NOTES

ON

THE CLIMATE OF VICTORIA.

AN ESSAY:

BY

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GOVERNMENT ASTRONOMER OF VICTORIA.

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A GENERAL idea of the climate of any country may sometimes be derived simply from its geographical position, especially when its isothermal, isotheral, and isocheimonal lines have been established. There are nevertheless conditions peculiar to every locality or every position of a country, dependent on the conformation of the coast lines, the relation of oceanic currents therewith, the trend and altitude of mountain ranges, which give rise to variations, within whose limits may be comprised climates of very different latitudes; so that some acquaintance with the physical aspect of a country becomes almost essential to a clear comprehension of the character of its climate. It will be well, therefore, to preface the following brief notes on the climate of Victoria with a rough sketch of the more prominent physical features which characterise that portion of Australia.

The colony of Victoria, which has an area of about fifty-six millions of acres, occupies the south-east portion of Australia, and may be said to be included between the parallels 30° and 39° south latitude, and the 141st and 148th meridians. The whole southern boundary is formed by the waters of Bass's Straits, which separate Tasmania from Australia; the northern boundary consists of the River Murray; on the west it is limited by a marked line approximately coinciding with the 141st meridian; while on the east it is separated from the adjacent colony of New South Wales by a line running N. 64° W. from Cape Howe to the nearest waters of the Murray. Its sea-board, lying generally east and west, extends over about 500 miles.

By an examination of a contoured plan of the colony, we find that the most prominent feature is an extensive mountain range running approximately east and west, rising somewhat abruptly about lat. 37° 30′ and long. 141° 40′, varying in altitude from 1000 to 5000 feet, and culminating in the N.E. in lat. 36° 30′, long. 148° 20′, at Mount Kosciusko, the highest part of the Australian Alps, where it attains an altitude of over 7000 feet. The higher parts of this range are covered with snow for several months in the year. The mountain country is for the most part densely wooded with fine timber, even to the very summits; at some of the higher elevations, however, especially in the N.E., many of the peaks are quite bare, or only partially covered with dwarfed trees or shrubs. The country north and south of this great dividing range is moderately undulating or flat, consisting often of large plains, in some parts quite destitute of trees, but closely wooded in others. Along some parts of the coast line, however, especially in the Cape Otway, Western Port, and Wilson's Promontory districts, the land rises to considerable altitudes (from 2000 to 3000 feet) by ranges generally well covered by timber to their summits. On the whole, the country is not well watered; the rivers are few and insignificant, and are often nearly dry in summer; there are several lakes, both salt and fresh, in different parts, but not of sufficient extent to have any marked influence on the climate. The coast line itself is for the most part comparatively flat, with a moderate elevation; although, as just stated, at some places lofty ranges abut on the sea, and the coast becomes precipitous and rugged.

An extensive sea-board, open to polar winds and oceanic currents, modified, no doubt, by the presence of the island of Tasmania; an extensive and wooded mountain range running across the whole breadth of the colony, the higher portions of which are often clothed in snow; and the generally arid sub-tropical Australian interior, dominating on its northern and western boundary, must each necessarily exercise considerable influence in producing conditions of climate varying with the locality.

For many years past the Colonial Government has maintained a system of Meteorological Stations in various parts of the colony, of which the Melbourne Observatory forms the centre; and regular observations of temperature, pressure of air, humidity, radiation, rain, &c., have been obtained for longer or shorter intervals at each. These stations are distributed so that nearly all districts possessing any climatic peculiarity are represented, with the exception, perhaps, of the higher altitudes in our mountain districts, and the arid plains in the north-west. They are here enumerated:—

	Lat. South.	Long. East.	Elevation above Sea Level.
Melbourne	37° 50′ ...	144° 59′ ...	91 feet
Ballarat	37° 34′ ...	143° 49′ ...	1438 ,,
Sandhurst	36° 47′ ...	144° 17′ ...	778 ,,
Beechworth	36° 20′ ...	146° 43′ ...	1783 ,,
Portland	38° 20′ ..	141° 35′ ...	37 ,,
Cape Otway	38° 54′ ...	143° 31′ ...	300 ,,
Port Albert	38° 39′ ...	146° 41′ ...	30 ,,
Gabo Island	37° 35′ ...	149° 55′ ...	40 ,,
Ararat	37° 18′ ...	142° 58′ ...	1072 ,,
Stawell	37° 4′ ...	142° 46′ ...	749 ,,
Berwick	38° 2′ ...	145° 21′ ...	—
Daylesford	37° 21′ ...	144° 10′ ...	2036 ,,
Heathcote	36° 55′ ...	144° 42′ ...	789 ,,
Castlemaine	37° 4′ ...	144° 14′ ...	1000 ,,
Camperdown	38° 14′ ...	143° 9′ ...	770 ,,

In Melbourne, observations have been systematically recorded for the last fourteen years; in Ballarat, Sandhurst, and Portland complete records have been made since 1858, with some interruptions in the two last-named stations; at other stations observations for shorter periods have as yet only been obtained. The results of these, however, are sufficient to establish many of the most prominent characteristics of our climate, and are now annexed in order.

TEMPERATURE.

As temperature is undoubtedly the chief meteorological element upon which climate depends, it will first engage our attention. Appended are tables giving the mean monthly and annual temperatures for the various stations, as well as tables of maxima, minima, and range, both of air and soil, and of solar and terrestrial radiation.

TABLE I.—MEAN MONTHLY AND ANNUAL TEMPERATURE FOR THE VARIOUS METEOROLOGICAL STATIONS IN VICTORIA.

STATIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
Melbourne..	66·6	65·6	63·8	59·0	53·3	49·5	47·8	50·2	53·2	57·0	60·9	63·7	57·5
Portland ..	67·0	67·2	66·4	63·0	58·4	55·3	53·6	55·5	57·6	60·6	62·4	64·1	60·9
Cape Otway	60·4	60·8	59.8	57·4	54·2	51·4	49·2	50·7	50·7	53·0	56·1	58·0	55·1
Port Albert	65·3	63·4	62·4	56·5	52·7	48·9	47·0	50·0	53·8	55·3	60·8	60·2	56·4
Gabo Island	64·3	65·0	64.4	61·9	57·0	53·5	51·2	52·4	54·6	57·1	59·5	62·2	58·6
Ararat.. ..	70·7	67·9	65·7	57·6	51·6	47·1	46·4	49·1	51·1	57·4	63·2	67·6	58·0
Ballarat ..	63·7	62·7	60·9	54·7	49·0	45·4	42·5	45·8	47·7	52·7	57·7	60·8	53·6
Sandhurst ..	70·7	70·0	66·8	59·7	53·9	48·1	45·6	48·7	51·8	57·7	64·4	67·5	58·7
Beechworth	70·4	69·5	68·0	58·3	49·0	46·1	40·8	45·4	47·2	58·9	65·6	67·0	57·2
Stawell ..	70·1	68·5	64·7	57·3	52·0	48·3	45·3	48·5	51·0	57·2	62·6	66·7	57·7
Berwick ..	64·9	65·0	63·4	58·9	54·1	51·5	48·6	50·9	51·7	54·8	59·5	62·3	57·1
Daylesford..	58·4	61·7	63·1	52·6	50·3	44·2	42·2	45·3	48·1	52·1	58·6	60·4	53·1
Heathcote..	70·4	67·6	66·0	57·4	50·5	45·2	44·4	47·8	51·2	57·9	63·4	67·7	57·4
Castlemaine	67·9	65·2	64·8	55·9	50·1	45·8	43·2	47·2	50·2	56·0	61·5	66·5	56·2
Camprdwn.	63·2	62·1	61·0	54·6	49·9	46·9	45·7	47·5	49·1	54·4	59·4	61·7	54·6

TABLE II.—SHOWING THE MAXIMA, MINIMA, AND RANGE IN TEMPERATURE OF AIR AT THE FOLLOWING STATIONS DURING A PERIOD OF FOURTEEN YEARS (1858-1871).

MONTHS.	MELBOURNE.				PORTLAND.				SANDHURST.				BALLARAT.			
	Max.	Min.	Greatest Monthly Rge.	Mean Monthly Rge.	Max.	Min.	Greatest Monthly Rge.	Mean Monthly Rge.	Max.	Min.	Greatest Monthly Rge.	Mean Monthly Rge.	Max.	Min.	Greatest Monthly Rge.	Mean Monthly Rge.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
January ..	111·2	44·0	67·2	55·4	108·0	42·0	66·0	50·1	117·4	41·5	75·9	57·2	109·0	37·3	71·7	58·4
February	109·0	40·3	68·7	53·3	104·0	39·0	65·0	50·4	105·0	45·0	60·0	52·4	100·1	36·2	63·9	56·5
March ..	104·6	41·8	62·8	48·9	100·0	41·0	59·0	47·8	101·5	42·0	59·5	47·7	98·0	34·0	64·0	51·4
April	94·0	35·1	58·9	45·0	86·0	36·0	50·0	39·7	93·0	39·0	54·0	42·9	89·1	31·2	57·9	45·1
May	82·1	31·8	50·3	35·2	78·0	31·0	47·0	34·9	78·5	35·0	43·5	35·7	75·4	30·5	44·9	35·4
June	68·1	28·0	40·1	30·9	70·0	27·0	43·0	32·3	71·5	31·0	40·5	31·0	66·4	27·2	39·2	30·1
July	65·7	27·0	38·7	31·1	68·0	30·0	38·0	30·6	63·0	27·5	35·5	30·0	61·0	22·0	39·0	29·3
August ..	74·0	28·3	45·7	34·9	78·0	30·0	48·0	34·9	73·0	31·0	42·0	34·4	72·2	26·5	45·7	34·4
September	79·0	33·0	46·0	40·3	79·0	30·0	49·0	37·8	80·7	32·0	48·7	39·2	82·4	28·4	54·0	39·4
October ..	95·8	32·1	63·7	46·9	95·0	35·0	60·0	45·0	95·0	34·0	61·0	48·1	91·3	31·5	59·8	47·6
November	103·2	38·8	64·4	52·0	100·0	37·0	63·0	46·6	100·5	37·0	63·5	54·5	99·7	33·0	66·7	55·9
December..	110·0	40·0	70·0	54·9	104·0	37·0	67·0	51·8	110·5	41·0	69·5	57·7	108·3	31·2	77·1	58·5
Greatest range during the period	84·2				81·0				89·9				87·0			
Average yearly range ..	76·0				69·5				76·3				75·9			

TABLE III.—TEMPERATURE OF SOIL AT MELBOURNE.

MONTHS.	Mean Temperature of Surface Soil during a period of 14 years (1858-1871).	GROUND THERMOMETERS AT THE FOLLOWING DEPTHS DURING A PERIOD OF 11 YEARS (1861-1871).											
		14 Inches Deep.			3 Feet Deep.			6 Feet Deep.			8 Feet Deep.		
		Mean Temperat.	Mean Range.	Greatest Range.	Mean Temperat.	Mean Range.	Greatest Range.	Mean Temperat.	Mean Range.	Greatest Range.	Mean Temperat.	Mean Range.	Greatest Range.
	°	°	°	°	°	°	°	°	°	°	°	°	°
January..	78·7	64·9	8·1	28·1	68·3	3·8	14·1	66·6	2·9	8·2	63·9	2·6	6·1
February.	76·7	64·4	7·1	22·1	68·9	3·1	9·1	68·1	1·2	7·1	65·6	1·2	5·6
March ..	70·3	64·4	7·8	27·2	67·8	3·5	9·4	67·9	1·6	7·1	66·2	0·8	5·5
April ..	61·6	58·2	8·4	24·7	64·1	5·1	10·6	65·6	3·2	8·8	65·0	1·9	6·6
May ..	53·7	52·0	7·3	18·1	58·6	6·1	11·4	61·6	3·9	9·6	62·3	2·9	5·9
June ..	49·2	47·8	5·0	15·4	53·4	4·0	11·5	57·2	3·6	10·4	59·1	3·1	8·0
July ..	47·6	45·7	4·3	16·2	50·6	3·2	7·6	54·6	2·5	8·0	56·3	2·6	7·8
August ..	50·8	46·2	5·6	17·4	50·4	3·1	7·7	53·3	1·2	6·3	54·4	1·4	7·5
September	55·4	49·4	5·8	20·3	53·3	4·3	8·0	54·6	2·0	5·3	54·8	0·9	4·2
October..	61·8	53·8	8·5	26·1	57·0	5·6	10·8	56·9	3·1	6·7	56·2	2·1	4·3
November	68·8	58·4	7·7	27·2	61·5	4·9	12·4	60·4	3·3	7·3	58·7	2·4	4·7
December	73·7	62·3	8·5	28·7	65·0	4·3	8·6	63·6	3·1	6·5	61·2	2·5	5·0
Mean for the year ..	62·4	55·6	7·0	..	59·9	4·3	..	60·9	2·6	..	60·3	2·0	..
Mean yearly range ..	..	..	29·5	..	..	22·4	..	..	16·0	..	..	12·9	..
Greatest range during the period..	..	..	..	45·9	..	..	29·0	..	..	22·9	..	..	20·4

TABLE IV.—TEMPERATURE OF SOLAR AND TERRESTRIAL RADIATION AT MELBOURNE DURING A PERIOD OF THIRTEEN YEARS (1859-1871).

MONTHS.	RADIATION.		—	
	Highest Solar.	Lowest Terrestrial.	Greatest Difference.	Means of Greatest Differences.
	°	°	°	°
January	160·0	37·0	123·0	101·8
February	149·0	36·0	113·0	98·7
March	146·0	35·0	111·0	96·3
April	151·7	29·4	122·3	91·3
May	142·6	27·2	115·4	81·5
June	107·5	25·0	82·5	72·1
July	102·2	22·0	80·2	73·2
August	114·8	24·0	90·8	78·7
September	120·2	28·0	92·2	85·6
October	135·8	25·9	109·9	94·7
November	141·1	32·0	109·0	96·9
December	151·8	35·0	116·8	102·5

Greatest difference during the above period .. .. 138·0

From these tables the following facts may be derived:—The mean annual temperature of Melbourne is 57°.6, which approximately represents that of the colony generally, namely, 56°.8. The highest mean occurs at Portland, Gabo Island, and Sandhurst (the two former being coast stations), while the lowest occurs at Daylesford and Ballarat. There can be little doubt that the high means at Portland and Gabo Island are caused by the neighbourhood of warm ocean currents, for although the annual mean temperature of most stations on the coast are high, these, and more especially Portland, appear above the average, while at Sandhurst the temperatures range higher during the summer months than at any other inland station. The low mean at Daylesford and Ballarat is also due to the altitude of the stations on the dividing range, the former being 2090, and the latter 1438 feet above the sea.

The annual mean temperature which obtains at Melbourne places it within the same isotherms in the Southern Hemisphere as Lisbon, Madrid, Marseilles, Florence, &c., in the Northern Hemisphere. The ranges of temperature between summer and winter months, however, appear to be much less than at most of these places, and a more equable temperature may be assumed to exist in Melbourne than at similar isotherms in the south of Europe. As regards the extremes and range of temperature at the various localities, Table II. informs us that the highest temperatures in

the shade occur at Sandhurst in January, namely, 117°, while Melbourne reaches 111°. There are, however, localities in which even higher temperatures rule in the same month, especially on the plains north of the Dividing Range and along the banks of the Murray, between latitudes 34° and 36° 30′, in which localities the temperature has often been as high as 123° to 125° for several days together. It is during the hot winds to which this climate is subject in summer that our highest temperatures occur, but they seldom last many hours, and are usually rapidly followed by a change in direction of the wind, and by a comparatively low thermometer, when a fall of 20° to 25° often occurs in as many minutes.

The minimum temperatures occur in June, July, and August, the lowest yet known in Melbourne being 27°·0, or 5° below freezing point; at Portland, 27°; at Sandhurst, 27°·5; and at Ballarat, 22°, or 10° below freezing.

Table IV. exhibits the results of observations on terrestrial and solar radiation obtained in Melbourne, the only station at which they have been systematically made. The observations of solar radiation are made with a thermometer whose bulb is made of black glass, and also covered with a coating of very fine lamp-black; the thermometer is enclosed in an outer exhausted and hermetically-sealed glass tube. From the results of a series of experiments with black-bulb thermometers, it appears that at high temperatures such as are reached in this colony, no two black-bulb thermometers agree; even when obtained from the best makers, a difference of as much as 10° or 12° is often seen between thermometers, which will register alike in ordinary temperatures, when exposed to the sun's rays at a temperature of 130° to 140°.

The temperature of the soil has been obtained at Melbourne only. The results are given in Table III., from whence it will be found that the greatest yearly ranges for the several depths are—for 14 inches, 45°·9; three feet, 29°; six feet, 22°.9; and eight feet, 20°·4; while the mean temperatures in the same order are 59°·5, 59°·5, 60°·3, and 59°·9.

The following table or Thermic Wind-rose will show the mean temperatures for the various directions of the wind in winter and summer:—

	Winter.	Summer.
	°	°
S.	49·40	68·93
S. E.	47·63	61·27
E.	50·10	65·02
N. E.	43· 0	68·09
N.	50·37	75·26
N. W.	47·38	62·67
W.	49·09	58·85
S. W.	50·07	63·34

HUMIDITY.

Next in importance among the meteorological elements as regards climate is probably that of humidity. The results obtained from hygrometrical observations at the various stations are here given in Table V.

TABLE V.—MEAN RELATIVE HUMIDITY FOR DIFFERENT STATIONS.

STATIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean Annual Humidity.
Melbourne ..	0·64	0·66	0·67	0·73	0·78	0·81	0·81	0·76	0·72	0·71	0·66	0·65	0·72
Portland	0·77	0·78	0·78	0·79	0·83	0·83	0·83	0·82	0·79	0·77	0·81	0·77	0·80
Cape Otway ..	0·86	0·84	0·84	0·84	0·84	0·85	0·85	0·83	0·86	0·88	0·84	0·85	0·85
Port Albert ..	0·73	0·75	0·75	0·80	0·79	0·82	0·84	0·83	0·79	0·81	0·78	0·80	0·79
Gabo Island ..	0·87	0·88	0·89	0·89	0·90	0·89	0·89	0·88	0·89	0·88	0·88	0·88	0·88
Ballarat	0·67	0·64	0·66	0·76	0·82	0·89	0·87	0·80	0·80	0·73	0·67	0·65	0·75
Sandhurst ..	0·51	0·52	0·57	0·71	0·75	0·82	0·81	0·75	0·72	0·67	0·55	0·52	0·66
Beechworth ..	0·63	0·50	0·54	0·60	0·75	0·74	0·80	0·75	0·72	0·61	0·55	0·55	0·65

The mean temperature of the dew-point at Melbourne for each month has been found to be—

	°	°	°	°
September...43·9	December...50·7	March.....51·6	June.....43·8
October.....46·7	January ...52·9	April .....49·6	July .....41·7
November...48·5	February ...52·9	May .....46·1	August...42·2
Spring .....46·4	Summer ...52·2	Autumn ...49·1	Winter...42·6

Giving a mean annual temperature of the dew-point of 47°·6. The humidity of the air is subject to very great and rapid variations, especially during the summer months, when it is not at all unusual that it is reduced from 60 to 24 per cent. in a few hours; and frequently during the occurrence of hot winds, with a daily mean of 30 or 40 per cent., it has been reduced as low as 13 or 15 per cent. In such cases of minimum humidity, however, the daily mean or even an excessive humidity immediately follows the change of wind.

PRESSURE OF AIR.

The mean pressure of air in Melbourne from discussion of fourteen years' observation appears to be 29·931 inches; this, reduced to the sea level, becomes 30·022 inches. Tables VI. and VII., appended, give the mean monthly and annual pressure, and monthly and annual range for the several meteorological stations in the colony.

TABLE VI.—MEAN PRESSURE OF AIR AT DIFFERENT STATIONS.

STATIONS.	Height above sea level in ft.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly Mean.
Melbourne.	91	29·823	29·872	29·977	30·026	30·010	30·013	29·998	29·994	29·908	29·876	29·876	29·811	29·931
Portland ..	37	29·898	29·940	30·030	30·071	30·039	30·050	30·037	30·023	29·989	29·922	29·936	29·863	29·979
Cape Otway	270	29·659	29·692	29·794	29·828	29·781	29·796	29·733	29·758	29·679	29·606	29·677	29·634	29·725
Port Albert	10	29·883	29·957	30·048	30·092	30·088	30·060	30·091	30·022	29·928	29·965	29·928	29·883	29·996
Gabo Island	40	29·795	29·851	29·947	29·998	29·999	29·950	29·971	29·952	29·869	29·821	29·818	29·797	29·897
Ararat ..	1050	28·765	28·811	28·900	28·948	28·950	28·937	28·895	28·896	28·834	28·801	28·781	28·749	28·856
Ballarat ..	1438	28·445	28·477	28·574	28·617	28·589	28·574	28·558	28·561	28·489	28·469	28·466	28·418	28·519
Sandhurst .	758	29·096	29·136	29·249	29·308	29·300	29·293	29·277	29·286	29·195	29·137	29·147	29·081	29·209
Beechwrth.	1783	28·085	28·081	28·174	28·250	28·146	28·281	28·194	28·066	28·054	28·173	28·102	28·019	28·135

TABLE VII.—MEAN MONTHLY RANGE IN PRESSURE OF AIR AT DIFFERENT STATIONS.

STATIONS.	Height above sea level.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean monthly range per year.
Melbourne.	91	0·754	0·786	0·708	0·810	0·912	0·969	0·966	1·022	1·025	0·958	0·814	0·896	0·884
Portland ..	37	0·729	0·750	0·676	0·825	1·056	0·999	0·919	1·016	1·058	0·948	0·798	0·993	0·896
Cape Otway	270	0·849	0·698	0·700	0·765	0·984	1·068	1·138	1·060	1·094	0·954	0·782	0·876	0·914
Port Albert	10	0·729	0·781	0·836	0·786	0·932	0·959	0·775	1·012	0·893	0·872	0·806	0·967	0·862
Gabo Islnd.	40	0·821	0·820	0·718	0·799	0·832	0·869	0·975	0·937	0·881	1·045	0·825	0·662	0·849
Ararat ..	1050	0·667	0·532	0·601	0·614	0·829	0·825	0·870	0·889	0·901	0·794	0·695	0·753	0·748
Ballarat ..	1438	0·635	0·637	0·546	0·721	0·907	0·855	0·811	0·876	0·892	0·805	0·652	0·813	0·762
Sandhurst .	758	0·705	0·616	0·569	0·670	0·835	0·878	0·830	0·896	0·962	0·831	0·701	0·806	0·774
Beechwrth.	1783	0·488	0·618	0·619	0·590	0·815	0·722	0·648	0·895	0·784	0·783	0·552	1·177	0·724

The barometer is subject to very considerable oscillations, and sometimes in very short periods—the greatest occurring during storms from the W., S.W., and S.S.W. The greatest range yet observed, amounting to 1·719 inches, took place in 1863; the maximum, 30·587, occurring in September, and the minimum, 28·868, in December in the same year, during a violent storm from the west. The pressure, as influenced by the direction of wind, will be seen by the following table of mean pressures observed at Melbourne during winds from the various points of the compass :—

	Inches.		Inches.
S.	29·930	N.	29·821
S.E.	29·954	N.W.	29·840
E.	29·896	W.	29·854
N.E.	29·878	S.W.	29·885

The mean daily range in pressure of air for Melbourne, 120 feet, and for Ballarat, 1437 feet, above the level of the sea, is given in the table below:—

	Melbourne. Inches.	Ballarat. Inches.
Spring	0·191	0·104
Summer	0·163	0·088
Autumn	0·157	0·092
Winter	0·152	0·098
Year	0·166	0·096

The mean daily range is greatest for Melbourne in September, and least in February, from which Ballarat seems to differ, in so far as there the greatest range occurs in August, the differences for these months being 0·056 and 0·032 inches respectively.

As a rule, the greatest pressure occurs with the wind from S. to S.E., and the lowest from N. to W. From discussion of many years' observation, there appears to be a maximum of mean pressure in the early part of August.

RAINFALL.

Although Victoria has generally been considered a dry climate, we find that the rainfall usually attains to the average of similar latitudes in other parts of the world; but it is doubtless to the large amount of spontaneous evaporation, as well as perhaps to the immense tracts of unbroken surface soil, that the frequent inadequacy of our rainfall is due. In some localities, however, not only does the fall of rain reach a larger average, but, owing to sheltered and most frequently submontane positions, the evaporation is almost reduced to a minimum. This is particularly the case in the valleys and gullies at the foot of our mountain ranges, where the character of the vegetation is considerably modified thereby.

From observations of the rainfall carried on since 1840, but unfortunately with a break in the years 1851, '52,' 53, and '54, we may assume the annual average to be 25·66. From Professor Neumayer's observations of spontaneous evaporation it appears that it amounts to 42 inches per annum, and occurs principally during the spring and summer months; in winter and autumn the rainfall generally exceeds the evaporation by a considerable amount. It would thus appear that spontaneous evaporation exceeds the rainfall by 16·4 inches. The conditions that generally affect spontaneous evaporation can scarcely be brought to bear upon any of the methods of observation usuually adopted, and determinations made from a small surface of water in an open

position will, doubtless, give a result in excess of the average evaporation, and such, I think, we may assume to be the case in this instance; nevertheless, spontaneous evaporation in most parts of Victoria is greatly in excess of the rainfall.

In the tables appended, the annual rainfall in Melbourne, and other localities in which reliable observations have been made, is given for each year, as well as the number of days' rain and amount of rainfall for every month and each year in Melbourne from 1858 to 1865.

Table VIII.—Yearly Rainfall at Different Stations.

Years.	Melbourne.	Buninyong.	Ballarat.	Portland.	Camperdown.	Heathcote.	Beechworth.	Echuca.	Gabo Island.	Longerenong, Wimmera.	Sandhurst.	Ararat.	Cape Otway.	Werrack-nebeal.	Stawell.	Berwick.	Daylesford.	Warrnambool.	Kew.	Mornington.	Katandra.	Wahgunyah.	Hamilton.	Geelong.	Salc.
1840	22·57	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1841	30·18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1842	31·16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1843	21·54	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1844	28·26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1845	23·93	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1846	30·53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1847	30·18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1848	33·15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1849	44·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1850	26·98	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1851	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1852	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1853	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1854	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1855	28·21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1856	29·75	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1857	28·90	25·29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1858	26·02	26·11	24·47	27·30	27·97	23·79	30·87	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1859	21·80	—	23·72	31·42	27·60	21·86	—	15·76	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1860	25·40	25·49	28·80	26·31	29·97	29·01	—	19·13	32·82	17·26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1861	29·15	30·67	28·66	39·58	36·94	28·78	29·70	—	38·74	20·17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1862	22·08	26·79	23·50	31·01	26·15	16·99	26·94	—	—	—	18·50	23·35	—	—	—	—	—	—	—	—	—	—	—	—	—
1863	36·43	43·64	37·22	45·31	—	—	—	—	49·12	33·08	33·92	37·37	49·66	21·45	—	—	—	—	—	—	—	—	—	—	—
1864	27·40	25·75	24·02	33·06	—	—	—	—	—	—	23·03	—	38·82	8·81	—	—	—	—	—	—	—	—	—	—	—
1865	15·94	25·01	20·09	34·37	—	—	—	—	—	—	10·85	15·71	38·62	6·17	—	—	—	—	—	—	—	—	—	—	—
1866	22·41	28·68	23·95	31·75	—	—	—	—	—	—	21·41	18·21	34·29	14·17	18·57	—	—	—	—	—	—	—	—	—	—
1867	25·79	31·89	29·87	33·87	—	—	—	—	—	—	26·66	25·28	38·98	—	25·41	38·36	—	—	—	—	—	—	—	—	—
1868	18·27	22·74	17·23	30·32	—	—	—	—	26·28	—	17·34	23·27	31·99	—	17·55	29·81	31·74	27·58	—	—	—	—	—	—	—
1869	24·59	28·31	22·85	28·53	—	—	—	—	42·80	—	21·29	20·68	36·84	—	15·98	34·38	—	26·84	27·95	26·53	20·02	20·20	19·97	—	—
1870	33·75	41·72	36·38	—	—	—	—	—	—	—	38·37	28·20	36·60	—	29·39	46·38	50·70	—	35·90	45·92	37·13	43·90	31·15	—	—
1871	30·17	29·07	27·51	—	28·14	—	—	—	41·22	—	27·12	25·75	36·66	—	23·20	42·39	40·36	—	33·76	30·81	—	27·10	25·26	20·04	28·61

TABLE IX.—SHOWING THE AMOUNT OF RAINFALL AND THE NUMBER OF DAYS OF RAIN FOR EVERY MONTH AND FOR EACH YEAR, TOGETHER WITH THE AVERAGE AMOUNT AND AVERAGE NUMBER OF DAYS OF RAIN FOR EVERY MONTH, FOR THE PERIOD OF 14 YEARS (1858-1871).

YEARS.	January.		February.		March.		April.		May.		June.		July.		August.		September		October.		November.		December.		For the whole year	
	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.	Amount.	No. of Days.
1858	0·88	9	4·91	12	1·09	9	0·60	11	1·38	15	0·76	13	2·07	18	1·62	16	2·17	22	0·87	10	3·19	11	6·47	12	26·01	158
1859	2·86	13	0·83	10	0·18	8	1·29	8	2·32	14	4·51	21	1·04	13	0·95	17	2·77	16	2·33	13	1·71	12	1·03	11	21·82	156
1860	1·97	10	1·08	4	0·96	6	4·53	12	0·99	11	1·72	16	1·21	9	0·79	10	2·72	17	1·97	15	2·38	12	5·06	11	25·38	133
1861	2·25	14	4·62	13	2·65	9	1·29	11	0·84	12	1·78	16	2·14	16	1·47	14	3·19	17	4·89	14	1·46	11	2·58	12	29·16	159
1862	1·25	4	0·19	3	1·08	8	3·56	14	4·31	19	2·99	16	2·26	20	1·95	14	0·98	14	2·03	11	0·32	9	1·16	7	22·08	139
1863	1·84	9	2·74	12	3·84	14	1·76	10	2·54	16	1·16	10	2·87	16	2·10	18	1·99	15	4·89	18	3·51	13	7·18	14	36·42	165
1864	2·07	7	2·63	9	1·80	7	4·53	18	1·02	9	0·81	10	2·83	13	2·50	18	2·28	14	4·08	18	0·64	9	2·21	12	27·40	144
1865	0·16	3	0·59	8	1·26	8	0·72	7	3·41	18	1·64	10	2·05	14	1·22	14	1·87	13	0·78	8	0·89	7	1·35	9	15·94	119
1866	1·43	4	0·35	5	2·14	6	0·57	5	2·92	7	1·64	11	2·04	11	2·26	15	2·08	14	3·25	15	2·17	10	1·56	4	22·41	107
1867	1·92	6	2·68	7	0·75	8	2·42	11	2·38	12	1·08	7	1·66	20	1·91	14	3·43	18	3·35	18	0·87	3	3·34	9	25·79	133
1868	2·11	10	0·99	6	1·02	5	1·44	10	1·48	8	1·21	11	1·46	15	1·01	10	2·13	15	1·05	11	3·19	11	1·18	8	18·27	120
1869	1·46	6	0·89	10	1·53	3	1·27	7	1·99	14	2·37	13	1·13	13	1·65	10	1·58	13	7·61	20	2·12	13	0·98	7	24·58	129
1870	3·15	4	0·03	1	0·34	3	4·83	15	2·78	10	3·32	21	3·16	14	2·14	15	5·87	17	4·38	12	3·23	13	0·49	4	33·77	129
1871	3·00	9	3·23	6	2·37	9	1·29	6	1·39	11	1·25	9	2·08	15	3·58	11	1·86	15	2·88	11	4·19	16	3·05	7	30·17	125
Average	1·88	7·7	1·84	7·6	1·50	7·3	2·15	10·4	2·13	12·6	1·87	13·1	2·00	14·8	1·80	14·0	2·49	15·7	3·17	13·9	2·13	10·7	2·69	9·1	25·66	137

By selecting Melbourne as the locality in which the most extended series of observations have been obtained, we remark that in the years 1848, 1849, and in 1863, the rainfall was far above the average; in 1864, 1865, 1866, and 1870 it fell below the average, especially 1865, when it only reached 15·9 inches. In 1848 and 1849 extensive and destructive floods occurred, and again in 1863; in 1865 and 1866 the country suffered from a severe drought; and the year 1851, following the heavy rains of 1849, was also a dry one, although the amount of rainfall, if ever observed, cannot yet be ascertained. An opinion has often been expressed that there is a periodicity in the excessive rainfalls and droughts in Australia generally; but although the above results may give some slight grounds for this supposition, a far greater number of years' observations will be necessary from which to deduce any law of this kind.

WINDS.

The alternation of the polar and equatorial currents of air constitutes the main feature of the prevalent winds, modified, of course, in the various localities by the physical features, and by their situation with regard to the mountain system. From discussion of the Melbourne observations, it seems evident the northerly winds have the ascendancy both in frequency and force, more especially during the winter months. S. and S.W. winds come next in force, and, generally speaking, in frequency also. The following tables give the results of frequency and velocity of the different winds for each month, as deduced from the records of the self-registering anemometer, and also the percentage of hours during which the wind has blown from different points of the compass.

TABLE X.—SHOWING THE AVERAGE NUMBER OF HOURS THE WIND BLEW FROM THE DIFFERENT POINTS OF THE COMPASS AND THE NUMBER OF MILES IT TRAVELLED, TOGETHER WITH THE MEAN NUMBER OF MILES FOR EACH POINT OF THE COMPASS AND FOR THE WHOLE YEAR, FOR A PERIOD OF SIX YEARS (1866-1871).

MONTHS.	N.		N.W.		W.		S.W.		S.		S.E.		E.		N.E.		Number of hours of Calm.	Total number of Miles the Wind Travelled.
	Number of		Number of		Number of		Number of		Number of		Number of		Number of		Number of			
	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.		
January	52·8	687	28·5	338	59·2	655	143·7	1891	202·4	2738	147·0	1208	42·3	206	61·2	496	6·9	8219
February	50·5	674	25·6	314	49·2	482	121·9	1604	149·2	1889	156·2	1392	55·0	296	64·2	476	4·2	7127
March	74·8	1041	29·6	315	71·2	799	122·8	1575	162·5	1990	147·1	1283	51·3	244	78·7	574	5·9	7821
April	104·0	1397	54·9	492	74·6	827	97·1	1071	117·3	1084	116·8	868	34·6	151	110·5	763	10·2	6653
May	138·4	1794	55·2	579	100·7	1224	77·1	827	72·8	578	97·5	654	57·8	258	129·2	827	15·3	6741
June	240·2	3532	83·3	928	107·6	1353	54·2	500	35·1	226	44·6	403	31·7	178	115·9	828	7·4	7948
July	244·1	3666	105·1	1119	104·4	1180	58·3	546	39·7	292	34·5	310	20·0	98	128·1	928	9·8	8139
[illegible]	195·1	2769	108·1	13[illegible]	104·8	1340	79·0	7[illegible]3	52·6	371	[illegible]3·	125	24·3	107	151·3	1234	4·9	8051
[illegible]	[illegible]	[illegible]	[illegible]	9·2	37·7	1·6[illegible]	97·0	200	75·6	63[illegible]	39·1	252	25·2	131	03·0	927	8·2	8387
[illegible]	[illegible]	[illegible]	[illegible]	900	112·9	142	126·3	1680	124·4	1301	65·6	413	3 ·8	154	84·1	683	8·2	8353
[illegible]	[illegible]8·4	821	41·4	469	96·8	340	151·5	2157	160·1	1987	91·6	610	37·9	169	64·5	557	9·8	8110
[illegible]	52·9	733	35·3	4·3	90·1	1·89	156·3	2169	188·7	2369	121·8	933	33·6	176	55·1	465	10·2	8513
Sums for the year..	1488·1	21326	716·0	8281	1109·2	13672	1285·2	15943	1389·4	15457	1085·7	8457	443·6	2168	1145·8	8758	101·0	94062
Means for the year	..	14·3	..	11·6	..	12·3	..	12·4	..	11·1	..	7·8	..	4·9	..	7·6	..	10·73

TABLE XI.—SHOWING THE AVERAGE PERCENTAGE OF HOURS DURING WHICH THE WIND BLEW FROM THE DIFFERENT POINTS OF THE COMPASS FOR THE FOUR SEASONS, AND FOR THE YEAR, FOR A PERIOD OF SIX YEARS (1866-1871).

SEASONS.	N.	N.W.	W.	S.W.	S.	S.E.	E.	N.E.	Calms.
Spring (September to November) ..	16·2	8·6	15·9	17·0	16·1	8·9	4·3	12·0	1·0
Summer (December to February) ..	7·4	4·0	8·6	19·3	24·9	20·2	6·2	8·5	0·9
Autumn (March to May)	14·4	6·2	10·4	13·3	16·0	16·7	6·7	14·9	1·4
Winter (June to August)	31·8	13·5	13·9	8·7	5·3	4·8	3·3	17·7	1·0
Year	17·5	8·1	12·2	14·5	15·6	12·6	5·1	13·3	1·1

CLOUD.

Table XII. shows the mean amount of cloud present for each month, at the several Meteorological Stations.

From discussion of the Melbourne observations respecting cloud, a minimum seems to occur at 9 p.m., and a maximum at 7 a.m., the averages being respectively for these periods 5·13 and 6·51. It further appears that the amount in day-time exceeds that in night-time.

TABLE XII.—MEAN AMOUNT OF CLOUD FOR DIFFERENT STATIONS.

STATIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean for the year.
Melbourne .	5·3	5·0	5·2	5·8	6·4	6·5	6·4	6·1	6·1	6·0	5·9	5·5	5·8
Portland ..	6·0	5·7	5·8	6·0	6·7	6·6	6·5	6·5	6·2	6·4	6·1	6·2	6·2
Cape Otway.	6·5	6·2	6·3	6·5	6·6	6·9	6·7	6·9	6·9	6·3	6·0	6·1	6·5
Port Albert .	5·7	5·0	5·0	6·0	5·4	5·4	6·5	4·5	5·0	5·4	5·5	5·2	5·4
Gabo Island.	4·6	5·5	4·3	4·7	4·1	5·2	4·9	4·8	4·8	5·0	5·7	5·1	4·9
Ararat	1·9	2·3	3·3	3·6	4·9	4·8	5·6	4·5	4·2	3·6	2·9	3·2	3·7
Ballarat ..	5·0	5·1	5·0	5·9	6·9	6·7	6·9	6·6	6·3	6·1	5·6	5·4	6·0
Sandhurst ..	2·7	3·5	3·4	4·0	5·3	5·4	5·5	4·7	4·7	4·3	4·0	3·9	4·3
Beechworth.	4·4	3·1	2·8	3·2	5·0	4·5	6·8	5·4	6·1	3·8	4·0	3·8	4·4

As regards the presence of ozone, or of ozonic reaction, it is now well established that this particular condition of the atmosphere is always at its maximum during strong south-west and south winds, and at its minimum during easterly and north-easterly winds; and, further, that its presence is evinced to a greater extent during the night than during the day.

The electric condition of the air seems, so far as observations

have yet been made, to follow approximately the same variations as have been observed in other countries. During the hot, dry winds prevalent here in summer months, and the dust storms that often accompany them, negative electricity prevails; this is also generally the case during heavy rains, frequently to a large degree. Positive electricity is usually observed as the wind springs up and increases after calm weather, and especially when the wind comes from the S. or S.W.

Although a moderately precise conception of the climate of this colony may be obtained from the foregoing remarks, there will yet remain much that modifies a climate, even to a large extent, which cannot be expressed in tables, or directly deduced from discussion of the various meteorological elements. A brief description, therefore, of a cycle of the seasons will, in connection with the tables already given, enable the reader to form a moderately correct idea of the climate of Victoria.

The spring season, which may be said to include September, October, and November, generally sets in about the beginning of September; during which month, although slight frosts sometimes occur, the weather is usually mild and often quite warm. Rather above the monthly average of rain also frequently falls. Strong northerly and westerly winds are prevalent in September and October, but the currents of air, both as regards frequency and velocity, seem to be more equally distributed during these months than at other parts of the year. The northerly winds begin to assume the dry and warm condition which characterises them throughout the summer months, and it is not at all unfrequent that quite a hot wind may prevail for a short period even in October; the weather generally, however, in September and October, is genial and pleasant. November, also representing the height of spring, is usually characterised by fine, warm, and sometimes even hot weather. It is not at all unusual to get a large rainfall in October or November, sometimes giving rise to extensive floods; in some seasons, however, the rainfall after the commencement of October diminishes considerably, and frequent dry, and even hot, northerly winds in November parch the grass and other herbage, giving to the plains and hills a sand-like appearance; but in others the pastures remain green till January, and in many parts of the colony throughout the year.

The summer season includes the months of December, January, and February. December is often marked by very changeable weather, and although generally hot and dry, it is not unfrequently broken up by cold and stormy intervals, with heavy rains, and gales of wind. The northerly winds become more or less hot according to the amount and distribution of the rainfall throughout the interior during spring. Very great changes of temperature

often take place in a few hours; for instance, a warm north wind prevails in the morning, with a temperature reaching as high as 90° to 100°; a lull in the afternoon is quickly followed by a strong breeze from the S.W., and the temperature becomes reduced to 65° or 60° in fifteen or twenty minutes.

The highest mean temperature occurs in January; February also is often characterised by great heat and dryness. It is during these months that the northerly winds become perfect siroccos for short periods, and if the spring has been dry, extensive bush-fires occur on the plains and in the forests, giving rise to a considerable increase of temperature, and superadding to the already unpleasant state of things a smoky and lurid atmosphere over considerable areas in the vicinity. Although unpleasantly hot weather very frequently intervenes throughout the summer months, yet a large and often the largest portion of the weather is fine and pleasant, with cool southerly or south-westerly winds.

The autumn season, including the months of March, April, and May, although subject to stormy weather, gales of wind, and large rainfall—especially in its earlier part, and following the equinoxes—may nevertheless be called the most genial and beautiful portion of the year. It constitutes a second spring, for so soon as vegetation receives the moisture it has thirsted for through the summer, the indigenous plants and trees put forth a growth that often exceeds that of spring. The temperature on the whole maintains a moderate mean; the northerly winds now become cooler, and solar radiation is considerably reduced; heavy dews fall at night, and sometimes towards the end of this season fog occurs during the night and early morning in very calm weather. In April the mean temperature becomes 59°, and in May 53°.

Winter includes June, July, and August. This season, though usually marked by frequent rain and strong winds, especially from the north, is in some years remarkably dry, with a small rainfall; the temperature does not reach its minimum till the middle of July and the beginning of August, and seldom in Melbourne falls much below freezing point. Ice and hoar-frost occur generally only on a very few occasions during the winter in the neighbourhood of Melbourne, the former sometimes attaining a quarter of an inch in thickness. At higher levels, however, frost and ice have been observed as early as May, and forms much more frequently during the winter months than at the lower levels; the highest mountain summits too are in most seasons seen to be clothed in snow by June, and sometimes even as early as the beginning of May. The strongest winds in winter are usually from the north, from which quarter it often blows with great violence; wind from this direction is dry, and usually very cold at this season.

The worst vicissitude to which the climate of Victoria is subject, in common with Australia generally, is the occasional droughts; these as already stated appear to follow those years characterised by unusual rainfall; a fact that has given rise to a conjecture that both the excessively wet and the excessively dry seasons are periodical. The last drought to which the colony was subject extended from the summer of 1865 till almost the winter of 1866, and was doubtless due to the small rainfall in the autumn and spring months.