	(83)	..	..	(79)	..	..	(80)

NOTE.—The above average rainfall figures for Brisbane, Sydney, and Melbourne differ slightly from the mean annual falls given in the Climatological Tables, which are for a less number of years. Annual totals from 1860 to 1900 inclusive will be found in Year Book No. 15, page 53.

9. **Remarkable Falls of Rain.**—The following are the more remarkable falls of rain in the various States and in the Northern Territory, which have occurred within a period of twenty-four hours. In New South Wales and Queensland falls of less than 15 inches in the twenty-four hours are not included. Reference, however, to them may be found in preceding Official Year Books (see No. 14, pp. 60-3) :—

HEAVY RAINFALLS—NEW SOUTH WALES, UP TO 1922, INCLUSIVE.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Anthony ..	28 Mar., 1887	17.14	Madden's Creek ..	13 Jan., 1911	18.68
Bega	27 Feb., 1919	17.88	Morpeth ..	9 Mar., 1893	21.52
Broger's Creek ..	14 ,, 1898	20.05	Mount Kembla ..	13 Jan., 1911	18.25
,, ,, ..	13 Jan. 1911	20.83	Numbugga ..	27 Feb., 1919	17.87
Bulli Mountain ..	13 Dec., 1898	17.14	Tongarra Farm ..	14 ,, 1898	15.12
Burragate ..	27 ,, 1919	16.38	Towamba ..	5 Mar., 1893	20.00
Candelo	27 Feb., ,,	18.58	South Head (near Sydney) ..	29 Apr., 1841	20.12
Condong ..	27 Mar. 1887	18.66	,, ,, ..	16 Oct., 1844	20.41
Cordeaux River ..	14 Feb., 1898	22.58			
Kembla Heights ..	13 Jan., 1911	17.46			

HEAVY RAINFALLS—QUEENSLAND, UP TO 1922, INCLUSIVE.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Anglesey ..	26 Dec., 1909	18.20	Flying Fish Point	31 Jan., 1913	16.10
Atherton (Cairns) ..	31 Jan., 1913	16.69	Gladstone ..	4 Feb., 1911	18.83
Babinda (Cairns) ..	1 Feb., ,,	20.51	Glen Boughton ..	5 Apr., 1894	18.50
,, ,, ..	24 Jan., 1916	22.30	Goldsborough (Cairns) ..	31 Jan., 1913	19.92
,, ,, ..	21 Apr., 1920	16.05	Goondi Mill (Innisfail)	6 Apr., 1894	15.69
Babinda	25 Mar., 1921	15.76	,, ,, ..	29 Dec., 1903	17.83
Bloomsbury ..	14 Feb., 1893	17.40	,, ,, ..	10 Feb., 1911	17.68
,, ..	10 Jan., 1901	16.62	,, ,, ..	6 Apr., 1912	15.55
Brisbane ..	21 ,, 1887	18.31	Goondi	30 Jan., 1913	24.10
Buderim Mountains	11 ,, 1898	26.20	Goorganga ..	23 ,, 1918	18.17
Bundaberg ..	16 ,, 1913	16.94	Halifax	5 Feb., 1899	15.37
Burnett Head (Bundaberg) ..	16 ,, 1913	15.22	,, ...	6 Jan., 1901	15.68
Cairns	11 Feb., 1911	15.17	Hambledon Mill ..	2 ,, 1911	18.61
,, ...	2 Apr., ,,	20.16	,, ,, ..	1 Apr., ,,	19.62
Carbrook ..	23 Jan., 1918	22.66	,, ,, ..	30 Jan., 1913	17.32
,, ..	24 ,, ,,	15.77	Hampden ..	23 Apr., 1918	17.30
Cardwell ..	18 Mar., 1904	18.24	,, ...	24 ,, ,,	17.19
Carmilla ..	23 Jan., 1918	15.92	Harvey Creek ..	8 Mar., 1899	17.72
Clare	26 ,, 1896	15.30	,, ,, ..	11 Jan., 1905	16.96
Collaroy	23 ,, 1918	18.06	,, ,, ..	3 ,, 1911	27.75
Crohamhurst (Blackall Range)	2 Feb., 1893	35.71	,, ,, ..	2 Apr., ,,	16.46
,, ,,	9 Jan., 1898	19.55	,, ,, ..	31 Jan., 1913	24.72
,, ,,	6 Mar., ,,	16.01	,, ,, ..	25 Mar., 1921	15.80
Croydon	29 Jan., 1908	15.00	Haughton Valley ..	26 Jan., 1896	18.10
Dungeness ..	16 Mar., 1893	22.17	Holmwood (Woodford)	2 Feb., 1893	16.19
Dunira	9 Jan., 1898	18.45	Howard ..	15 Jan., 1905	19.55
,, ...	6 Mar., ,,	15.95	Huntley ..	27 Dec., 1916	18.94
Fairymead Plantation (Bundaberg)	16 Jan., 1913	15.32	Innisfail (formerly Geraldton) ..	11 Feb., 1889	17.13
Flying Fish Point ..	7 Apr., 1912	16.06			

HEAVY RAINFALLS—QUEENSLAND—*continued.*

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Innisfail (formerly Geraldton) ..	6 Apr., 1894	16.02	Mourilyan ..	7 Apr., 1912	18.97
,, ,, ..	24 Jan., 1900	15.22	,, ..	31 Jan., 1913	15.05
,, ,, ..	29 Dec., 1903	21.22	Mundoolun ..	21 ,, 1887	17.95
,, ,, ..	2 Apr., 1911	15.00	Nambour ..	9 ,, 1898	21.00
,, ,, ..	7 ,, 1912	20.50	,, ..	27 Dec., 1909	16.80
,, ,, ..	31 Jan., 1913	20.91	Netherdale ..	22 Jan., 1918	19.50
Kamerunga (Cairns)	2 Apr., 1911	21.00	Oxenford ..	14 Mar., 1908	15.65
,, ,,	31 Jan., 1913	16.00	Palmwwoods ..	10 Jan., 1898	15.85
Koumala ..	23 ,, 1918	22.31	,, ..	25 Dec., 1909	17.75
,, ..	24 ,, ,,	20.65	Pialba (Marybor'gh)	16 Jan., 1913	17.22
Kuranda (Cairns) ..	11 Feb., 1911	16.30	Plane Creek (Mackay) ..	26 Feb., ,,	27.73
,, ,, ..	17 Mar., ,,	15.10	Port Douglas ..	10 Mar., 1904	16.34
,, ,, ..	31 ,, ,,	18.60	,, ,, ..	17 ,, 1911	16.10
,, ,, ..	1 Apr., ,,	24.30	,, ,, ..	1 Apr., ,,	31.53
,, ,, ..	2 ,, ,,	28.80	Proserpine ..	23 Jan., 1918	18.17
,, ,, ..	31 Jan., 1913	16.34	Ravenswood ..	24 Mar., 1890	17.00
Landsborough ..	2 Feb., 1893	15.15	Redcliffe ..	16 Feb., 1893	17.35
Low Island ..	10 Mar., 1904	15.07	Rosedale ..	16 Jan., 1913	18.90
,, ...	1 Apr., 1911	15.30	Sarina	23 ,, 1918	22.60
Lyndon (*via* Brixton)	3 ,, 1917	17.00*	St. Lawrence ..	30 ,, 1896	15.00
Mackay	21 Jan., 1918	24.70†	The Hollow (Mackay)	23 Feb., 1888	15.12
,, ...	22 ,, ,,	17.25‡	Thornborough ..	20 Apr., 1903	18.07
Sugar Experimental Farm, Mackay ..	21 ,, ,,	16.80	Townsville ..	24 Jan., 1892	19.20
,, ..	22 ,, ,,	17.20	,, ...	28 Dec., 1903	15.00
Macnade Mill ..	5 Feb., 1899	15.20	Victoria Mill ..	6 Jan., 1901	16.67
,, ..	6 Jan., 1901	23.33	Woodlands (Yepp'n)	31 ,, 1893	23.07
,, ..	4 Mar., 1915	22.00	Wootha ..	10 Feb., 1915	15.93
Mapleton ..	26 Dec., 1909	15.72	Yandina ..	1 ,, 1893	20.08
Mirani	12 Jan., 1901	16.59	,, ..	9 Jan., 1898	19.25
Miriam Vale (B'berg)	17 ,, 1913	15.80	,, ..	28 Dec., 1909	15.80
Mooloolah ..	13 Mar., 1892	21.53	Yarrabah ..	2 Apr., 1911	30.65
,, ..	2 Feb., 1893	19.11	,, ..	24 Jan., 1916	27.20
Mount Cuthbert ..	8 Jan., 1911	18.00	,, ..	25 ,, ,,	18.60
Mount Molloy ..	31 Mar., ,,	20.00	Yeppoon ..	31 ,, 1893	20.05
,, ..	1 Apr., ,,	20.00	,, ..	8 ,, 1898	18.05
,, ..	2 ,, ,,	20.00	,, ..	8 Oct., 1914	21.70
Mourilyan ..	11 Feb., ..	17.40			

HEAVY RAINFALLS—WESTERN AUSTRALIA, UP TO 1922, INCLUSIVE.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Alice Downs ..	15 Mar., 1922	10.58	Derby	7 Jan., 1917	16.47
Balla Balla ..	21 ,, 1899	14.40	Exmouth Gulf ..	2 Feb., 1918	12.50
Bamboo Creek ..	22 ,, ,,	10.10	Fortescue ..	3 May, 1890	23.36
Boodarie ..	21 ,, ,,	14.53	Frazier Downs ..	3 Mar., 1916	11.25
,, ..	3 Jan., 1896	10.03	Kerdiadary ..	7 Feb., 1901	12.00
Broome	6 Jan., 1917	14.00	Meda	2 Mar., 1916	10.55
Carlton	11 ,, 1903	10.64	Millstream ..	5 ,, 1900	10.00
Cossack	3 Apr., 1898	12.82	Obagama ..	28 Feb., 1910	12.00
,, ...	16 ,, 1900	13.23	,, ..	24 Dec., 1920	13.02
Croydon	3 Mar., 1903	12.00	Pilbara	2 Apr., 1898	14.04
Derby	29 Dec., 1898	13.09	Point Cloates ..	20 Jan., 1909	10.87

* Mr. Jas. Laidlaw, of Lyndon, states that this fell in 4 hours. † 37½ hours. ‡ 22½ hours.

HEAVY RAINFALLS, WESTERN AUSTRALIA—*continued.*

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Point Torment ..	17 Dec., 1906	11.86	Whim Creek ..	3 Apr., 1898	29.41
Port George IV. ..	17 Jan., 1915	11.24	,, ,, ..	21 Mar., 1899	18.17
Roebourne ..	3 Apr., 1898	11.44	,, ,, ..	6 ,, 1900	10.03
,, ..	6 Mar., 1900	10.32	,, ,, ..	3 ,, 1903	10.44
Roebuck Plains ..	5 Jan., 1917	14.01	Woodstock ..	21 ,, 1912	13.00
,, ,, ..	6 ,, ,,	22.36	Wyndham ..	27 Jan., 1890	11.60
Springvale ..	14 Mar., 1922	12.25	,, ..	4 Mar., 1919	12.50
Tambray ..	6 ,, 1900	11.00	Yardie Creek ..	3 Feb., 1918	10.00
,, ..	3 ,, 1903	10.47	Yeeda	2 Mar., 1916	10.70
Thangoo	17-19 Feb. '96	24.18	,, ...	6 Jan., 1917	10.20
,, ...	28 Dec., 1898	11.15	,, ...	7 ,, ,,	11.75

HEAVY RAINFALLS—NORTHERN TERRITORY, UP TO 1922, INCLUSIVE.

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

HEAVY RAINFALLS—SOUTH AUSTRALIA, UP TO 1922, INCLUSIVE.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Wilmington ..	28 Feb., 1921	3.97	Wilmington ..	1 Mar., 1921	7.12

HEAVY RAINFALLS—VICTORIA, UP TO 1922, INCLUSIVE.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Balook	26 Sept., 1917	5.32	Mt. Buffalo ..	6 June, 1917	8.53
,, ...	27 ,, ,,	7.23	,, ..	7 ,, ,,	6.56
,, ...	28 ,, ,,	2.08			

HEAVY RAINFALLS—TASMANIA, UP TO 1922, INCLUSIVE.

Name of Town or Locality.	Date.	Amnt.	Name of Town or Locality.	Date.	Amnt.
		ins.			ins.
Gould's Country ..	8-10 Mar., '11	15.33	Mathinna ..	8-10 Mar., '11	15.79
Lottah	8-10 ,, ,,	18.10	The Springs ..	30-31 Jan., '16	10.75

10. **Snowfall.**—Light snow has been known to fall occasionally so far north 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 so far north as Toowoomba in Queensland. During the winter, for several months, snow covers the ground to a great extent on the Australian Alps, where also the temperature falls below zero Fahrenheit during the night. In the ravines around Kosciusko and similar localities the snow never entirely disappears.

The antarctic "V"-shaped disturbances are always associated with the 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.**—Throughout Australia hail falls 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. A summer rarely passes without some station experiencing a fall of stones exceeding in size an ordinary hen-egg, and many riddled sheets of light-gauge galvanized iron bear evidence of the weight and penetrating power of the stones.

The hailstorms occur most frequently 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 29.95 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 and standard gravity have, under anticyclonic conditions in the interior of the continent, ranged as high as 30.77 inches (at Kalgoorlie on the 28th July, 1901) and have fallen as low as 27.55 inches. This lowest record was registered at Mackay during a tropical hurricane on the 21st January, 1918. An almost equally abnormal reading of 27.88 inches was recorded at Innisfail during a similar storm on the 10th March, 1918. The mean annual fluctuations of barometric pressure for the capitals of Australia are shown on the graph herein.

13. **Wind.**—Notes on the distinctive wind currents in Australia were given in preceding Year Books (see No. 6, page 83), but, owing to limitations of space, have not been included herein.

14. **Cyclones and Storms.***—The "elements" in Australia are ordinarily peaceful, and while destructive 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, or in that part of them which has a north-westerly to a south-westerly circulation.

The north-east coast of Queensland is occasionally visited by hurricanes from the north-east tropics. During the first four 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, locally known as "willy willies," are peculiar to the north-west coast of Western Australia from the months of November to April 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

* See also special article on "Australian Hurricanes and Related Storms" immediately following this article in Official Year Book No. 16.

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, and cause 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 coastline, 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 Official Year Book (see No. 6, pp. 84, 85, 86).

15. **Influences affecting Australian Climate.**—(i) *General.* 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 have, however, 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 shows a rise of two-tenths of a degree during the last twenty years, a change probably brought about by the great increase of residential and manufacturing buildings within the city and in the surrounding suburbs. Again, low-lying lands on the north coast of New South Wales, which 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.

(ii) *Influence 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 equalizing 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 shade temperatures by altering the extent of radiating surface by evaporation, and by checking the movement of air, and 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, and when a region is protected by trees, a 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 case of the inland rivers ; the River Murray, for example, which has never been known to run dry, deriving its steadiness of flow mainly through the causes indicated.

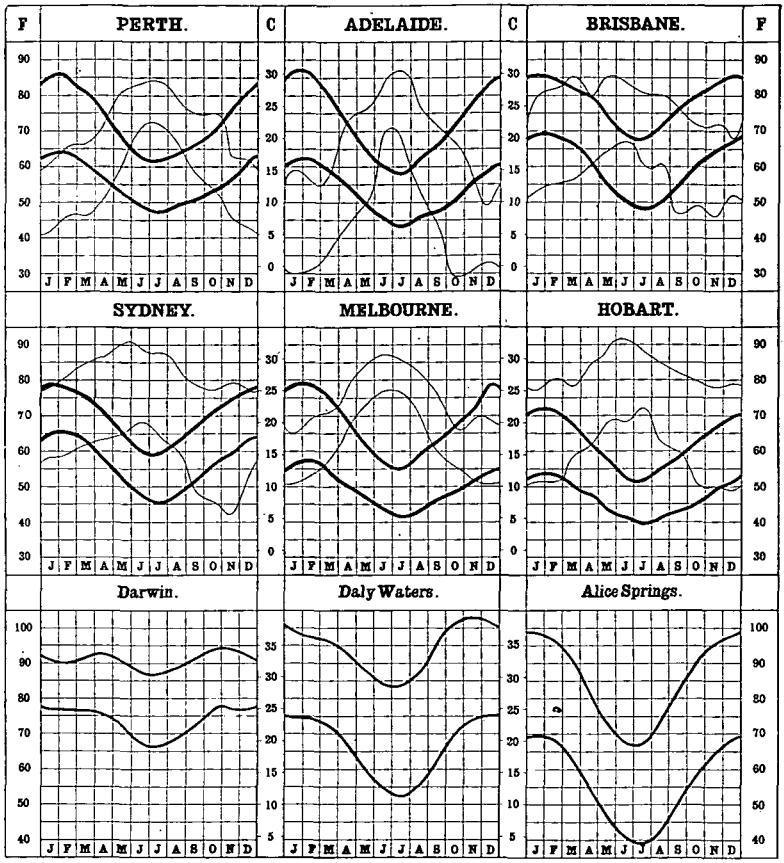
(iii) *Direct Influence of Forests on Rainfall.* Whether forests have a direct influence on rainfall is a debatable question, some authorities alleging that precipitation is undoubtedly induced by forests, while others take the opposite view.

Sufficient evidence exists, however, to prove that, even if the rainfall has not increased, the beneficial climatic effect of forest lands more than warrants their protection and extension. Rapid rate of evaporation, induced by both hot and cold winds, injures crops and makes life uncomfortable on the plains, and, while it may be doubted that the forest aids in increasing precipitation, it must be admitted that it does check 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 the treeless interior of Australia. 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 Official Year Book No. 6, pp. 86 and 95).

16. **Rainfall and Temperature, Various Cities.**—The following table shows rainfall and temperature for various important cities throughout the world, for the site of the Federal capital, and for the capitals of the Australian States.

ANNUAL FLUCTUATIONS OF NORMAL MAXIMUM AND MINIMUM TEMPERATURE AND HUMIDITY.



EXPLANATION.—The heavy lines denote "temperature" and the thin lines "humidity," and are plotted from the data given in the Climatological Tables herein. The temperatures are shown in degrees Fahrenheit, the inner columns giving the corresponding values in degrees Centigrade. Humidities have not been obtained for Darwin, Daly Waters, and Alice Springs.

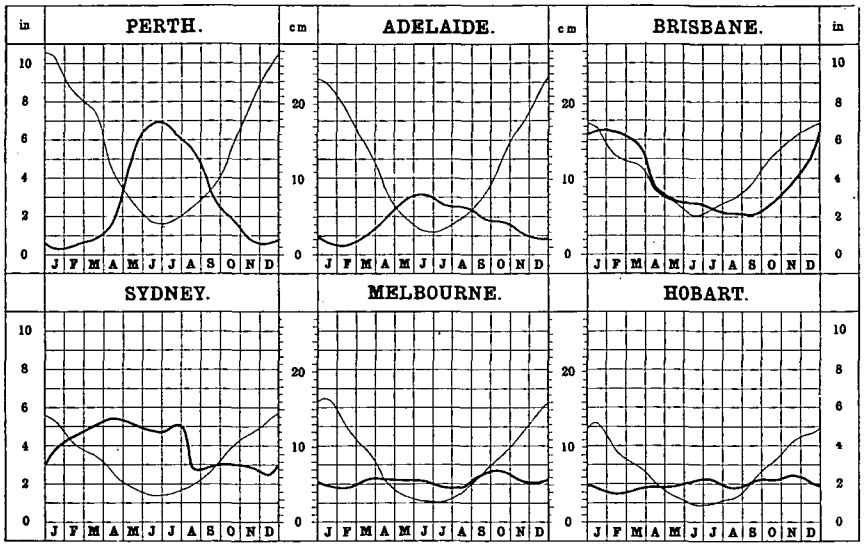
For the thin lines the degree numbers represent relative humidities, or the percentages of actual saturation (absolute saturation = 100).

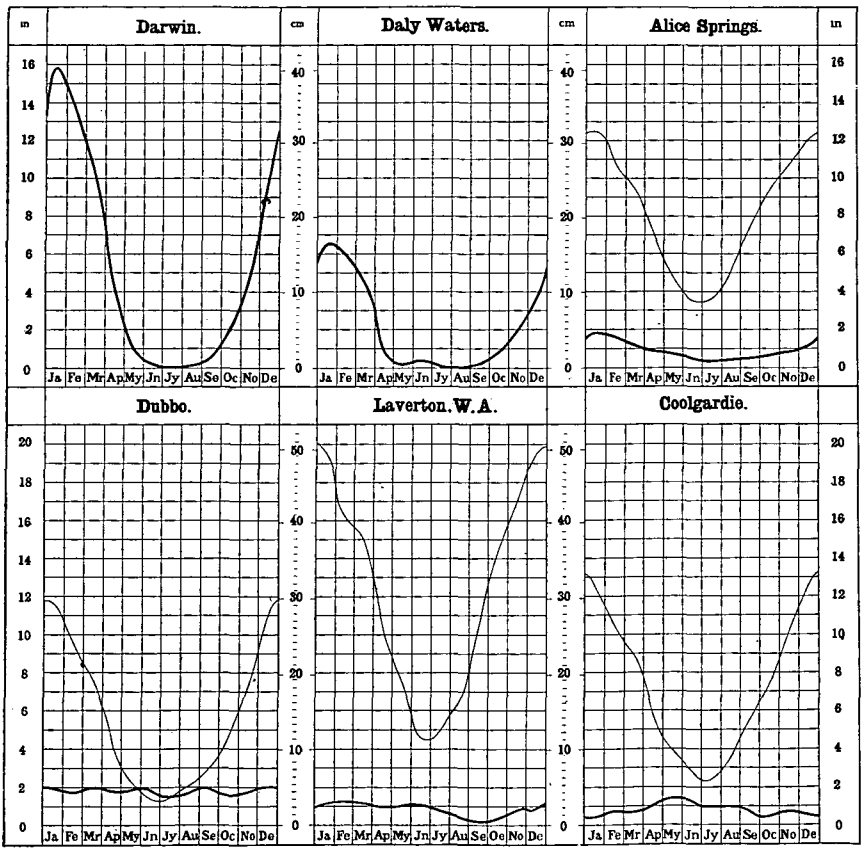
The upper temperature line represents the mean of the maximum, and the lower line the mean of the minimum results; thus the curves also show the progression of the range between maximum and minimum temperatures throughout the year. The humidity curves show the highest and lowest values of the mean monthly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

The curves denote mean monthly values. Taking for example, the temperature graphs for Perth, the mean readings of the maximum and minimum temperatures for a number of years in the middle of January would give respectively about 85° Fahr. and 63° Fahr. Thus the mean range of temperature on that date is the difference, viz., 22°. Similarly, observations about the middle of June would give respectively 64° Fahr. and 49° Fahr., or a range of 15°.

Similarly, the greatest mean humidity, say for March, is about 66% and the least mean humidity for that 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%.

MEAN MONTHLY RAINFALL AND EVAPORATION.





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

At Perth, Adelaide, Brisbane, Melbourne, Hobart, Alice Springs, and Coolgardie the results have been obtained from jacketed tanks sunk in the ground. At Sydney and Dubbo sunken tanks without water jackets are used, whilst at Laverton (W.A.) the records are taken from a small portable jacketed evaporation dish of 8 inches in diameter.

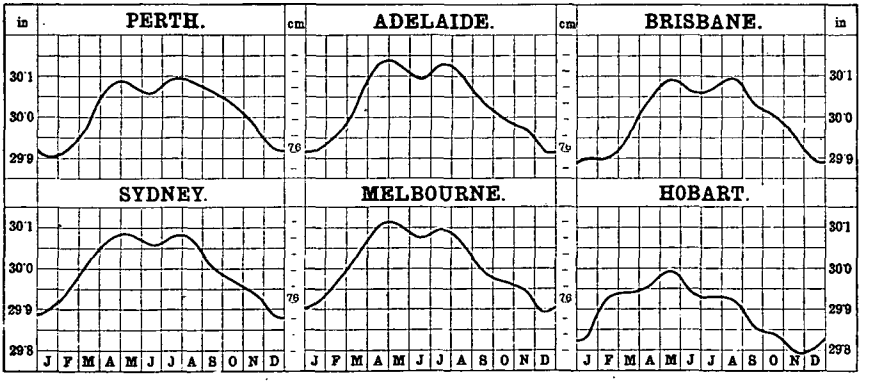
The distance for any date from the zero line to the curve represents the average number of inches, reckoned as per month, of rainfall at that date. Thus, taking the curves for Adelaide, in the middle of January the rain falls on the average at the rate of about three-fourths of an inch per month, or, say, at the rate of about 9 inches per year. In the middle of June it falls at the rate of a little over 3 inches per month, or, say, at the rate of about 37 inches per year. At Dubbo the evaporation is at the rate of nearly 11¾ inches per month about the middle of January, and only about 1½ inches at the middle of June.

The mean annual rainfall and evaporation at the places indicated are given in the appended table.

MEAN ANNUAL RAINFALL AND EVAPORATION.

Place.	Rainfall.	Evaporation.	Place.	Rainfall.	Evaporation.
	In.	In.		In.	In.
Perth ..	33.86	65.88	Darwin ..	61.97	—
Adelaide ..	21.08	54.56	Daly Waters ..	26.58	—
Brisbane ..	45.51	51.93	Alice Springs ..	11.24	93.99
Sydney ..	47.91	38.26	Dubbo ..	21.97	66.37
Melbourne ..	25.65	38.87	Laverton, W.A.	9.88	141.42
Hobart ..	23.65	32.37	Coolgardie ..	10.15	87.69

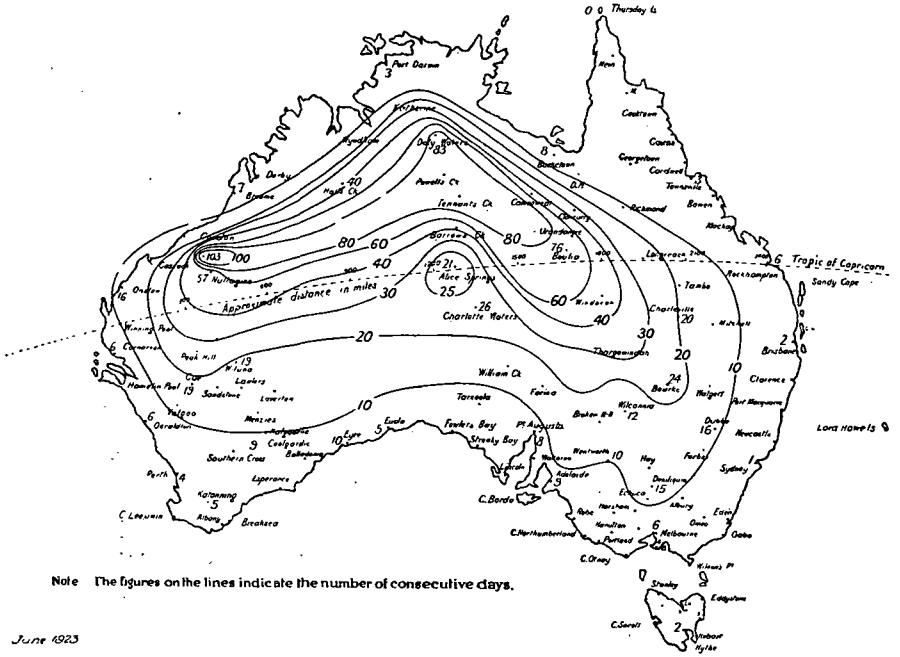
MEAN BAROMETRIC PRESSURE—CAPITAL CITIES.



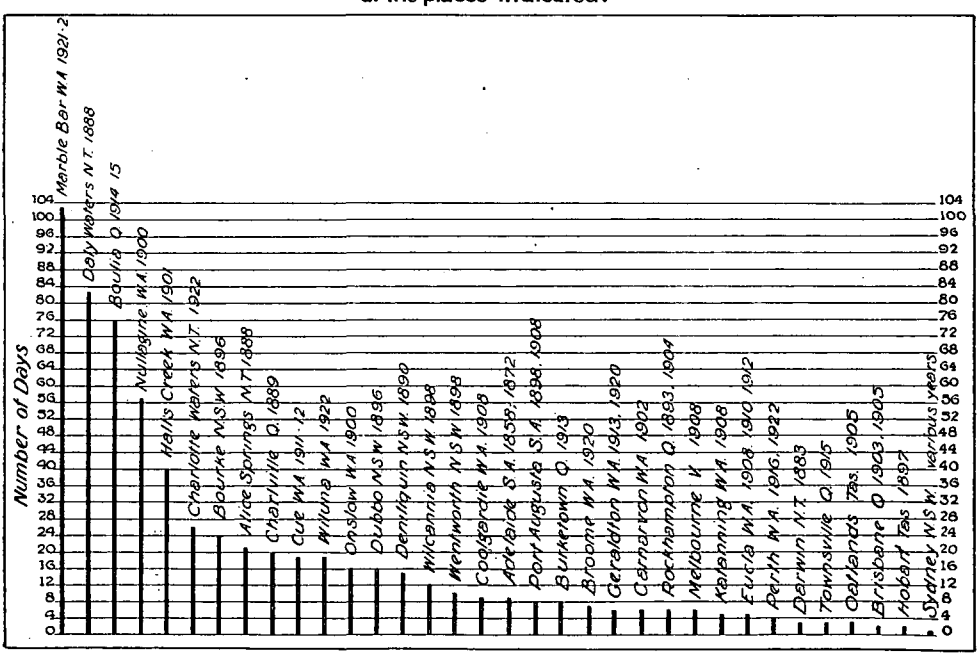
EXPLANATION.—The lines representing the yearly fluctuations of barometric pressure at the State capital cities are means for long periods, and are plotted from the Climatological Tables herein. The pressures are shown in inches on about 2½ times the natural scale, and the corresponding pressures in centimetres are also shown in the two inner columns, in which each division represents one millimetre.

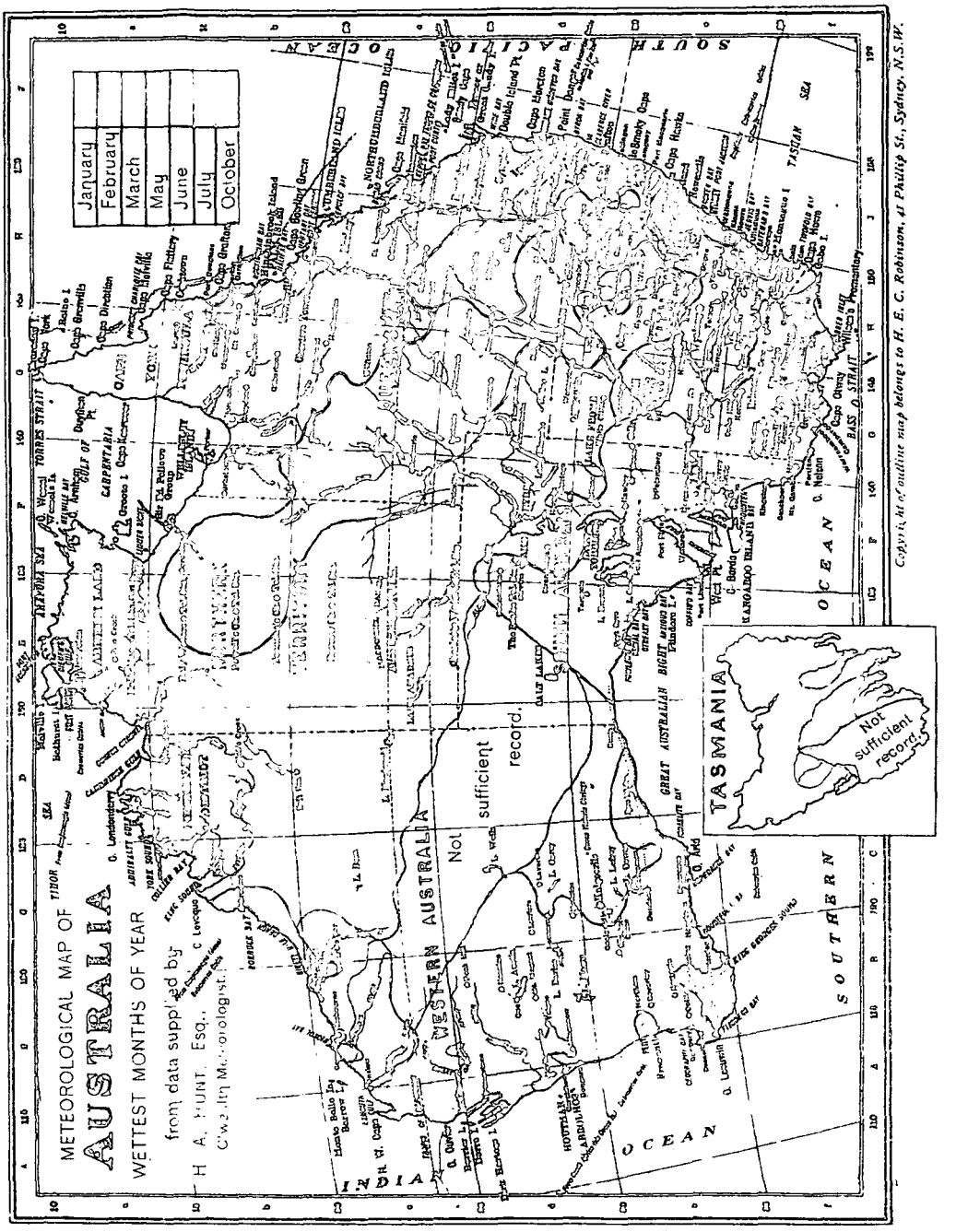
INTERPRETATION.—Taking the Brisbane graph for purposes of illustration, it will be seen that the mean pressure in the middle of January is about 29.87 inches, and there are maxima in the middle of May and August of about 30.09 inches.

Area affected and period of duration of the Longest Heat Waves when the Maximum Temperature for consecutive 24 hours reached or exeeeded 100° Fah.



Greatest number of consecutive days on which the Shade Temperature was over 100° Fah. at the places indicated.





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.

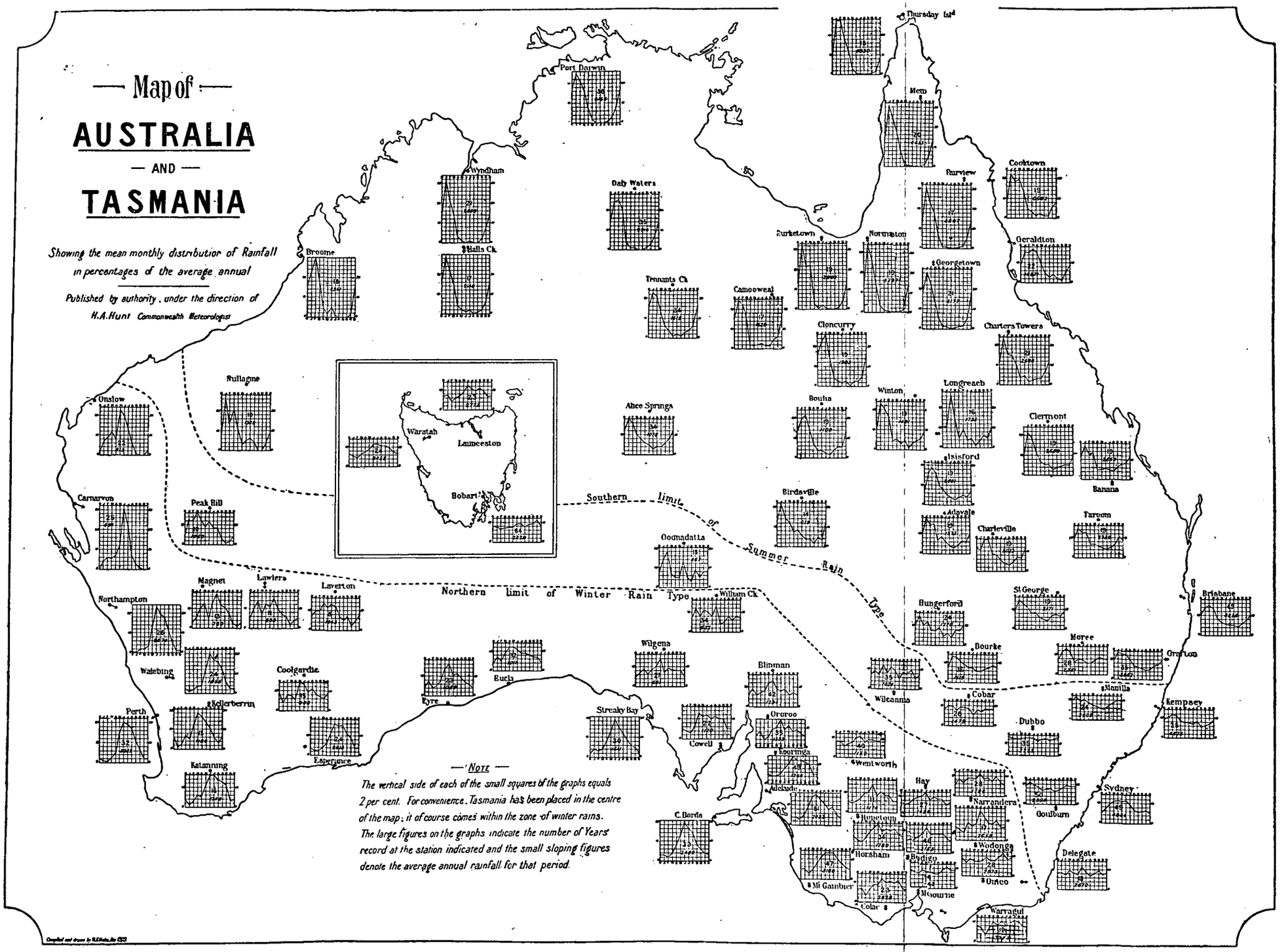
40. Gippsland.
41. North-East.
42. Central.

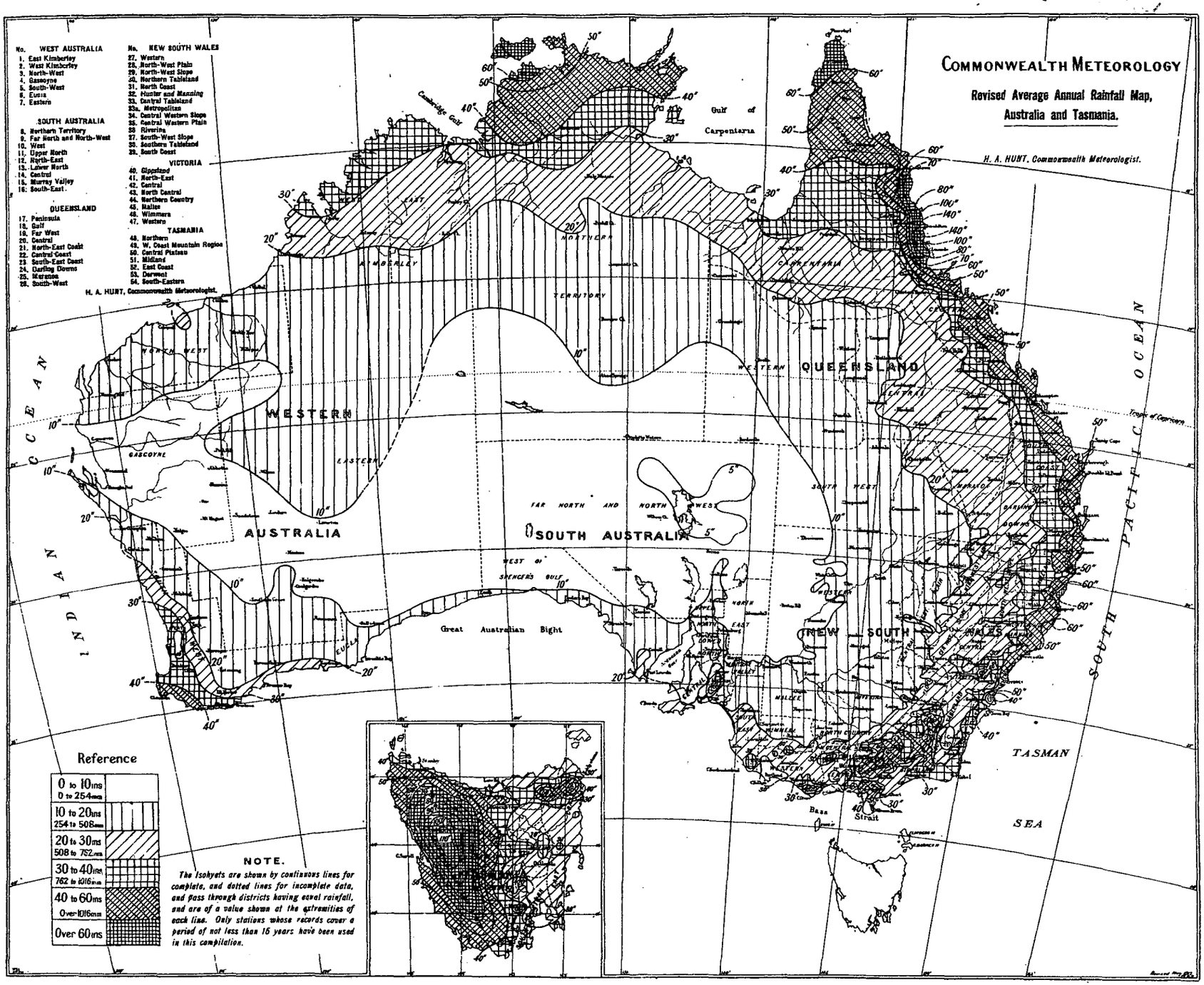
No.
43. North Central.
44. Northern Country.
45. Mallee.
46. Wimmera.
47. Western.

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.


— 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
Port Darwin
Thursday Isl
Mein
Wyndham
Daly Waters
Cooktown
Burketown
Normanton
Georgetown
Geraldton
Broome
Halls Ck
Tennants Ck
Camooweal
Cloncurry
Charters Towers
Onslow
Nullagine
Alice Springs
Boulia
Winton
Longreach
Clermont
Roma
Banana
Waratah
Launceston
Bobart
Carnarvon
Peak Hill
Southern limit of Summer Rain Type
Birdsville
Oodnadatta
Adavale
Charleville
Taroom
Northern limit of Winter Rain Type
Northampton
Magnet
Lawlers
Laverton
Wilkin Ck
Hungerford
St George
Brisbane
Bourke
Moree
Grafton
Wiluna
Blinman
Wilcannia
Cobar
Manilla
Kempsey
Dubbo
Coolgardie
Eucla
Eyre
Streaky Bay
Ororoo
Cowell
Wentworth
Hay
Narrandera
Sydney
Goulburn
Adelaide
Kooringa
Rutherglen
Wodonga
Delegate
Horsham
Bendigo
Mt Gambier
Melbourne
Colac
Warragul
C. Borda
Esperance
Katanning
Perth
Kellerberrin
Wallabing
— 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.


COMMONWEALTH METEOROLOGY
Revised Average Annual Rainfall Map, Australia and Tasmania.
H. A. HUNT, Commonwealth Meteorologist.
No. WEST AUSTRALIA
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 North-West
10. West
11. Upper North
12. North-East
13. Lower North
14. Central
15. Murray Valley
16. South-East.
QUEENSLAND
17. Peninsula
18. Gulf
19. Far West
20. Central
21. North-East Coast
22. Central-Coast
23. South-East Coast
24. Darling Downs
25. Maranoa
26. South-West
No. NEW SOUTH WALES
27. Western
28. North-West Plain
29. North-West Slope
30. Northern Tableland
31. North Coast
32. Hunter and Manning
33. Central Tableland
33a. Metropolitan
34. Central Western Slope
35. Central Western Plain
36 Riverina
37. South-West Slope
38. Southern Tableland
39. South Coast
VICTORIA
40. Gippsland
41. North-East
42. Central
43. North Central
44. Northern Country
45. Mallee
46. Wimmera
47. Western
TASMANIA
48. Northern
49. W. Coast Mountain Region
50. Central Plateau
51. Midland
52. East Coast
53. Derwent
54. South-Eastern
H. A. HUNT, Commonwealth Meteorologist.
INDIAN OCEAN
SOUTH PACIFIC OCEAN
TASMAN SEA
Gulf of Carpentaria
Cambridge Gulf
Great Australian Bight
Bass Strait
Tropic of Capricorn
WESTERN AUSTRALIA
SOUTH AUSTRALIA
NEW SOUTH WALES
WESTERN QUEENSLAND
NORTHERN TERRITORY
Reference
0 to 10ins 0 to 254mm
10 to 20ins 254 to 508mm
20 to 30ins 508 to 762mm
30 to 40ins 762 to 1016mm
40 to 60ins Over 1016mm
Over 60ins
NOTE.
The Isohyets are shown by continuous lines for complete, and dotted lines for incomplete data, and pass through districts having equal rainfall, and are of a value shown at the extremities of each line. Only stations whose records cover a period of not less than 16 years have been used in this compilation.

RAINFALL AND TEMPERATURE—VARIOUS CITIES.

Place.	Height above M.S.L.	Annual Rainfall.			Temperature.					
		Average.	Highest.	Lowest.	(a)Mean Summer.	(b)Mean Winter.	Highest on Record.	Lowest on Record.	Average Hottest Month.	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	33.33	4.56	79.2	49.1	109.4	19.6	81.0	47.4
Bergen	72	77.09	111.58	44.49	56.8	34.2	88.5	4.8	57.9	33.6
Berlin	161	22.72	30.04	14.25	64.8	33.0	98.6	−13.0	66.0	31.8
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	22.52	32.56	16.50	64.1	33.5	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 ..	82	38.78	79.72	20.04	72.7	50.9	103.1	22.3	73.8	50.0
Calcutta ..	21	61.82	98.48	38.43	85.6	68.0	108.2	44.2	86.0	66.4
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	33.28	45.86	24.52	70.0	26.1	103.0	−23.0	72.4	23.7
Christchurch ..	25	25.45	35.30	13.54	61.1	43.4	95.7	21.3	61.6	42.4
Christiania ..	75	23.23	32.21	16.26	61.0	24.5	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 ..	10	20.79	25.83	15.47	60 4	33.3	85.5	− 3.3	61.9	32.4
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 ..	149	23.50	35.54	16.38	62.0	39.5	100.0	6.9	63.5	38.5
Hong Kong ..	109	84.28	119.72	45.84	86.2	64.8	97.0	32.0	86.7	62.9
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 (Kew) ..	18	23.80	38.20	16.64	61.2	39.8	94.0	9.4	62.7	38.9
Madras	22	49.85	88.41	18.45	89.0	76.8	113.0	57.5	89.9	76.1
Madrid	2,149	16.23	27.48	9.13	73.0	41.2	107.1	10.5	75.7	39.7
Marseilles ..	246	22.24	43.03	12.28	70.5	45.3	100.4	11.7	72.3	44.6
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	44.63	58.68	33.17	71.4	31.8	102.0	−13.0	73.5	30.2
Ottawa	236	33.40	53.79	25.63	67.2	14.1	98.0	−33.0	69.7	12.0
Paris	164	22.64	29.57	16.46	63.5	37.2	101.1	−14.1	64.9	36.1
Pekin	143	24.40	36.00	18.00	77.7	26.6	114.0	− 5.0	79.2	23.6
Petrograd ..	16	21.30	29.52	13.75	61.1	17.4	97.0	−38.2	63.7	15.2
Quebec	296	40.50	53.79	32.12	63.5	12.4	96.0	−34.0	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	22.27	38.82	9.00	58.8	50.5	101.0	29.0	59.3	49.5
Shanghai ..	21	45.00	62.52	27.92	78.0	41.1	102.9	10.2	80.4	37.8
Singapore ..	8	91.99	158.68	32.71	81.2	78.6	94.2	63.4	81.5	78.3
Stockholm ..	144	19.09	28.27	11.81	59.5	27.3	96.8	−25.6	61.9	26.4
Tokio	65	61.45	86.37	45.72	74.8	39.2	97.9	17.2	77.7	37.5
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 ..	112	43.50	61.33	30.85	74.7	34.5	106.0	−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
Zürich	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	22.51	41.29	10.45	(a) 68.4	(b) 44.2	102.6	18.0	68.8	43.4
STATE CAPITALS.										
Perth	197	33.86	46.73	20.21	(a) 73.1	(b) 56.0	108.4	34.2	74.2	55.2
Adelaide ..	140	21.08	30.87	11.39	73.1	53.1	116.3	32.0	74.2	51.7
Brisbane	137	45.51	88.26	16.17	76.6	59.7	108.9	36.1	77.1	58.4
Sydney	133	47.91	82.76	21.49	71.0	54.1	108.5	35.9	71.6	52.6
Melbourne ..	115	25.65	44.25	15.61	66.6	50.0	111.2	27.0	67.6	48.6
Hobart	177	23.65	43.39	13.43	61.6	46.8	105.2	27.0	62.4	45.5

(a) Mean of the three hottest months. (b) 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 1922. These are given in the following tables :—

CLIMATOLOGICAL DATA—PERTH, WESTERN AUSTRALIA.

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. and 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 (inches).	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	38	25		25	25	25	24	25	26	26
January	29.907	797	27/98	0.68	11,225	S S E	10.42	1.8	2.7	13.9
February	29.922	650	6/08	0.63	9,868	S S E	8.58	1.6	2.9	11.6
March	29.987	651	6/13	0.53	9,957	S S E	7.64	1.4	3.2	12.0
April	30.075	955	25/00	0.40	8,361	S E	4.74	1.3	4.1	8.0
May	30.077	768	5/12	0.35	7,990	E N E	2.72	2.2	5.2	5.2
June	30.061	861	27/10	0.36	7,895	N	1.74	2.2	5.8	3.2
July	30.090	949	11/99	0.39	8,461	N	1.72	2.4	5.4	4.9
August	30.084	966	15/03	0.42	8,809	W	2.36	1.6	5.3	4.7
September	30.060	864	11/05	0.47	8,973	S W	3.30	1.3	4.9	5.7
October	30.032	809	6/16	0.53	9,907	S S W	5.25	1.1	4.8	6.0
November	29,988	777	18/97	0.60	10,214	S	7.63	1.4	3.8	7.9
December	29.926	776	6/22	0.65	10,974	S	9.78	1.7	3.0	12.1
Year Totals	—	—		—	—	—	65.88	20.0	—	95.2
Year Averages	30,017	—		0.50	9,386	S	—	—	4.3	—
Year Extremes	—	966	15/8/03	—	—	—	—	—	—	—

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature (Fahr.). Mean Max.	Mean Min.	Mean.	Extreme Shade Temperature (Fahr.). Highest.		Lowest.		Extreme Range.	Extreme Temperature (Fahr.). Highest in Sun.		Lowest on Grass.		Mean Hours of Sunshine.
No. of yrs. over which observation extends	26	26	26	26		26		26	24		24		25
January	84.5	63.3	73.9	108.4	28/21	49.9	1/21	58.5	177.3	22/14	40.4	1/21	321.0
February	84.9	63.5	74.2	107.3	12/15	47.7	1/02	59.6	169.0	4/99	39.8	1/13	272.5
March	81.4	60.9	71.2	106.4	14/22	45.8	8/03	60.6	167.0	19/18	36.7	8/03	270.6
April	75.9	57.0	66.4	99.7	9/10	39.3	20/14	60.4	157.0	8/16	31.0	20/14	219.8
May	68.6	52.4	60.5	90.4	2/07	34.3	11/14	56.1	141.0	2/21	25.3	11/14	178.7
June	63.9	49.5	56.7	81.7	2/14	35.0	30/20	46.7	135.5	9/14	26.5	30/20	144.4
July	62.6	47.7	55.2	76.4	21/21	34.2	7/16	42.2	133.2	13/15	25.1	30/20	167.4
August	63.8	48.1	56.0	81.0	12/14	35.3	31/08	45.7	145.1	29/21	27.9	10/11	186.0
September	66.1	50.2	58.2	90.9	30/18	38.9	17/13	52.0	153.6	29/16	29.2	21/16	203.8
October	69.4	52.7	61.0	95.3	30/22	40.9	4/17	54.4	154.0	29/14	30.5	4/17	237.7
November	75.4	56.6	66.0	104.6	24/13	42.0	1/04	62.6	166.6	23/15	35.5	(a)	287.8
December	80.6	60.5	70.6	107.9	20/04	48.0	2/10	59.9	168.7	25/15	39.0	12/20	324.1
Year Averages	73.1	55.2	64.2	—		—		—	—		—		2813.8b
Year Extremes	—	—	—	108.4	28/1/21	34.2	7/7/16	74.2	177.3	22/1/14	25.1	30/7/20	—

(a) 6/10 and 14/12. (b) Total for year.

HUMIDITY, RAINFALL, AND DEW.

Month.	Rel. Hum. (%) Mean 9 a.m.	Highest Mean.	Lowest Mean.	Rainfall (inches). Mean Monthly.	Mean No. of Days Rain.	Greatest Monthly.		Year.		Greatest in One Day.		Dew (inches). Mean Amount of Dew.	Mean No. Days Dew.
No. of yrs. over which observation extends	26	26	26	47	47	47		47		47		—	26
January	52	61	42	0.32	3	2.17	1879	nil	(a)	1.74	28/79	—	2.5
February	54	65	46	0.47	2	2.98	1915	nil	(a)	1.63	26/15	—	3.0
March	57	66	46	0.74	4	4.50	1896	nil	(a)	1.53	17/76	—	5.7
April	64	72	51	1.60	7	4.97	1882	nil	1920	2.62	30/04	—	9.0
May	72	81	61	4.91	14	12.13	1879	0.98	1903	2.80	20/79	—	12.4
June	78	83	72	6.80	17	12.11	1890	2.16	1877	3.90	10/20	—	12.0
July	78	84	72	6.54	17	10.90	1902	2.42	1876	3.00	4/91	—	13.3
August	74	79	67	5.68	18	10.33	1882	0.46	1902	2.79	7/03	—	11.2
September	68	75	58	3.33	15	7.72	1903	0.62	1914	1.73	23/09	—	9.3
October	62	75	54	2.10	12	7.87	1890	0.49	1892	1.38	15/10	—	5.3
November	55	63	46	0.78	6	2.78	1916	nil	1891	1.11	30/03	—	3.8
December	52	62	44	0.59	4	3.05	1888	nil	1886	1.72	1/88	—	2.9
Year Totals	—	—	—	33.86	119	—		—		—		—	90.4
Year Averages	62	—	—	—	—	—		—		—		—	—
Year Extremes	—	84	42	—	—	12.13	5/79	nil	(b)	3.90	10/6/20	—	—

(a) Various years. (b) January, February, March, November, and December, various years.

CLIMATOLOGICAL DATA—ADELAIDE, SOUTH AUSTRALIA.

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. and 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 (inches).	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	66	45	45	45	45	53	51	55	41
January	29.916	758 19/99	0.34	7,898	S	8.98	2.3	3.4	8.3
February	29.953	691 22/96	0.29	6,758	S	7.35	2.0	3.4	7.1
March	30.038	628 9/12	0.24	6,707	S	5.82	2.2	3.9	7.0
April	30.120	773 10/96	0.22	6,133	S x W	3.42	1.6	5.0	4.0
May	30.125	760 9/80	0.21	6,187	N x E	2.01	1.7	5.8	1.9
June	30.095	750 12/78	0.25	6,590	N	1.24	2.1	6.1	1.6
July	30.127	674 25/82	0.25	6,756	N	1.29	1.6	5.8	1.8
August	30.098	773 31/97	0.28	7,172	N N W	1.87	2.2	5.6	2.5
September	30.040	720 2/87	0.31	7,312	W	2.86	2.4	5.2	3.2
October	30.000	768 28/98	0.34	7,886	S W x W	4.77	3.4	4.9	4.0
November	29.974	677 2/04	0.33	7,554	S S W	6.54	3.6	4.6	5.1
December	29.918	675 12/91	0.34	7,924	S S W	8.41	2.4	3.8	7.3
Year Totals	—	—	—	—	—	54.56	27.5	—	53.8
Year Averages	30.034	—	0.28	7,073.1	S W x S	—	—	4.8	—
Year Extremes	—	773 (a)	—	—	—	—	—	—	—

(a) 10/4/96 and 31/8/97.

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature (Fahr.). Mean Max.	Mean Min.	Mean.	Extreme Shade Temperature (Fahr.). Highest.	Lowest.	Extreme Range.	Extreme Temperature (Fahr.). Highest in Sun.	Lowest on Grass.	Mean Hours of Sunshine.
No. of yrs. over which observation extends	66	66	66	66	66	66	45	62	41
January	86.4	61.6	74.0	116.3 26/58	45.1 21/84	71.2	180.0 18/82	36.5 14/79	310.6
February	86.2	62.1	74.2	113.6 12/99	45.5 23/18	68.1	170.5 10/00	36.7 (c)	264.3
March	80.8	58.9	69.8	108.0 12/61	44.8 –/57	63.2	174.0 17/83	33.8 27/80	239.9
April	73.2	54.6	63.9	98.0 10/66	39.6 15/59	58.4	155.0 1/83	30.2 16/17	177.5
May	65.6	50.2	57.9	89.5 4/21	36.9 (a)	52.6	148.2 12/79	25.9 10/91	147.8
June	60.3	46.7	53.5	76.0 23/65	32.5 27/76	43.5	138.8 18/79	22.9 12/13	121.6
July	58.8	44.5	51.7	74.0 11/06	32.0 24/08	42.0	134.5 26/90	23.3 25/11	138.4
August	62.0	45.9	54.0	85.0 31/11	32.3 17/59	52.7	140.0 31/92	23.5 7/88	163.4
September	66.3	47.9	57.1	90.7 23/82	32.7 4/58	58.0	160.5 23/82	26.2 15/08	184.1
October	72.5	51.4	62.0	102.9 21/22	36.0 –/57	66.9	162.0 30/21	27.8 2/18	228.5
November	78.7	55.4	67.0	113.5 21/65	40.8 2/09	72.7	166.9 20/78	31.5 2/09	262.2
December	83.4	59.0	71.2	114.2 14/76	43.0 (b)	71.2	175.7 7/99	32.5 4/84	303.5
Year Averages	72.8	53.2	63.0	—	—	—	—	—	2541.8d
Year Extremes	—	—	—	116.3 26/1/58	32.0 24/7/08	84.3	180.0 18/1/82	22.9 12/6/13	—

(a) 26/1895 and 24/1904. (b) 16/1861 and 4/1906. (c) 24/78 and 23/18. (d) Total for year.

HUMIDITY, RAINFALL, AND DEW.

Month.	Rel. Hum. (%) Mean 9 a.m.	Highest Mean.	Lowest Mean.	Rainfall (inches). Mean Monthly.	Mean No. of Days Rain.	Greatest Monthly.	Least Monthly.	Greatest in One Day.	Dew (inches). Mean Amount of Dew.	Mean No. Days Dew.
No. of yrs. over which observation extends	55	55	55	84	84	84	84	84	—	51
January	38	59	30	0.73	4	4.00 1850	nil (a)	2.30 2/89	—	4.2
February	40	56	31	0.64	4	2.89 1919	nil (b)	2.24 14/13	—	5.7
March	47	58	36	1.05	6	4.60 1878	nil (c)	3.50 5/78	—	11.1
April	56	72	44	1.78	9	6.78 1853	0.06 1910	3.15 5/60	—	13.9
May	68	76	49	2.74	13	7.75 1875	0.20 1891	2.75 1/53	—	15.8
June	77	84	69	3.11	16	8.58 1916	0.42 1886	2.11 1/20	—	15.8
July	76	87	68	2.65	16	5.38 1865	0.37 1899	1.75 10/65	—	17.3
August	69	77	54	2.52	16	6.24 1852	0.35 1914	2.23 19/51	—	16.5
September	61	72	44	1.98	14	4.64 1840	0.45 1896	1.42 (d)	—	15.7
October	51	67	29	1.73	11	3.83 1870	0.17 1914	2.24 16/08	—	12.7
November	43	57	31	1.16	8	3.55 1851	0.04 1885	1.88 28/58	—	7.1
December	39	50	33	0.99	6	3.98 1861	nil 1904	2.42 23/13	—	4.8
Year Totals	—	—	—	21.08	123	—	—	—	—	140.6
Year Averages	53	—	—	—	—	—	—	—	—	—
Year Extremes	—	87	29	—	—	8.58 6/16	nil (e)	3.50 5/3/78	—	—

(a) 1848, &c. (b) 1848, &c. (c) 1859, &c. (d) 25/93 and 12/17.

CLIMATOLOGICAL DATA—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. Min. Sea Level and Standard Gravity from 9 a.m. and 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 (Inches).	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.	36	12	12	12	36	14	36	31	14
January	29.872	361 1/22	0.11	4,599	E & S E	6.562	5.5	5.7	3.1
February	29.902	347 5/22	0.14	4,525	S E	5.219	5.1	5.5	1.9
March	29.958	305 29/16	0.09	4,161	S E & S	4.778	4.3	5.2	5.1
April	30.050	335 6/21	0.08	3,700	S	3.707	3.2	4.5	8.2
May	30.088	307 20/22	0.07	3,641	S	2.824	3.3	4.4	8.4
June	30.066	307 23/16	0.07	3,467	S	2.125	2.2	4.2	8.0
July	30.070	311 18/22	0.07	3,592	S to W	2.329	2.4	3.7	11.6
August	30.095	306 5/22	0.08	3,866	S	2.919	3.5	3.5	12.0
September	30.039	269 19/21	0.07	3,569	S	3.697	5.8	3.6	11.6
October	30.005	325 25/18	0.09	3,981	N E	5.159	6.9	4.0	8.0
November	29.957	272 22/21	0.11	4,346	N E	5.995	8.2	4.7	6.3
December	29.886	295 21/13	0.12	4,661	N E	6.619	8.6	5.2	3.6
Year Totals	—	—	—	—	S to E	51.933	59.0	—	87.8
Year Averages	29.999	—	0.09	4,009	and N E	—	—	4.5	—
Year Extremes	—	361 1/1/22	—	—	—	—	—	—	—

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature (Fahr.). Mean Max.	Mean Min.	Mean.	Extreme Shade Temperature (Fahr.). Highest.	Lowest.	Extreme Range.	Extreme Temperature (Fahr.). Highest in Sun.	Lowest on Grass.	Mean Hours of Sunshine.
No. of yrs. over which observation extends	36	36	36	36	36	36	36	36	14
January	85.4	68.8	77.1	108.9 14/02	58.8 4/93	50.1	166.4 10/17	49.9 4/93	219.2
February	84.4	68.2	76.3	101.9 11/04	58.7 (a)	43.2	165.2 6/10	49.3 9/89	199.9
March	82.3	66.3	74.3	99.4 5/19	52.4 29/13	47.0	160.0 1/87	45.4 29/13	204.4
April	79.1	61.6	70.4	95.2 (b)	48.6 17/00	46.6	153.8 11/16	37.0 17/00	206.4
May	73.5	55.4	64.4	88.8 18/97	41.3 24/99	47.5	147.0 1/10	29.8 8/97	191.6
June	69.4	51.0	60.2	88.9 19/18	36.3 29/08	52.6	136.0 3/18	25.4 23/88	161.9
July	68.4	48.4	58.4	83.4 28/98	36.1 (c)	47.3	146.1 20/15	23.9 11/90	192.5
August	71.1	49.8	60.4	87.5 28/07	37.4 6/87	50.1	141.9 20/17	27.1 9/99	229.3
September	75.7	54.8	65.2	95.2 16/12	40.7 1/96	54.5	155.5 26/03	30.4 1/89	229.0
October	79.8	59.9	69.8	101.4 18/93	43.3 3/99	58.1	157.4 31/18	34.9 8/89	248.0
November	83.0	64.2	73.6	106.1 18/13	48.5 2/05	57.6	162.3 7/89	38.8 1/05	241.8
December	85.3	67.5	76.4	105.9 26/93	56.4 13/12	49.5	160.4 7/14	49.1 3/94	241.5
Year Averages	78.1	59.7	68.9	—	—	—	—	—	2565.5d
Year Extremes	—	—	—	108.9 14/1/02	36.1 (c)	72.8	166.4 10/1/17	23.9 11/7/90	—

(a) 10 and 11/04. (b) 9/96 and 5/03. (c) 12/94 and 2/96. (d) Total for year.

HUMIDITY, RAINFALL, AND DEW.

Month.	Rel. Hum. (%) Mean 9 a.m.	Highest Mean.	Lowest Mean.	Rainfall (inches). Mean Monthly.	Mean No. of Days Rain.	Greatest Monthly.	Least Monthly.	Greatest in One Day.	Dew (inches). Mean Amount of Dew.	Mean No. Days Dew.
No. of yrs. over which observation extends	36	36	36	71	63	71	71	—	—	36
January	67	79	53	6.42	14	27.72 1895	0.32 1919	18.31 21/87	—	5.5
February	71	82	55	6.35	14	40.39 1893	0.58 1849	8.36 16/93	—	5.6
March	72	85	56	5.84	15	34.04 1870	nil 1849	11.18 14/08	—	9.0
April	74	80	60	3.59	12	15.28 1867	0.04 1847	4.47 13/16	—	11.8
May	74	85	64	2.88	10	13.85 1876	nil 1846	5.62 9/79	—	12.6
June	74	84	67	2.64	9	14.03 1873	nil 1847	6.01 9/93	—	10.6
July	75	81	61	2.31	8	8.46 1889	nil 1841	3.54 (b)	—	12.1
August	70	80	61	2.14	7	14.67 1879	nil (a)	4.89 12/87	—	10.0
September	65	76	47	2.10	9	5.43 1886	0.10 1907	2.46 2/94	—	9.7
October	61	72	49	2.62	9	9.99 1882	0.14 1900	1.95 20/89	—	8.1
November	60	72	46	3.66	10	12.40 1917	nil 1842	4.46 16/86	—	4.9
December	63	68	52	4.96	12	13.99 1910	0.35 1865	6.60 28/71	—	4.3
Year Totals	—	—	—	45.51	129	—	—	—	—	104.2
Year Averages	69	—	—	—	—	—	—	—	—	—
Year Extremes	—	85	46	—	—	40.39 2/1893	nil (c)	18.31 21/1/87	—	—

(a) 1862, 1869, 1880. (b) 15/76, 16/89. (c) March, May, June, July, August, and November, various years.

CLIMATOLOGICAL DATA—SYDNEY, NEW SOUTH WALES.

LAT. 33° 52′ S., LONG. 151° 12′ E. HEIGHT ABOVE M.S.L., 133 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.				Mean Amount of Evaporation (inches).	No. of Days Lightning.	Mean Amount of Clouds, 9 a.m., 3 p.m. & 9 p.m.	No. of Clear Days.
		Greatest Number of Miles in One Day.	Mean Hourly Pressure. (lbs.)	Total Miles.	Prevailing Direction.				
No. of yrs. over which observation extends	64	56	56	56	56	43	63	61	59
January	29.901	721 1/71	0.36	8,111	N E	5.241	4.8	5.8	2.2
February	29.945	871 12/69	0.32	6,977	N E	4.110	4.2	6.0	1.5
March	30.012	943 20/70	0.25	6,767	N E	3.553	4.1	5.5	2.3
April	30.073	803 6/82	0.22	6,094	N E	2.532	3.9	5.0	3.1
May	30.082	758 6/98	0.22	6,322	W	1.745	3.3	4.8	3.7
June	30.058	712 7/00	0.27	6,876	W	1.412	2.2	4.8	4.0
July	30.074	930 17/79	0.27	7,083	W	1.507	2.4	4.4	4.8
August	30.069	756 22/72	0.25	6,842	W	1.871	3.2	4.0	5.3
September	30.009	964 6/74	0.29	7,077	W	2.643	4.0	4.4	4.4
October	29.972	926 4/72	0.32	7,723	N E	3.801	5.0	5.0	2.8
November	29.939	720 13/68	0.33	7,548	N E	4.533	5.5	5.6	1.9
December	29.880	938 3/84	0.34	7,991	N E	5.310	5.7	5.6	2.2
Year Totals	—	—	—	—	—	38.258	48.3	—	38.2
Year Averages	30.001	—	0.29	7,118	N E	—	—	5.1	—
Year Extremes	—	964 6/9/74	—	—	—	—	—	—	—

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature (Fahr.).			Extreme Shade Temperature (Fahr.).		Extreme Range.	Extreme Temperature (Fahr.).		Mean Hours of Sunshine.
	Mean Max.	Mean Min.	Mean.	Highest.	Lowest.		Highest in Sun.	Lowest on Grass.	
No. of yrs. over which observation extends	64	64	64	64	64	64	61	64	12
January	78.4	64.9	71.6	108.5 13/96	51.2 14/65	57.3	164.3 26/15	44.2 18/97	201.8
February	77.5	64.9	71.2	101.0 19/66	49.3 28/63	51.7	156.5 7/64	43.4 25/91	178.4
March	75.6	62.9	69.2	102.6 3/69	48.8 14/86	53.8	158.0 19/11	39.9 17/13	191.9
April	71.2	58.1	64.6	91.0 20/22	44.6 27/64	46.4	144.1 10/77	33.3 24/09	149.7
May	65.2	52.2	58.7	86.0 1/19	40.2 22/59	45.8	129.7 1/96	29.3 25/17	131.4
June	60.9	48.2	54.6	75.5 13/19	38.0 5/20	37.5	123.0 14/78	28.1 24/11	121.6
July	59.3	45.9	52.6	74.9 17/71	35.9 12/90	39.0	124.7 19/77	24.0 4/93	132.4
August	62.5	47.5	55.0	82.0 31/84	36.8 3/72	45.2	149.0 30/78	26.1 4/09	183.2
September	66.8	51.5	59.2	92.3 27/19	40.8 18/64	51.5	142.2 12/78	30.1 17/05	184.2
October	71.2	55.8	63.5	99.7 19/98	42.3 3/18	57.4	151.9 (a)	32.7 9/05	203.7
November	74.5	59.7	67.1	102.7 21/78	45.8 1/05	56.9	158.5 28/99	36.0 6/06	190.8
December	77.3	63.0	70.2	107.5 31/04	49.3 2/59	58.2	164.5 27/89	41.5 6/09	198.6
Year Averages	70.0	56.2	63.1	—	—	—	—	—	2067.7b
Year Extremes	—	—	—	108.5 13/1/96	35.9 12/7/90	72.6	164.5 27/12/89	24.0 4/7/93	—

(a) 30 and 31/14. (b) Total for year.

HUMIDITY, RAINFALL, AND DEW.

Month.	Rel. Hum. (%)			Rainfall (inches).					Dew (inches).	
	Mean 9 a.m.	Highest Mean.	Lowest Mean.	Mean Monthly.	Mean No. of Days Rain.	Greatest Monthly.	Least Monthly.	Greatest in One Day.	Mean Amount of Dew.	Mean No. Days Dew.
No. of yrs. over which observation extends	64	64	64	64	64	64	64	64	60	61
January	69	78	58	3.67	14.2	15.26 1911	0.42 1888	7.08 13/11	0.002	1.2
February	72	81	59	4.42	14.0	18.56 1873	0.34 1902	8.90 25/73	0.004	2.0
March	74	85	62	4.97	14.9	18.70 1870	0.42 1876	6.52 9/13	0.008	3.3
April	77	87	63	5.33	13.3	24.49 1861	0.06 1868	7.52 29/60	0.016	5.5
May	76	90	66	5.14	15.0	23.03 1919	0.18 1860	8.36 28/89	0.022	6.2
June	78	89	68	4.84	12.6	16.30 1885	0.19 1904	5.17 16/84	0.018	5.3
July	77	88	65	4.97	12.5	13.21 1900	0.12 1862	5.72 28/08	0.016	5.3
August	73	84	56	3.01	11.3	14.89 1899	0.04 1885	5.33 2/60	0.014	4.9
September	69	79	49	2.91	12.0	14.05 1879	0.08 1882	5.69 10/79	0.008	3.4
October	66	77	46	2.96	12.5	11.14 1916	0.21 1867	6.37 13/02	0.007	3.0
November	66	79	42	2.84	12.3	9.89 1865	0.07 1915	4.23 19/00	0.004	2.1
December	67	77	52	2.85	13.0	15.82 1920	0.23 1913	4.75 13/10	0.003	1.4
Year Totals	—	—	—	47.91	157.6	—	—	—	0.122	43.6
Year Averages	72	—	—	—	—	—	—	—	—	—
Year Extremes	—	90	42	—	—	24.49 April/61	0.04 Aug./85	8.90 25/2/73	—	—

CLIMATOLOGICAL DATA—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 from 9 a.m., 3 & 9 p.m. readings.	Wind.			Mean Amount of Evaporation (inches).	No. of Days Lightning.	Mean Amount of Clouds, 9 a.m., 3 p.m. & 9 p.m.	No. of Clear Days.
		Greatest Number of Miles in One Day.	Mean Hourly Pressure. (lbs.)	Total Miles.	Prevailing Direction.			
No. of yrs. over which observation extends	65	49	49	49	49	50	15	65	15
January	29.913	583 10/97	0.29	7,345	S W, S E	6.42	1.7	5.0	7.5
February	29.962	566 8/68	0.28	6,441	S W, S E	5.07	2.5	5.0	7.1
March	30.033	677 9/81	0.22	6,398	S W, S E	3.96	1.6	5.5	5.3
April	30.103	597 7/68	0.19	5,719	S W, N W	2.37	0.9	5.9	4.1
May	30.106	693 12/65	0.19	5,958	N W, N E	1.46	0.6	6.5	3.3
June	30.074	761 13/76	0.24	6,461	N W, N E	1.10	0.8	6.7	2.3
July	30.093	755 8/74	0.23	6,482	N W, N E	1.06	0.6	6.3	3.4
August	30.065	637 14/75	0.26	6,882	N W, N E	1.47	1.1	6.3	2.9
September	29.999	617 11/72	0.29	7,108	N W, S W	2.31	1.7	6.1	3.8
October	29.968	899 5/66	0.29	7,377	S W, N W	3.34	1.8	6.0	4.4
November	29.949	734 13/66	0.29	7,083	S W, S E	4.55	2.4	5.9	3.7
December	29.896	655 1/75	0.30	7,503	S W, S E	5.76	1.9	5.5	4.3
Year Totals	—	—	—	—	—	38.87	17.6	—	52.1
Year Averages	30.013	—	0.26	6,730	S W, N W	—	—	5.9	—
Year Extremes	—	899 5/10/66	—	—	—	—	—	—	—

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature (Fahr.).			Extreme Shade Temperature (Fahr.).		Extreme Range.	Extreme Temperature (Fahr.).		Mean Hours of Sunshine.
	Mean Max.	Mean Min.	Mean.	Highest.	Lowest.		Highest in Sun.	Lowest on Grass.	
No. of yrs. over which observation extends	67	67	67	67	67	67	63	63	41
January	78.2	56.8	67.5	111.2 14/62	42.0 28/85	69.2	178.5 14/62	30.2 28/85	268.8
February	78.0	57.1	67.6	109.5 7/01	40.3 9/65	69.2	167.5 15/70	30.9 6/91	245.5
March	74.4	54.6	64.5	105.5 2/93	37.1 17/84	68.4	164.5 1/68	28.9 (a)	208.4
April	68.4	50.7	59.5	94.0 (c)	34.8 24/88	59.2	152.0 8/61	25.0 23/97	163.5
May	61.4	46.7	54.1	83.7 7/05	29.9 29/16	53.8	142.6 2/59	21.1 26/16	142.0
June	56.8	44.0	50.4	72.2 1/07	28.0 11/66	44.2	120.0 11/61	20.4 17/95	112.8
July	55.6	41.7	48.6	68.4 24/78	27.0 21/69	41.4	125.8 27/80	20.5 12/03	106.9
August	58.7	43.4	51.0	77.0 20/85	28.3 11/63	48.7	137.4 29/69	21.3 14/02	155.8
September	62.6	45.6	54.1	85.0 19/19	31.1 16/08	53.9	142.1 20/67	22.8 8/18	174.0
October	67.0	48.2	57.6	98.4 24/14	32.1 3/71	66.3	154.3 28/68	24.8 22/18	208.7
November	71.4	51.2	61.2	105.7 27/94	36.5 2/96	69.2	159.6 29/65	24.6 2/96	246.5
December	75.4	54.2	64.8	110.7 15/76	40.0 4/70	70.7	170.3 20/69	33.2 1/04	258.2
Year Averages	67.3	49.5	58.4	—	—	—	—	—	2291.1(b)
Year Extremes	—	—	—	111.2 14/1/62	27.0 21/7/69	84.2	178.5 14/1/62	20.4 17/6/95	—

(a) 17/1884 and 20/1897. (b) Total for year. (c) 6/1865 and 17/1922.

HUMIDITY, RAINFALL, AND DEW.

Month.	Rel. Hum. (%)			Rainfall (inches).					Dew (inches).	
	Mean 9 a.m.	Highest Mean.	Lowest Mean.	Mean Monthly.	Mean No. of Days Rain.	Greatest Monthly.	Least Monthly.	Greatest in One Day.	Mean Amount of Dew.	Mean No. Days Dew.
No. of yrs. over which observation extends	15	15	15	67	67	67	67	67	—	15
January	58	65	50	1.87	7	5.68 1904	0.04 1878	2.97 9/97	—	2.3
February	61	69	53	1.73	7	6.24 1904	0.03 1870	3.37 18/19	—	3.0
March	64	71	57	2.20	9	7.50 1911	0.18 1859	3.55 5/19	—	7.3
April	71	78	66	2.22	11	6.71 1901	0.33 1908	2.28 22/01	—	8.1
May	79	84	73	2.20	13	4.31 1862	0.45 1901	1.85 7/91	—	8.6
June	83	87	77	2.09	14	4.51 1859	0.73 1877	1.74 21/04	—	8.4
July	82	86	76	1.85	14	7.02 1891	0.57 1902	2.71 12/91	—	10.3
August	76	82	70	1.85	14	3.59 1909	0.48 1903	1.87 17/81	—	7.7
September	69	76	60	2.47	14	7.93 1916	0.52 1907	2.62 12/80	—	6.4
October	62	67	56	2.63	13	7.61 1869	0.29 1914	3.00 17/69	—	6.2
November	60	69	52	2.23	11	6.71 1916	0.25 1895	2.57 16/76	—	1.7
December	57	69	51	2.31	9	7.18 1863	0.11 1904	2.62 28/07	—	1.5
Year Totals	—	—	—	25.65	136	—	—	—	—	71.5
Year Averages	68	—	—	—	—	—	—	—	—	—
Year Extremes	—	87	50	—	—	7.93 9/16	0.03 2/70	3.55 5/3/19	—	—

CLIMATOLOGICAL DATA—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. Min. Sea Level and Standard Gravity from 9 a.m. and 3 p.m. readings.	Wind. Greatest Number of Miles in One Day.		Wind. Mean Hourly Pressure. (lbs.)	Wind. Total Miles.	Wind. Prevailing Direction. 9 a.m.	Wind. Prevailing Direction. 3 p.m.	Mean Amount of Evaporation (inches).	No. of Days Lightning.	Mean Amount of Cloud, 9 a.m., 3 p.m. & 9 p.m.	No. of Clear Days.
No. of yrs. over which observation extends	38	12		12	12	16		12	15	60	16
January	29.835	500	30/16	0.19	5,911	N N W	S E	5.206	0.9	5.9	2.7
February	29.928	393	19/13	0.13	4,476	N N W	S E	3.804	1.3	5.9	2.6
March	29.937	407	16/21	0.13	4,930	N N W	S E	3.041	1.2	5.9	2.1
April	29.957	475	12/22	0.14	4,988	N N W	N W	2.054	0.8	6.1	1.6
May	29.992	411	3/16	0.12	4,660	N N W	N N W	1.379	0.5	6.0	2.2
June	29.943	569	27/20	0.13	4,753	N N W	N N W	0.894	0.7	6.1	1.7
July	29.930	425	16/21	0.12	4,749	N N W	N N W	0.888	0.7	5.7	2.7
August	29.927	459	30/11	0.13	4,906	N N W	N N W	1.213	0.6	5.9	2.0
September	29.851	516	26/15	0.18	5,616	N N W	N W	2.022	0.9	6.1	1.8
October	29.840	461	8/12	0.18	5,811	N N W	S E	3.160	0.8	6.3	1.7
November	29.800	508	18/15	0.19	5,844	N N W	S E	4.115	1.0	6.3	1.6
December	29.807	486	30/20	0.18	5,693	N N W	S E	4.597	1.3	6.2	1.2
Year Totals	—	—		—	—	—		32.373	10.7	—	23.9
Year Averages	29.896	—		0.15	5,195	N N W	S E & N N W	—	—	6.0	—
Year Extremes	—	569	27/6/20	—	—	—		—	—	—	—

TEMPERATURE AND SUNSHINE.

Month.	Mean Temperature (Fahr.). Mean Max.	Mean Min.	Mean.	Extreme Shade Temperature (Fahr.). Highest.	Lowest.	Extreme Range.	Extreme Temperature (Fahr.). Highest in Sun.	Lowest on Grass.	Mean Hours of Sunshine.
No. of yrs. over which observation extends	52	52	52	76	76	76	35	55	28
January	71.4	53.0	62.2	105.0 1/00	40.3 (a)	64.7	160.0 (b)	30.6 19/97	209.3
February	71.5	53.3	62.4	104.4 12/99	39.0 20/87	65.4	165.0 24/98	28.3 –/87	176.4
March	68.0	50.8	59.4	98.8 5/46	36.0 31/05	62.8	150.0 3/05	27.5 30/02	171.4
April	62.7	47.6	55.2	90.0 2/56	30.0 25/56	60.0	142.0 18/93	25.0 –/86	138.7
May	57.3	43.6	50.4	77.5 1/41	29.2 20/02	48.3	128.0 (c)	20.0 19/02	131.0
June	52.8	41.0	46.9	75.0 7/74	28.0 22/79	47.0	122.0 12/94	21.0 6/87	102.5
July	51.9	39.2	45.5	72.0 22/77	27.0 18/66	45.0	118.7 19/96	18.7 16/86	124.3
August	55.0	41.0	48.0	77.0 3/76	30.0 10/73	47.0	129.0 –/87	20.1 7/09	140.1
September	58.8	43.1	51.0	80.0 9/72	30.0 12/41	50.0	138.0 23/93	22.7 –/86	144.8
October	62.8	45.4	54.1	92.0 24/14	32.0 12/89	60.0	156.0 9/93	23.8 (d)	168.6
November	66.2	48.3	57.3	98.0 20/88	35.2 5/13	62.8	158.0 18/21	26.0 1/08	197.4
December	69.4	51.2	60.3	105.2 30/97	38.0 13/06	67.2	161.0 24/20	27.2 –/86	190.9
Year Averages	62.3	46.5	54.4	—	—	—	—	—	1895.4
Year Extremes	—	—	—	105.2 30/12/97	27.0 18/7/66	78.2	165.0 24/2/98	18.7 16/7/86	—

(a) 3/72 and 2/06. (b) 5/86 and 13/05. (c) –/88 and –/92. (d) 1/86 and –/99.

HUMIDITY, RAINFALL, AND DEW.

Month.	Rel. Hum. (%) Mean 9 a.m.	Highest Mean.	Lowest Mean.	Rainfall (inches). Mean Monthly.	Mean No. of Days Rain.	Greatest Monthly.	Least Monthly.	Greatest in One Day.	Dew (inches). Mean Monthly.	Mean No. of Days.
No. of yrs. over which observation extends	39	39	39	80	79	80	80	56	—	13
January	63	77	51	1.79	10	5.91 1893	0.03 1841	2.96 30/16	—	0.8
February	65	80	51	1.45	8	9.15 1854	0.07 1847	4.50 25/54a	—	2.0
March	68	78	58	1.68	10	7.60 1854	0.02 1843	2.79 5/19	—	4.0
April	73	84	61	1.88	11	6.50 1909	0.07 1904	5.02 20/09	—	9.5
May	78	88	68	1.84	13	6.37 1905	0.10 1843	3.22 14/58	—	13.2
June	82	92	68	2.19	14	8.15 1889	0.22 1852	4.11 14/89	—	7.7
July	80	88	72	2.20	14	6.02 1922	0.30 1850	2.51 18/22	—	8.2
August	77	85	64	1.84	14	10.16 1858	0.23 1854	4.35 12/58	—	8.1
September	71	82	60	2.10	14	7.14 1844	0.39 1847	3.50 29/44	—	4.3
October	66	80	51	2.22	15	6.67 1906	0.26 1850	2.58 4/06	—	3.2
November	63	78	50	2.46	14	8.92 1849	0.16 1868	3.97 6/49	—	1.4
December	61	79	49	2.00	11	9.00 1875	0.11 1842	2.48 13/16	—	0.8
Year Totals	—	—	—	23.65	148	—	—	—	—	63.2
Year Averages	70	—	—	—	—	—	—	—	—	—
Year Extremes	—	92	49	—	—	10.16 8/1858	0.02 3/1843	5.02 20/4/09	—	—

(a) 4.18 on 26/54 also.

§ 3. Australian Hurricanes and Related Storms.*

1. **Types of Windstorms.**—Almost every country has occasional destructive windstorms, and Australia is no exception to the rule. In Australia there are five chief sorts of windstorms: (*a*) the gales which frequently occur about deep southern depressions, "lows" or southern cyclones; (*b*) squall winds, which normally occur in violent thunderstorms; (*c*) the "southerly bursters" and related "line squalls"; (*d*) tornadoes, "cock-eyed bobs," "cyclones," or "twisters"; (*e*) hurricanes or "willy-willies," and related tropical cyclonic storms. In addition, there are innumerable dust whirlwinds, which rarely cause serious damage. Of the five chief types enumerated, high latitude cyclones seldom cause much destruction, although, at times, they give ships a stormy passage across the Bight, through Bass Straits, or in the Tasman Sea, especially in winter. The second, or thunder-squall winds, are most frequent in summer, and towards the north. They occasionally unroof houses, blow down trees, or, while they last, give shipmasters an anxious time. The "southerly burster" is a sudden shift of the wind to the south or south-west, and is most frequent and violent along the coast of New South Wales. Occasionally, however, it occurs so far north as Brisbane, and similar sudden shifts of winds are very common. Most of the southerly bursters of gale force accompany the passage eastward of a southern cyclonic system having V-shaped isobars on its northern side. Gales of considerable severity occasionally occur in southerly bursters on the New South Wales coast, and have caused shipwrecks, especially in the days of sailing vessels, and frequently unroofed houses.

The fourth type of windstorm, the tornado, is often very destructive in the area it covers, but fortunately its effects are confined within narrow limits, seldom more than a fraction of a mile wide, or more than a few miles long. As is the case in respect to all types of storms, tornadoes vary in severity. Some cause little more damage than a sharp thunder-squall, while others demolish everything in their paths, twisting off even large trees. Tornadoes are relatively frequent in Australia, especially in summer and in the tropical portions, although they occur occasionally in all parts of the continent. They usually accompany tropical disturbances or "lows." It is not known how frequent they are, since many, because of their small size, do no appreciable damage in the vast sparsely-settled portions of the continent, and are not reported. Indeed, most of them are reported from the south-eastern better-settled part of the continent, although it is practically certain that they are more frequent elsewhere. On an average about 50 a year are reported in the United States. Judging from the numbers recorded, it appears possible that there are as many in Australia.

2. **The Tropical Cyclone or Hurricane.**—The type of storm with which this article is primarily concerned—the tropical cyclone or hurricane—is somewhat similar to the tornado, but affects a far wider strip. Indeed, hurricanes often produce gales throughout a belt three hundred miles wide, and sometimes an area a thousand miles wide will experience them. Furthermore, the hurricane travels for hundreds and sometimes for thousands of miles. Instead of affecting any spot for a few minutes only, as is the case with the tornado and the thunder-squall, its passage normally takes several hours, and sometimes, in the case of slow-moving storms, a day or two. The hurricane, however, is nowhere as powerful as a well-developed tornado. Instead of twisting off all the trees, for example, the hurricane usually uproots a few, breaks off some branches, and strips the leaves. Moreover, the weaker houses only are as a rule demolished. In consequence of the wide area affected, and the great distance travelled, hurricanes, however, are more destructive than tornadoes. They likewise do much more good, since they commonly bring heavy rainfall to a large area instead of to a small one only, and many parts of Australia receive a large share of their rainfall from hurricanes and related storms.

Tropical cyclones occur in most parts of the tropics. They are very frequent (much more frequent than in Australia) in the region of the China Sea, where they are known as typhoons. Many occur in the West Indies, Gulf of Mexico, and in nearby parts of the United States. The Bay of Bengal, the Arabian Sea, the South Indian Ocean, and the South Pacific, are likewise frequently traversed by tropical cyclones.

* Contributed by Stephen S. Visher, M.A., Ph.D. (Chicago), F.R.G.S., F. Am. Meteorol. S., M. Assoc. Am. Geog., etc., Professor of Geography, Indiana State University, U.S.A.; temporarily connected with the Commonwealth Bureau of Meteorology, Melbourne; and D. Hodge, Commonwealth Bureau of Meteorology, Melbourne.

3. **Queensland Hurricanes.**—In Australia, the Queensland coast is most often affected by hurricanes. During the 30 years 1892–1921 they averaged one or two a year, coupled annually with two or three storms of less severity. Two-thirds of the storms occur in January, February and March, and four-fifths in the five months December to April inclusive. It cannot, however, be said that there is no risk from hurricanes during the other seven months, for one-eleventh of the severe storms of the period 1870–1921 occurred in those months, viz., three in June, one in September and one in November. Including the less severe type of storms, every month except August has had two or more.

Most of the hurricanes which affect Queensland come from the east, and approach the coast somewhere between Townsville and Cooktown. Many recurve near the coast, and pass southward frequently as far as Brisbane, and then move off to the east-south-east. Others recurve some distance east of the coast, near the Barrier Reef, for example, and pass southward and then eastward without causing much damage. Still others, especially those which strike the more northern portions of the York Peninsula, pass inland, and some cross the continent to Western Australia, while others recurve in the interior and pass out to sea again across southern Queensland. While most hurricanes lose force shortly after coming on to the land, some strengthen considerably on reaching the coast after their journey across the land. The Queensland coast is affected by still another type of hurricane—the rarest type—viz., that which has developed or at least is first recorded in the interior of the continent and which then moves east-south-east across the southern part of the State. More numerous meteorological stations would perhaps show that these storms, instead of developing in the interior as they seem to do, enter the interior from the east or north in sparsely-settled districts and are not recorded until they have recurved and are passing out towards the south-east.

4. **Western Australian Hurricanes.**—Western Australia has, on the average, rather more than one hurricane a year. In the fifty years 1872–1921, 62 severe tropical cyclones were recorded, and for the 20 years, 1902–1921, 27 were recorded. Some years have had three, and one year, 1917, five, while two years in succession have had none. Of the less severe types of storm, Western Australia has fewer than Queensland, there being perhaps one or two a year instead of two or three.

The hurricanes which affect Western Australia come chiefly from three directions, viz., from the east across the Northern Territory, from the north or from the north-west. Of the two last-mentioned, a number develop in the Cambridge Gulf, or in the Arafura Sea south of Timor, move south-westward, recurve not far west of Australia, and come on to the Australian coast from the west-north-west. The area between Broome and Onslow is hit most frequently by such storms. Some change their direction after reaching the coast, and pass southward along it, while others continue into the interior where they often disappear. Some, however, proceed straight on across the continent, and reach the southern coast near the eastern side of the Bight. Adelaide has been affected several times by such storms, once in 1916 quite severely. Of the storms which reach Western Australia from the east, some appear to have developed in the northern interior, while others are known to have come across northern Queensland. Indeed, several recent storms travelled from east of Queensland across the Northern Territory, then far southward along the western coast of Australia, next across the south-western corner of the continent, and thence eastward through Bass Strait to New Zealand, a total of more than 9,000 miles. Few, however, of such storms are destructive over much of the distance. The portion of Western Australia which is most often damaged severely by hurricanes lies far north of Perth, between Geraldton and Broome. Indeed, hurricanes are rare at Perth. Many, however, cross the south-western corner of the continent, pass east of Perth, and reach the Goldfield towns.

In regard to the season of occurrence, hurricanes are most frequent in the hotter months in Western Australia and Queensland. Of the 68 tropical cyclones affecting Western Australia, concerning which facts were obtained by the writers, January had twenty, February sixteen, March twelve, April seven, December eight, November two, and July, September, and October one each.

5. **Northern Territory Hurricanes.**—The Northern Territory appears to have fewer cyclones than Queensland or Western Australia. Records of 31 only were obtained, in contrast with 126 and 68. Nevertheless, during the 13 years 1909–1921, there was an

average of over one hurricane a year, and this suggests that the information as to earlier years was inadequate. Most of the hurricanes which affect the Northern Territory come from the east, although about one-fifth arrive from the west. The latter appear to be storms which recurve to the north-west of the continent, after having perhaps developed in the Arafura Sea. In respect to season of occurrence, all the recorded storms of the Northern Territory have occurred in the warmer six months, November to April. January, March, and December each had seven; February and November, four each; and April, two.

6. **Rate of Hurricane Movement.**—The rate of movement of the storms varies from only a few miles a day to 500 or more, the average being, perhaps, 300. It usually is least far to the north while moving westward, and greatest after the recurve has taken place and the storm is moving eastward in higher latitudes. Occasionally storms "hover" or "oscillate" for a day or two, making only slight progress.

7. **Local Evidences of Approach of Hurricanes.**—The local evidences of the approach of a hurricane consist of a pronounced fall in the barometer, a thickening of the weather, and an increase in the wind velocity. The barometer often falls half-an-inch below normal, and sometimes, in severe storms, more than two inches. The direction in which the storm is moving is indicated by the direction of the wind. Since the wind blows in towards the "low" spirally, clockwise, a storm coming from the west is signalized by a northerly wind, one approaching from the north has easterly winds on its front, and one coming from the east has southerly winds. Since the wind spirals inwards towards the centre it does not follow the isobars, and the angle between the wind and a line connecting the centre and the observer is less than a right angle, usually about 10° or 15° less. Hence a storm moving straight west towards the observer is preceded by a wind from between S. and S.S.W. If the wind direction does not change notably, the storm is coming straight on. If the wind shifts steadily, the centre will pass to one side of the observer. In the case of storms coming from the east, a shift in the wind direction from south to south-west and then to west indicates that the centre is passing to the southward. Conversely, if the wind shifts from southerly to easterly, the centre is passing to the north. In case the centre passes over the observer, the wind will die down, only to spring up from the opposite direction with the same violence as before the calm, as soon as the centre has passed. The duration of the calm depends on the size of the storm, and whether the full width or merely a chord of the "eye of the storm" is experienced. The maximum duration of calm is rarely more than two hours. A progressive rise in the barometer indicates that the storm is passing away. With eastward moving storms, the wind shifts from north to east, and then to south-east as the centre passes to the north. If the centre passes to the south, the wind shifts from north to west, and then to south-west.

8. **Prediction of Hurricanes.**—The advantages which would accrue from successful long-previous predictions of hurricanes are so great that many attempts have been made to find some method of making such predictions. Up to the present, however, a completely satisfactory result has not been attained. It will, perhaps, be impossible at any time to do more than state the probabilities of a hurricane occurring somewhere in a rather large region. This is due to the many complicated factors influencing atmospheric circulation, and also to the circumstance that the hurricane often affects a narrow zone only. For example, Queensland might experience an unusually large number of hurricanes in a year, but they might recurve far east, passing off without doing much damage, or they might enter the State in sparsely-settled regions, thus causing little destruction. On the other hand, in a year during which only one storm occurred, if the centre passed over some town, even a storm of moderate severity would cause a great deal of damage.

In spite, however, of the present impossibility of making satisfactory predictions, the great interest in forecasting may warrant some statement as to apparent probabilities. With this in view, the distribution of hurricanes in Australia has been studied. The following generalizations are offered as having probably some value in regard to forecasting, but too much weight should not be attached to them.

Taking Australia as a whole, there seems to be a strong tendency for years of many hurricanes to be followed by a year when there are few. Each of the five years since 1890 characterized by few storms followed a year of many storms. In years before 1890

the same relation is indicated, though the relative incompleteness of the data makes the earlier records less valuable. It sometimes happens, however, that several years in succession have about the normal number of storms.

There are some indications of a four-year cycle between maxima. A ten to twelve-year cycle is also faintly suggested by the data at hand, the minima occurring in 1873, 1885, 1895, 1905, 1917, and the maxima in 1872, 1884, 1894, 1909, and 1916. The records are not long enough, however, to prove the existence of either of these cycles.

It was thought possible that the storminess of December might give some indication of the probability of storms in the following months. There seems, however, to be no distinct relationship, for, following a December with a hurricane somewhere in Australia or Fiji, there were, in about a third of the cases, fewer than the normal number of storms during the rest of the season, and in about one-third there were more than the normal number.

In respect to Queensland, whenever there have been hurricanes in December or January, the prospects of having no storm in the rest of the season are very poor, about 1 : 12. Instead, there are nearly equal chances that the rest of the season will have more than the normal number of storms. On the other hand, in those seasons during which no storm occurred in December or January, the likelihood that there will be none during the rest of the year is about equal to the chance of their being an abnormal number. In about one-fifth of the years the first storm of the season occurred in February, and in about another one-fifth the first occurred in March or later.

In Western Australia, according to the data at hand, a December or January hurricane is followed by a storm later in the season nearly four times as often as it is followed by none. If there is no storm anywhere in Western Australia in December or January, the probability of there being no storm during the rest of the season is about 11 : 17, and the probability of their being two storms about 3 : 11.

In about one year in five, on the average, a hurricane occurs somewhere in Queensland during April to July inclusive, and in about one year in six in Western Australia.

[NOTE.—In a Bulletin which it is hoped will be published shortly by the Commonwealth Meteorological Bureau, it is proposed to show the tracks of more than 100 Australian hurricanes and related tropical storms, and to give lists and full details of storms referred to above, as well as lists for Fiji, Tonga, Samoa, and other South Sea Island groups.]

9. ***Methods of Reducing Losses from Hurricanes.***—The question naturally arises as to what can be done to reduce the destructiveness of hurricanes. It may be pointed out in reply that the storms behave with sufficient regularity to enable ships in wireless communication with a number of well-distributed barometric stations to avoid generally the worst part of such storms. Indeed an alert and cautious pilot on the Queensland coast has piloted ships up and down for 40 years almost continuously, without having experienced a disastrous encounter with a hurricane. The storms normally advance so slowly, and the barometric and wind warnings are so sure, that a well-managed steamship can usually avoid disaster by getting out of the storm's course, or, if need be, by seeking shelter and anchoring with two or three anchors. Buildings and crops unfortunately cannot be moved out of the way of the storm and must, therefore, be prepared for it. Buildings of concrete are almost proof against the worst hurricanes, while well-built frame houses anchored by stay cables will usually offer effective resistance. It is very desirable, however, to make at least a part of the house exceptionally strong. In Fiji, and elsewhere, sometimes one or two rooms are made of concrete, and form a haven of refuge in a storm, as well as a vault for valuables. In the case of an all-frame house, it is recommended that the central portion be made doubly secure and provided with an independent roof, so that even if the wind takes the porches and the wings of the house as well as the main roof, there will be little likelihood of its taking all. The independent or supplementary roof is required because of the heavy rains which accompany most hurricanes. In locating the dwelling, allowance must be made for the circumstance that heavy floods often occur. On the coast, high waves are to be expected, and houses should therefore be erected at least 10 feet above normal sea level. Occasionally, indeed, waves reach as high as 20 feet above normal high tide.

In regard to crops, the desirability of selecting those which are little subject to injury during the hurricane season is obvious. Further, steps should be taken to ascertain

as long as possible in advance when a hurricane is to be expected, so that whatever is about ready for harvesting can be garnered. Outlying barometric stations may give several days' warning of the approach of a slowly-moving storm. The Willis Island Station certainly merits an alert observer, and it is desirable that all ships passing along the Queensland coast, and especially between Queensland and the Solomons, New Hebrides and New Caledonia, should be asked to report barometric readings daily, or oftener in case of low pressures to some station like Brisbane, where a specialist can assemble the data and make the necessary forecasts. The importance of more information concerning conditions off the northern coast of Western Australia is also great.

With every precaution, however, insurance is necessary if the tropical portions of Australia are to be fully developed. The Government might, perhaps, provide cheap insurance for buildings and crops, and this could be effected if most of the buildings and crops over a large area were insured. The premiums to be paid would necessarily depend upon the location and upon the character of the buildings and crops.

10. **List of Especially Disastrous Hurricanes.**—Australian hurricanes which have been especially disastrous include the following: 1875, 24th Dec., Exmouth Gulf, W.A., 69 lives lost; 1881, 9th Feb., near Roebourne, W.A., 12 vessels lost; 1884, 30th Jan., Bowen, Qld., nearly the entire town unroofed; 1887, 22nd April, Ninety-mile Beach, W.A., over 200 lives lost; 1894, 9th Jan., Roebourne and Cossack, W.A., 40 lives lost; 1896, 26th Jan., Townsville, Qld., a great deal of damage done over a wide area; 1897, 6–7th Jan., Darwin, N.T., many lives lost, £150,000 worth of damage in Darwin, and Palmerston demolished; 1899, 5th Mar., Bathurst Bay, Qld., 300 lives lost; 1907, 19th Jan., Cooktown, Qld., £20,000 worth of damage done; 1908, 26th Apr., Lagrange Bay. W.A., 50 lives lost, £140,000 worth of property destroyed; 1908, 9th Nov., Broome, W.A., perhaps 50 lives lost and £20,000 loss in property; 1910, 19th Nov., Broome, W.A., 40 lives lost and 26 luggers wrecked; 1911, 16th Mar., Port Douglas District, Qld., Port Douglas demolished, Cairns and Innisfail damaged; 1911, 23rd Mar., "Yongala" hurricane; 1913, 29th Jan., Cairns, Qld., severe damage at Innisfail and Cairns where record floods occurred; 1918, 20th Jan., Mackay, Qld., 30 lives lost and £1,000,000 worth of damage to property; 1918, 9th Mar., Innisfail, Qld., town demolished; 1920, 2nd Feb., Port Douglas, Qld., severe as far west as Victoria River, N.T.