fall of tide, has been supplied for this work by Captain C. B. Payne, the Chief Harbor Master of Victoria :—

TIDES.

Place.	Time of High Water at full and change.		Range of Tide.		Place.	Time of High Water at full and change.		Range of Tide.	
	h.	m.	ft.	in.		h.	m.	ft.	in.
Portland Bay ...	0	30	3	0	Venus Bay ...	11	56	7	0
Port Fairy ...	0	31	3	0	Waratah Bay ...	12	0	8	0
Warrnambool ...	0	37	3	0	Glennie Islands	11	44	9	0
Point Lonsdale ...	9	42	7	0	Refuge Cove ...	12	14	8	0
Point Nepean ...	10	50	3	0	Rabbit Island ...	12	14	8	0
Queenscliff (Port Phillip Heads)	10	50	3	1	Port Albert ...	12	14	8	0
					Lakes' Entrance	8	30	3	0
Hobson's Bay ...	2	31	2	8	Gabo Island ...	8	50	6	0
Melbourne Quay	2	48	2	8					

METEOROLOGY AND CLIMATE.

Government Observatory.

54. It is creditable to the liberality of the Government and people of Victoria that for years past a first-class Observatory, with an efficient staff of assistants, has been maintained by the State.* By means of the very complete observations taken and worked out at this Observatory, under the able direction, first, of Professor George Neumayer, and latterly of Mr. R. L. J. Ellery, the present Government Astronomer, the task of compiling an account of the climate of Victoria is rendered a comparatively easy one. To the tables and reports published by these officers I am indebted for most of the facts on which I propose to treat in this chapter.†

Temperature

55. The most important meteorological element, and the one by which, more than any other, the healthfulness and rate of mortality in a country is affected, is undoubtedly the temperature. This, therefore, it is my intention first to touch upon.

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* A description of this Observatory, and of the instruments it contains, by Mr. J. E. White, the present Acting Government Astronomer, will be found in an appendix *post.*

† I have derived most of my facts from "Climatological Outlines of the Colony of Victoria," by George Neumayer, and from the "Monthly Record of Results of Observations, &c.," by R. L. J. Ellery.

Yearly mean temperature at Melbourne.

56. The mean temperature of the air in Melbourne, derived from observations* extending over a period of fourteen years, is 57·6°. Upon examining a chart showing isothermal lines, it will be found that Melbourne is situated upon or near the line corresponding with that in the northern hemisphere on which Marseilles, Bordeaux, Bologna, Nice, Verona, and Madrid are situated. Professor Neumayer, however, points out that the difference between winter and summer, and the hottest and coldest month, is far less in Victoria than in any of these places; and that, with regard to the differences referred to, Melbourne more closely resembles Lisbon, and still more so Maffra, 18 miles to the north-west of Lisbon, situated 700 feet above the level of the sea, and in latitude 38° 55′ north.

Seasons.

57. The three months from September to November are considered in Victoria to be the spring quarter; those from December to February the summer quarter; those from March to May the autumn quarter; and those from June to August the winter quarter.

Mean temperature of quarters at Melbourne.

58. The mean temperature of the autumn quarter in Melbourne is, on the average, nearly two degrees (1·7°) higher than that of the spring quarter; and the mean temperature of the summer quarter is, on the average, over sixteen degrees (16·1°) higher than that of the winter quarter. This will be observed from the following figures, based upon observations extending over fourteen years :—

		Mean Temperature of Air at Melbourne.			Mean Temperature of Air at Melbourne.
		°			°
Spring	...	57·0	Autumn	...	58·7
Summer	...	65·3	Winter	...	49·2

Mean temperature of months at Melbourne.

59. January and February are the warmest months in Melbourne, June and July the coldest. This will be seen by the following figures, which give the average for sixteen years :—

		Mean Temperature of Air at Melbourne.			Mean Temperature of Air at Melbourne.
					°
January	...	66·7	July	...	47·7
February	...	65·6	August	...	50·1
March	...	63·8	September	...	53·3
April	...	58·8	October	...	57·1
May	...	53·3	November	...	60·8
June	...	49·8	December	...	63·9

Hottest days at Melbourne.

60. During the last seventeen years the thermometer in the shade, at Melbourne, has risen sixty-one times to or above 100° Fahrenheit. The following are the dates and the highest readings. It will be observed

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* These observations are obtained from readings of the thermometer in the shade, but fully exposed to the open air.

that 1861 and 1864 are omitted, as the thermometer never reached 100° in those years:—

HOTTEST DAYS AT MELBOURNE.

1858.—Jan.	5	101·6	1866.—Feb.	7	100·9	1870.—Jan.	24	107·1
„	27	106·8	„	8	102·5	Feb.	3	102·8
„	28	107·8	„	11	102·0	„	15	109·0
„	31	101·0	1867.—Jan.	12	108·4	„	21	102·0
Nov.	22	103·2	„	25	101·0	1871.—Dec.	4	101·0
1859.—Feb.	6	104·0	„	26	103·0	„	21	100·2
„	3	100·3	Dec.	19	104·6	„	22	106·0
Dec.	4	103·0	1868.—Jan.	25	100·3	„	30	102·8
„	20	100·1	Mar.	1	104·6	1872.—Jan.	9	101·0
1860.—Jan.	21	108·8	„	6	100·7	„	10	102·0
„	22	111·0	„	20	100·0	„	16	103·3
1862.—Jan.	13	105·0	Nov.	28	101·3	„	21	100·8
„	14	111·2	Dec.	11	101·0	1873.—Jan	20	101·0
Dec.	31	107·2	„	24	110·0	Feb.	16	102·4
1863.—Jan.	8	104·6	1869.—Feb.	19	100·8	Dec.	8	101·2
Feb.	1	103·9	Dec.	15	100·0	„	9	100·6
„	2	104·0	„	20	108·4	„	15	100·1
1865.—Feb.	27	103·4	„	21	101·3	1874.—Feb.	14	101·0
Dec.	27	101·8	1870.—Jan.	12	104·1	Dec.	17	102·7
1866.—Jan.	15	103·0	„	23	107·0	„	28	102·2
„	16	108·2						

61. During the same seventeen years fifty-two instances were recorded of the thermometer falling to or below the freezing point. The following are the dates and the lowest points indicated. The thermometer never fell so low as 32° in 1862, 1871, or 1872:— Frosts at Melbourne.

FROSTS AT MELBOURNE.

1859.—July	15	31·0	1866.—June	11	28·0	1869.—July	18	31·0
Aug.	1	31·3	„	12	29·6	„	19	31·4
1860.—July	13	29·7	July	18	32·0	„	21	27·0
„	14	29·0	„	31	30·1	„	22	29·8
„	19	31·1	Aug.	19	30·1	„	25	32·0
„	20	31·7	1867.—July	31	31·0	1870.—June	15	29·6
1861.—July	24	31·8	Aug.	1	29·7	July	13	30·6
1863.—Aug.	11	28·3	„	2	30 5	„	29	31·2
„	12	29·8	1868.—May	31	31·8	1873.—July	18	30 2
„	13	29·0	June	15	31·1	„	22	31·3
1864.—July	4	30·5	„	16	30 0	„	23	31·0
1865.—June	13	32·0	July	11	27·4	„	27	31·8
„	14	32·0	„	12	30·0	1874.—June	27	31·8
„	15	32·0	„	19	29·0	July	31	30·0
July	5	31·7	Aug.	15	30·2	Aug.	3	30·0
„	21	30·9	„	17	30·8	„	4	30·0
„	22	32·0	1869.—June	16	31·0	„	5	29·3
1866.—June	10	30·0						

62. The mean temperature of the air has been ascertained at the following places for a series of years. It will be observed that Portland, a seaport near the extreme west of the colony; Gabo Island, close to the point where the dividing line between Victoria and New South Wales meets the ocean, at the extreme east of the former; and Sandhurst, a city to the north of the Dividing Range, are warmer than Melbourne; Yearly mean temperature at six places.

but that Cape Otway, on the coast to the west of Port Phillip, and Ballarat, a city seventy miles in the interior, and south of the Dividing Range, are colder than Melbourne :—

	Number of Feet above Sea-level.	Mean Temperature of Air.
		°
Ballarat	1,438 ...	53·9
Cape Otway	270 ...	55·2
Gabo Island	40 ...	58·7
Melbourne	91 ...	57·6
Portland...	37 ...	61·1
Sandhurst	758 ...	58·6

Highest and lowest temperature at five places.

63. The highest and lowest temperatures in the shade at the same places, excepting Gabo Island, are given in the following table ; also the dates at which such extremes were experienced. It will be noticed that the highest temperature was observed at Sandhurst, and the lowest at Ballarat.

DAYS OF HIGHEST AND LOWEST TEMPERATURE.

Places.	Number of Years over which the Observations extend.	Highest Temperature in the Shade.		Lowest Temperature in the Shade.	
		Reading.	Date.	Reading.	Date.
		°		°	
Ballarat ...	16	109·0	January 1862 ...	22·0	July 1865
Cape Otway	12	105·0	Mar. 1868 & Jan. 1870	30·0	March 1866
Melbourne..	16	111·2	January 1862 ...	27·0	July 1869
Portland ...	12	108·0	January 1862 ...	27·0	June 1866
Sandhurst...	14	117·4	January 1862 ...	27·5	July 1869

Temperature of soil and dew-point.

64. The mean temperature of the soil in Melbourne, as derived from observations taken during a number of years by means of a thermometer on the surface slightly covered with earth, but fully exposed to the action of the sun and wind ; also the mean temperature of the bulb at various depths, and the mean temperature of the dew-point,* are given as follow for the four seasons and for the entire year :—

MEAN TEMPERATURE OF SOIL AND DEW-POINT AT MELBOURNE.

Seasons.	Mean Temperature of—					
	Surface Soil.	Bulb at the Depth of—				Dew-point.
		14 inches.	3 feet.	6 feet.	8 feet.	
	°	°	°	°	°	°
Spring ...	62·0	53·9	57·3	57·3	56·6	46·4
Summer ...	76·5	65·2	67·6	66·3	63·7	52·2
Autumn ...	61·9	58·2	63·5	65·0	64·5	49·1
Winter ...	49·2	46·6	51·5	55·0	56·6	42·6
Year ...	62·4	56·0	60·0	60·9	60·4	47·6

* The mean temperature of the dew-point is obtained from the readings of the wet and dry bulb thermometers by means of Regnault's tables.

65. The greatest monthly range of temperature in Melbourne during fourteen years (69·1°) was in December 1868; the smallest (22·9°) was in August 1861. The greatest yearly range (82·6°) was in 1868. The greatest range in fourteen years was 84·2°. The greatest mean daily range in fourteen years (27·2°) was in November 1862, and the smallest (7·7°) was in June 1860. The mean daily range for each of the four seasons and for the year was as follows :— Range of temperature.

	Mean Daily Range of Temperature at Melbourne.
	°
Spring	19·8
Summer	22·1
Autumn	18·6
Winter	14·8
Year	18·8

66. The following table shows the highest solar and the lowest terrestrial radiation* indicated in Melbourne during each month, over a period in some instances of fourteen, and in other instances of fifteen years, together with the dates at which such extremes occurred :— Solar terrestrial radiation.

SOLAR AND TERRESTRIAL RADIATION AT MELBOURNE.

Months.	Highest Solar Radiation.		Lowest Terrestrial Radiation.	
	Reading.	Date.	Reading.	Date.
	°		°	
January	160·0	1862, on 14th ...	37·0	1868, on 28th
February	149·0	1870, on 15th ...	36·0	1868, on 25th
March	146·0	1868, on 1st ...	35·0	1871, on 19th
April	151·7	1859, on 26th ...	29·4	1865, on 29th
May	142·6	1859, on 2nd ...	27·2	1870, on 10th
			27·6	1868, on 31st
June	107·5	1861, on 11th ...	25·0	1868, on 16th
			25·0	1870, on 15th
			25·4	1866, on 11th
July	102·2	1869, on 27th ...	22·0	1869, on 21st
August	114·8	1869, on 29th ...	24·0	1863, on 11th
September	120·2	1869, on 30th ...	28·0	1869, on 11th
October	135·8	1868, on 28th ...	25·9	1871, on 3rd
November	141·1	1865, on 29th ...	32·0	1867, on 12th
December	151·8	1869, on 20th ...	35·0	1867, on 31st
	151·1	1868, on 24th ...	35·0	1870, on 4th
Extremes in 14 years	160·0	1862, on 14th January	22·0	1869, on 21st July

* The means by which the highest solar radiation and the lowest terrestrial radiation are observed are thus described by the Government Astronomer:—"The maximum temperature of solar radiation is observed by means of a thermometer placed horizontally on a wooden frame 5 feet from the ground, whose bulb is made of black glass externally covered with fine lampblack and enclosed in an outer and exhausted tube of transparent glass. The minimum terrestrial radiation is observed by means of an ordinary self-registering minimum spirit thermometer, the bulb of which is placed in the focus of a parabolic reflector well silvered and polished, exposed to the sky; the instrument is placed in a double-sided box, the whole protected from undue radiation by a small wooden house, the walls of which are nearly 6 feet high, whilst the reflector itself is 17 inches from the ground."

Height and range of barometer at Melbourne.

67. The Observatory at Melbourne is 91 feet above the level of the sea. The following figures, derived from observations taken at that Observatory over a period of fourteen years, show, for each of the four seasons, the mean height and mean monthly range of the mercury. The height of the column is reduced to 32° Fahrenheit, but not to the level of the sea :—

	Mean Height of Barometer at Melbourne.	Mean Monthly Range of Barometer at Melbourne.
	inches.	inches.
Spring	29·887	·812
Summer	29·835	·810
Autumn	30·004	·983
Winter	30·002	·932
Year ...	29·932	·884

Extremes of barometer in Melbourne.

68. The greatest monthly range of the barometer in Melbourne in fourteen years (1·503 in.) occurred in August 1870, and the smallest (·525 in.) occurred in March 1870. The greatest yearly range (1·719 in.) occurred in 1863, and the smallest (1·218 in.) occurred in 1860. The greatest range during the whole period of fourteen years was 1·810.

Mean of barometer at eight places.

69. Subjoined is the mean height of the barometer during a series of years at the stations already named, and, in addition, at Ararat, an inland town situated near the Dividing Range, and at Port Albert, a seaport town in Gippsland, 120 miles to the south-east of Melbourne :—

Stations.	Number of Feet above Sea-level.	Mean Height of Barometer.	Stations.	Number of Feet above Sea-level.	Mean Height of Barometer.
		inches.			inches.
Ararat	1,050	28·850	Melbourne ...	91	29·932
Ballarat	1,438	28·517	Port Albert ...	10	29·993
Cape Otway ...	270	29·730	Portland ...	37	29·981
Gabo Island ...	40	29·896	Sandhurst ...	758	29·211

Barometric tides.

70. According to observations taken by Professor Neumayer,* the amplitude of the daily curve of atmospheric pressure increases towards the summer months, when it is ·071 in., assumes a mean in spring and autumn (·063 in.), and is at a minimum in winter (·037 in.). It is greatest in the month of January (·077 in.), and least in the month of July (·035 in.). The turning points occur at 9h. 20m. a.m., and 3h. 45m. p.m., the former being the maximum and the latter the minimum. A secondary maximum takes place at 9h. p.m., and a minimum at 4h. p.m. The

* Professor Neumayer's Melbourne observations were taken at the Flagstaff Observatory, 120·7 feet above the sea-level.

following figures show the mean pressure of air at each alternate turn of the day and night :—

	Mean Height of Barometer at Melbourne.* inches.		Mean Height of Barometer at Melbourne.* inches.
Midnight ...	29·912	Noon ...	29·908
2h. a.m. ...	29·899	2h. p.m. ...	29·879
4h. „ ...	29·893	4h. „ ...	29·871
6h. „ ...	29·909	6h. „ ...	29·889
8h. „ ...	29·928	8h. „ ...	29·912
10h. „ ...	29·930	10h. „ ...	29·920

Pressure of air during various winds.

71. The same authority records as follows the influence of the various winds upon the barometer in Melbourne. It will be observed that it is highest with S.E. and S. winds, and lowest with N. and N.W. winds :—

Winds.	Mean Height of Barometer at Melbourne.* inches.	Winds.	Mean Height of Barometer at Melbourne.* 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

Rainfall at Melbourne.

72. The rainfall in Melbourne differs greatly in different years. Observations are here given extending over a period of the thirty-five years ended with 1874. The spaces opposite the year of separation from New South Wales (1851), and the three subsequent years, are blank, as no observations were recorded in those years. The year of greatest rainfall during the period was 1849, in which 44·25 inches of rain fell; then 1863, with 36·42 inches; then 1870, with 33·77 inches. The year when least rain fell was 1865, with 15·94 inches; then 1868, with 18·27 inches; then 1843, with 21·54 inches.

RAINFALL AT MELBOURNE,† 1840–1874.

Year.	Number of Days on which Rain fell.	Number of Inches of Rain.	Year.	Number of Days on which Rain fell.	Number of Inches of Rain.
1840 ...	...	22·57	1852 ...	...	...
1841 ...	...	30·18	1853 ...	...	...
1842 ...	...	31·16	1854 ...	...	...
1843 ...	...	21·54	1855 ...	...	28·21
1844 ...	...	28·26	1856 ...	...	29·75
1845 ...	...	23·93	1857 ...	...	28·90
1846 ...	...	30·53	1858 ...	158	26·02
1847 ...	...	30·18	1859 ...	156	21·80
1848 ...	...	33·15	1860 ...	133	25·40
1849 ...	...	44·25	1861 ...	159	29·16
1850 ...	...	26·98	1862 ...	139	22·08
1851 ...	...	...	1863 ...	165	36·42

* From observations taken at Flagstaff Observatory, 120·7 feet above sea-level.

† The rain-gauge used at the Melbourne Observatory is 7 feet above the ground, and is examined every day at 9 a.m. and 9 p.m.

RAINFALL AT MELBOURNE—*continued.*

Year.	Number of Days on which Rain fell.	Number of Inches of Rain.	Year.	Number of Days on which Rain fell.	Number of Inches of Rain.
1864 ...	144	27·40	1871 ...	125	30·17
1865 ...	119	15·94	1872 ...	136	32·52
1866 ...	107	22·41	1873 ...	134	25·60
1867 ...	133	25·79	1874 ...	134	28·11
1868 ...	120	18·27			
1869 ...	129	24·58			
1870 ...	129	33·77	Means ...	136·5	27·581

Mean rainfall at each season.

73. The mean for fourteen years of the rainfall in Melbourne during the various seasons is set down as follows :—

RAINFALL AT MELBOURNE DURING THE VARIOUS SEASONS.

	Mean Number of Days' Rainfall.	Mean Number of Inches of Rain.
Spring	40·3	7·79
Summer	24·4	6·41
Autumn	28·9	5·78
Winter	41·9	5·67
Year	135·5	25·65

Rainfall at six places.

74. The following table shows the rainfall at various stations in each of the twelve years ended with 1874. It will be observed that the mean number of days on which rain falls is greatest at Cape Otway and Portland, next at Melbourne and Ballarat, next at Ararat, and least of all at Sandhurst; also that the mean rainfall is greatest at Cape Otway, next at Portland, next at Ballarat, next at Melbourne, next at Ararat, and least at Sandhurst :—

RAINFALL AT VARIOUS STATIONS, 1863–1874.

Years.	Ararat.		Ballarat.		Cape Otway.	
	Number of Days on which Rain fell.	Total Amount of Rainfall.	Number of Days on which Rain fell.	Total Amount of Rainfall.	Number of Days on which Rain fell.	Total Amount of Rainfall.
		inches.		inches.		inches.
1863	131	37·37	173	37·27	...	...
1864	131	...	133	24·02	...	...
1865	79	15·71	110	20·09	185	38·62
1866	115	18·21	127	23·35	182	34·28
1867	105	25·28	132	29·87	172	38·98
1868	115	23·27	111	17·23	162	31·99
1869	129	20·68	132	22.85	132	36·84
1870	141	28·20	138	36·38	149	36·60
1871	143	25·75	122	27·51	174	36·66
1872	141	28·79	134	31·81	173	37·90
1873	107	21·45	119	27·49	163	32·11
1874	80	23·17	130	27·83	157	42·44
Means ...	118·08	24·35	130·08	27·14	164·90	36·64

RAINFALL AT VARIOUS STATIONS, 1863–1874—*continued.*

Years.	Melbourne.		Portland.		Sandhurst.	
	Number of Days on which Rain fell.	Total Amount of Rainfall.	Number of Days on which Rain fell.	Total Amount of Rainfall.	Number of Days on which Rain fell.	Total Amount of Rainfall.
		inches.		inches.		inches.
1863	165	36·43	178	45·31	150	33·92
1864	144	27·40	153	33·06	105	23·03
1865	119	15·94	161	34·37	74	10·85
1866	107	22·41	160	31·75	106	21·41
1867	133	25·79	164	33·87	110	26·66
1868	120	18·27	175	30·32	102	17·34
1869	129	24·58	156	23·53	99	21·29
1870	129	33·77	135	...	127	38·37
1871	125	30·17	...	...	118	27·12
1872	136	32·52	175	37·01	111	26·25
1873	134	25·61	186	30·77	115	20·54
1874	134	28·10	170	32·11	80	19·58
Means ...	131·25	26·75	164·82	33·21	108·08	23·86

Rainfall in Melbourne, Sydney, and Adelaide.

75. The annual rainfall in Melbourne is not nearly so great as that of Sydney, but much greater than that of Adelaide. The following figures show the mean rainfall in those three places, the observations for Sydney and Adelaide being derived from the valuable work of Sir G. S. Kingston, recently laid before the Parliament of South Australia* :—

	Mean Number of Inches of Rain during the Year.
Melbourne	27·58
Sydney	49·95
Adelaide	21·36

Comparison of rainfall in the three colonies.

76. It will be observed that, on the average, nearly 6 inches (5·7 inches) more rain falls in Sydney in each year than in the year of greatest rainfall in Victoria (1849).† In the thirty-three years, ended with 1873, over which the Sydney observations extend, the rainfall has risen four times above seventy inches, and once, in 1860, above eighty inches (82·81 inches). Strange to say, the least rainfall in Sydney (21·49 inches) was experienced in 1849, the year of greatest rainfall in Melbourne. The year in which the greatest rainfall occurred in Adelaide during the thirty-five years ended with 1873 (30·63 inches) was 1851, and the year of the least rainfall (13·85 inches) was 1869.

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* "Register of the Rain-gauge, Adelaide," by Sir George Strickland Kingston; Adelaide, Cox, 1874.

† See par. 72 *ante*, and following table.

Mean humidity at Melbourne.

77. The mean humidity in Melbourne, as obtained from readings of the dry and wet bulb thermometers, during fourteen years, is recorded as follows for the four seasons of the year :—

	Mean Humidity at Melbourne. Per cent.
Spring	70
Summer	65
Autumn	73
Winter	79
Year	72

Mean humidity at six places.

78. The mean humidity at various stations for the entire year is set down as follows, the figures being derived from observations extending over periods of from ten to sixteen years :—

	Mean Annual Humidity. Per cent.
Ballarat	74
Cape Otway	86
Gabo Island	88
Melbourne	72
Portland	78
Sandhurst	67

Winds.

79. All writers upon the meteorology of Victoria agree that the alternation of the equatorial and polar currents is the main feature of the wind system. Near the sea the character of the winds is influenced by land and sea breezes, and in the interior the currents of air are affected by mountain chains and other features of the country.

Winds at each season.

80. The following table, taken from Mr. Ellery's monthly record, gives the average for six years of the percentage of hours in each of the seasons during which the wind blew at Melbourne from the different points of the compass :—

WINDS IN MELBOURNE DURING THE VARIOUS SEASONS.

Winds.	Spring.	Summer.	Autumn.	Winter.	Year.
North	16·2	7·4	14·4	31·8	17·5
N.W.	8·6	4·0	6·2	13·5	8·1
West	15·9	8·6	10·4	13·9	12·2
S.W.	17·0	19·3	13·3	8·7	14·5
South	16·1	24·9	16·0	5·3	15·6
S.E.	8·9	20·2	16·7	4·8	12·6
East	4·3	6·2	6·7	3·3	5·1
N.E.	12·0	8·5	14·9	17·7	13·3
Calms	1·0	·9	1·4	1·0	1·1
Total ...	100·0	100·0	100·0	100·0	100·0

Volocity of winds.

81. The mean number of miles travelled by the wind are set down as 7,838, the mean hourly velocity as 10·7 miles, and the greatest hourly

velocity during the six years as 58 miles, from midnight to 1 h. a.m. on the 8th March 1866.

Quarter from which winds are strongest and lightest.

82. The strongest winds in Melbourne are those from the north and south-west. Westerly winds are throughout the country at all seasons frequent, and blow generally with great violence and in heavy squalls. East winds are usually light.

Hours at which winds are lightest.

83. It has been noticed that the wind is lightest on the average at 1 a.m. and strongest at 1 p.m., and shows a regular increase and decrease between those points.

Winds prevailing at various places.

84. It has been observed that winds from the north and south prevail at Ararat, Ballarat, Castlemaine, Geelong, Heathcote, Melbourne, and Sandhurst; and that winds from the east and west are most frequent at Alberton, Beechworth, Camperdown, and Portland.

Hot winds.

85. The hot winds of Victoria form the peculiar feature of its climate which is most talked about in other countries, and is most dreaded by new arrivals. They frequently set in about 9 a.m., and blow from the north with great violence, raising clouds of dust. Vegetation becomes parched up, fruit falls from the trees, and most descriptions of animals appear to be greatly oppressed. The time is a trying one for young children and invalids. The wind often changes to the south towards evening, but sometimes continues to blow from the north for two and even three days. When the welcome southerly wind sets in it frequently does so in a heavy squall, accompanied with drops of rain and thunder and lightning, and the thermometer sometimes falls as much as twenty or thirty degrees in half an hour. According to Neumayer, the average number of hot winds for the colony amounts to eight or nine per annum, but the average is different in different localities, according to the following classification :—

	Average Number of Days of Hot Wind per Annum.
Melbourne and Castlemaine	14
Sandhurst, Heathcote, and Portland	11
Beechworth, Ararat, and Swan Hill	8
Geelong and Ballarat	6
Alberton and Camperdown	3

Ozone.

86. Observations for ozonic reaction have been carried on in Melbourne for some years. It is found that this element is smallest with east winds, that it slightly increases with north and north-west winds, and reaches the highest point with south-west winds. The following is a statement of the means of each month during fifteen years, the observations being taken at the Melbourne Government Observatory by means of Jame's (of Sedan) papers, with a scale ranging from 0 to 21. The ozone paper is suspended in a tin box which admits of a free circulation

of air, but in which it is protected from the direct action of the sun's rays and from rain. The observations are registered at 9 a.m. and 9 p.m. each day :—

	Mean Amount of Ozone at Melbourne.			Mean Amount of Ozone at Melbourne.
January	...	8·3	September ...	11·5
February	...	8·8	October ...	11·1
March	...	8·7	November ...	9·9
April ...	...	9·3	December ...	8·7
May ...	...	9·7		
June ...	...	10·3	Year ...	9·9
July ...	...	11·5		
August	...	11·4		

Cloud at Melbourne.

87. The amount of cloud is obtained at the Observatory by registering the sky when clear as 0, and when completely overset as 10, estimating the intermediate amounts. The following are figures showing the mean amount of cloud in Melbourne during each of the twelve months, the observations extending over a period of sixteen years :—

	Mean Amount of Cloud at Melbourne.			Mean Amount of Cloud at Melbourne.
January	...	5·3	September ...	6·1
February	...	5·2	October ...	6·0
March	...	5·3	November ...	5·9
April ...	...	5·9	December ...	5·4
May ...	...	6·5		
June ...	...	6·6	Year ...	5·9
July ...	...	6·4		
August	...	6·2		

Cloud at various places.

88. According to Neumayer the amount of cloud is on the average greater than half the sky in Ballarat, Camperdown, Geelong, Melbourne, Portland, and Port Albert, the yearly mean for the group being 5·61, and less than half the sky for Beechworth, Castlemaine, Heathcote, and Sandhurst, the yearly mean being 3·69. Camperdown he states to be the place where most, and Castlemaine and Sandhurst the places where least, clouds prevail in the colony.

Thunder-storms.

89. Thunderstorms in Victoria are often exceedingly heavy, and are accompanied with torrents of rain. The yearly average for Victoria has been observed to be sixteen, distributed over the different seasons as follows :—

	Mean Number of Thunderstorms in Victoria.
Spring	5
Summer	6
Autumn	3
Winter	2
Year	16

90. The average frequency of thunderstorms differs in different localities. It is said that these may be grouped as follow :— Thunderstorms at various places.

	Average Number of Thunderstorms in the Year.
Ararat, Beechworth, and Melbourne	26
Camperdown, Heathcote, and Alberton... ...	19
Ballarat, Sandhurst, Castlemaine, and Portland ...	13
Geelong and Swan Hill	3

91. Besides thunderstorms, lightning without thunder is frequently seen, the average number of days in Melbourne being thirty-five in the year. These are divided into the different seasons as follow :— Lightning without thunder.

	Average Number of Days of Lightning without Thunder at Melbourne.
Spring	12
Summer	8
Autumn	8
Winter	7
Year	35

92. Storms of hail occur chiefly in spring and in the end of winter, although they sometimes take place in summer. The average number of hailstorms in different localities has been recorded as follows :— Hailstorms.

	Average Number of Hailstorms in the Year.
Camperdown	9
Beechworth	6
Ballarat, Heathcote, and Portland	5
Melbourne and Swan Hill	4
Ararat, Castlemaine, and Sandhurst	3
Port Albert	1

93. Hoar-frost and ice occur pretty frequently in Melbourne in the month of July, sometimes also in June and August—rarely as late as September. Professor Neumayer mentions it as a fact worthy of notice that on one occasion hoar-frost was seen in Melbourne as late as the 22nd September. He, however, mentions that at the mountainous stations—Ballarat, Beechworth, Castlemaine, Heathcote, Sandhurst, and Warrenheip—ice occurs as early as the last days of March, and as late as the middle of October; whilst at stations near the seacoast it is never seen before the last days of May or after those of September. According to his observations, the average number of days on which ice occurs are thirty-five for Heathcote, sixteen for Ballarat, and eleven for Beechworth. In one year, a very favorable one for the formation of ice, it occurred on seven days in Melbourne. Hoar-frost and ice.

94. The following are the approximate values of the variation of the compass and magnetic dip for different localities in the colony of Victoria, derived from the magnetic survey of the colony made by Variation and dip of needle.

Professor G. Neumayer, and reduced to the year 1875 at the Melbourne Observatory :—

VARIATION AND DIP OF THE MAGNETIC NEEDLE, 1875.*

Names of Localities.	Variation East.	South Dip.	Names of Localities.	Variation East.	South Dip.
	° ′	° ′		° ′	° ′
Daylesford	10 8	66 59	Benalla	8 31	65 51
Upper Macalister ...	9 30	66 38	French Island ...	8 30	67 38
The Straits (Seacombe)	9 30	67 3	Longwood	8 28	66 10
Port Albert ...	9 26	67 40	Wahgunyah ...	8 27	65 19
Indi River (Groggan's Station)	9 26	65 29	Cranbourne	8 27	67 20
Dargo Station ...	9 21	66 37	Rothwell	8 23	67 12
Giffard	9 21	67 19	Melbourne Observatory	8 22	67 6
Buckland's Camp ...	9 17	66 5	Cummins's, near Geodetic Survey Observatory, 145° E. Long.	8 22	66 56
Rosedale	9 17	67 11	Donnybrook ...	—	67 45
Cape Schanck ...	9 15	67 20	Echuca	8 22	65 32
Buenboar	9 12	65 37	Mulwallah	8 22	65 20
Muddy Creek (Corner Inlet)	9 11	—	Sandy Point (Western Port)	8 21	67 43
Jericho	9 11	66 46	Kilmore	8 21	66 33
Keogh's Bridge, Mitta Mitta	9 9	65 41	Maryborough ...	8 19	66 37
Junction of Mitta and Snowy Creek ...	9 7	65 31	Spring Creek ...	8 18	—
Omeo, Livingstone ...	9 5	66 13	Shepparton	8 17	65 52
Flourbag Plain ...	—	66 19	Mt. Blackwood ...	8 17	66 31
Mansfield	9 4	66 33	Caddandra (Broken Creek)	8 16	65 34
Jamieson	9 3	66 17	Seymour	8 15	66 17
Sandy Point (Shallow Inlet)	9 3	67 48	Woodend	8 14	66 50
Donnelly's Creek ...	9 2	—	Rushworth	8 14	66 0
Tarwin River, Black's Station	9 2	67 47	Williamstown ...	8 13	67 15
Yabba	9 0	65 19	Dunkeld	8 12	66 46
Omeo Station ...	8 59	66 2	Mt. Disappointment ...	—	66 39
Mount Elephant ...	8 56	—	Footscray	8 11	—
Bright (Morse's Creek)	8 56	65 59	Bacchus Marsh, Darley	8 8	66 55
Powlett River ...	8 55	—	Mt. Ida	8 6	66 23
Baldhills Township ...	8 54	—	Yandari (St. Germain)	8 5	—
Fernhills, Holland River	8 52	66 2	Castlemaine... ...	8 4	66 43
Gibbo Creek ...	8 51	—	Keilor	—	67 10
Beechworth... ...	8 50	65 33	Baldhill, Keilor Plains	—	68 42
Albury—Wodonga ...	8 48	65 20	Carlsruhe	—	66 48
Chiltern	8 48	65 28	Mt. Tarrangower ...	—	66 43
Mount Juliet ...	8 48	—	Wyndham	—	67 29
Merton	8 44	66 21	Rochester	8 1	65 50
Wangaratta... ...	8 40	65 28	Greenhills, near Ballarat	8 1	67 42
Violettown	8 38	65 64	Heathcote East ...	8 1	66 22
Upper Acheron ...	8 37	66 51	Thomson's Creek, Shirley	7 59	67 2
Acheron Station ...	8 37	66 44	Campaspe, Kennedy's Punt	7 59	66 8
Geelong	8 36	67 26	Ballarat East ...	7 58	67 11
Molesworth... ...	8 35	66 28	Pitfield	7 58	67 17
Queenscliff	8 34	67 41			

* This useful table has been compiled specially for this work by Mr. E. J. White, Acting Government Astronomer of Victoria.

VARIATION AND DIP OF THE MAGNETIC NEEDLE, 1875—*continued.*

Names of Localities.	Variation. East.	South Dip.	Names of Localities.	Variation. East.	South Dip.
	° ′	°		° ′	° ′
Magnetic Hill, between Maupoke and Inkermann	7 57	66 55	Concongella Creek ...	7 26	66 34
Horsham	7 57	66 22	Ararat, Rainbow Inn	7 25	66 54
Blackhill, close to Ballarat	7 56	—	Mortwara	7 20	65 4
Corangamite Creek or Swamp	7 56	67 41	Piangil	7 20	64 49
Colac	7 56	67 37	Learmonth	7 20	66 56
Ararat (Quartzhill) ...	7 55	66 43	St. Arnaud	7 20	66 5
Morrison's Diggings ...	7 55	67 12	Longerenong ...	7 19	66 25
Cressy	7 54	67 37	Spring Hill	7 18	66 20
Blackhill Tunnel ...	—	66 59	Lake Buloke ...	7 18	65 55
Epsom (Bendigo) ...	7 52	66 17	Lake Tyrrell ...	7 17	—
Kangaroo Gully (Bendigo)	7 52	66 21	Murra Murra (Robertson's Station) ...	7 16	66 46
Serpentine Inn ...	7 51	65 53	Naroween	7 14	64 47
Schnapper Point ...	—	67 44	Boundary Line, South-west	7 14	67 42
Dandenong	7 51	67 15	Digby	7 13	67 20
Queenstown... ...	—	66 50	Tia Bolite	7 12	64 53
Newbridge, Loddon ...	7 50	66 18	Youngera	7 13	64 28
Apollo Bay, Point Bunbury	7 50	67 56	Manifold's Swamp ...	7 12	67 33
Pickaninny Creek (Power's Station) ...	7 50	65 47	Charlton West (banks of the Avoca) ...	7 11	65 59
Amphitheatre ...	7 50	—	Euston	7 8	64 27
Black's Station, near Mt. Nooran ...	7 49	67 46	The Pound below Euston	7 8	64 43
Glenorchy	7 49	66 34	Mt. Shadwell ...	7 8	68 19
Heathcote West ...	7 49	66 24	Yarriambiack Creek, near Batchina ...	7 7	65 56
Harrow	7 49	—	Nyppo	7 5	65 23
Avoca	7 49	66 48	Antwerp	7 5	65 54
Casterton	7 47	67 23	Melton	7 4	66 37
Clunes	7 46	66 53	Rosebrook	7 4	66 57
Cape Otway ...	7 41	68 4	Portland	7 3	68 3
Mt. Korong	7 40	66 1	Lake Coorong ...	7 3	65 28
Dunolly	7 40	66 26	Tereejee	7 1	65 28
Hopkins River ...	7 36	66 54	Lake Hindmarsh ...	7 1	65 47
Mt. Rouse	7 36	67 29	Goall, Spectacle Plains	7 1	65 22
Caramut	7 35	67 23	Pine Plains	6 59	65 3
Quambatook ...	7 35	65 26	Mournpall	6 59	64 27
Kerang	—	65 18	Pyalong	—	66 38
Mt Hope	—	65 31	Chetwynd	6 58	67 1
Belfast	7 33	68 2	Yellamyip	6 56	65 22
Beaufort (Fiery Creek)	7 33	66 53	Salt Lakes, Onetree Hill	6 53	64 58
Crowlands	7 33	66 49	Murray, Police Station	6 53	64 24
Warrnambool ...	7 29	68 3	Dartmoor	6 51	67 40
Mt. Sturgeon ...	7 29	—	Consolation Plains ...	6 52	—
Camperdown ...	7 28	67 50	Grassdale	6 48	—
Swanhill	7 28	64 51	Cavendish	6 44	67 9
Lalbert	7 28	65 21	Mt. Gambier ...	6 42	67 46
Wimmera (Upper region)	7 28	66 15	Mildura	6 40	64 19
The Richardson (Maranew)	7 28	66 10	Junction of Murray and Darling	6 36	64 2
Hamilton	7 27	67 38	Pentland	6 27	66 48
			Kulnine	6 27	64 5
			Boundary, N W. ...	6 25	64 1
			Walla Walla Lake ...	6 23	64 15
			Bochara	6 11	—

Daily variation of needle.

95. According to Neumayer, the magnetic declination (variation of the needle) reaches its minimum value for the day shortly after 9 h. a.m. ; it then increases rapidly until 2 h. 20 m. p.m., when it reaches its maximum. After this it decreases rapidly towards 6 h. p.m., from thence slowly until after 1 h. a.m., when it again slightly increases to 4 a.m., thence falling to its minimum.

CENSUS RESULTS.

Number of times census has been taken.

96. During the forty years that have elapsed since the first colonization of the territory now called Victoria, the population has been enumerated ten times. In the early days of settlement it was considered necessary to take a census, which, from the smallness of the population, was then a comparatively easy task, at frequent intervals. Between the last two censuses, however, a period of ten years was allowed to intervene, and a similar period will probably be permitted to pass before another census is taken.

Population at ten censuses.

97. The growth of the population of the colony is shown by the following table, which gives the number of persons enumerated at each census and the number of houses enumerated at most of those periods :—

INHABITANTS AND HOUSES, 1836–1871.

Date of Enumeration.	Population.			Number of Houses.
	Persons.	Males.	Females.	
25th May 1836	177	142	35	...
8th November 1836	224	186	38	...
12th September 1838 ...	3,511	3,080	431	...
2nd March 1841	11,738	8,274	3,464	1,490
2nd March 1846	32,879	20,184	12,695	5,198
2nd March 1851	77,345	46,202	31,143	10,935
26th April 1854	236,798	155,887	80,911	...
29th March 1857	410,766	264,334	146,432	102,001
7th April 1861	540,322	328,651	211,671	134,332
2nd April 1871*	731,528	401,050	330,478	158,481

Increase of population.

98. It will be seen by the above table that on the 2nd April 1871 the number of inhabitants in Victoria was 731,528, and that ten years

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* For latest estimate of population, *see* Digest of Statistics of 1874, Part III.—Population, *post.*