3

CLIMATE

CLIMATE IN VICTORIA

General conditions

Victoria is situated between latitudes 35°S and 39°S in the south-east of the Australian continent. The major topographical determinant of the climate is the Great Dividing Range, running east-west across the State, and rising to nearly 2,000 metres in the eastern half. This acts as a barrier to the moist south-east to south-west winds, causing the south of the State to receive more rain than the north.

To the south of Victoria, except for Tasmania and its islands, there is no land for 3,000 kilometres. This vast area of ocean has a moderating influence on Victoria's climate in winter. Snow, which is a common winter occurrence at similar latitudes on the eastern seaboard of the great land masses of the northern hemisphere, is rare in Victoria below elevations of 600 metres. To the north of Victoria, the land mass of Australia becomes very hot in the summer, and on several days at this time of the year the temperature over the State may rise to between 35°C and 40°C, often with a strong northerly wind.

Climatic divisions

Northern plains

The mean annual rainfall varies from below 300 mm in the northern Mallee to 500 mm on the northern slopes of the Dividing Range. Variability of rain from year to year is high and increases northwards. Average monthly rainfall totals range from 20 to 30 mm in the summer to between 30 and 50 mm during the colder six months—May to October.

Cold fronts bring rain to the Wimmera, particularly in winter, but have less effect in the Mallee and the northern country. Rain in these latter districts is usually brought by depressions moving inland from the region of the Great Australian Bight, or from depressions developing over New South Wales or northern Victoria itself.

Summers are hot with many days over 32°C, while winter nights can be very cold with widespread frost.

Highlands

The average annual rainfall depends on elevation, ranging from 500 mm in the foothills in the west to over 1,500 mm on the mountains in the east. The higher mountains are snow covered in the winter months. During the colder part of the year, essentially May to October, monthly rainfall is generally higher than for the remainder of the year. Pasture growth is limited by cold in winter and the main growth occurs in autumn and spring.

The low valleys are subject to hot summer days but mean temperature decreases by about 1°C per 200 metres elevation. Winter nights are very cold and the valleys are particularly prone to frost and fog.

Western districts

Most rain comes with the westerly winds and cold fronts that predominate in winter and the average rainfall shows a winter maximum which is most marked along the west coast. Average annual rainfall ranges from less than 600 mm over the plains from Geelong to Lismore to over 1,400 mm on the higher parts of the Otways. Pasture growth is limited by dryness in summer and cold in winter; the main growth occurs in autumn and spring.

Sea breezes near the coast temper the heat on many summer days and on many occasions the sea breeze develops into a weak cold front which extends over most of the area. There are, however, a number of days when the temperature exceeds 32°C.

Gippsland

In west and south Gippsland most rain comes with the westerly winds and cold fronts that predominate in winter, but some rain also falls in summer from depressions over eastern New South Wales. The difference between winter and summer rainfall is not as marked as in the western districts.

Depressions off the east coast bring most rain to east Gippsland and such rainfall can be very heavy. The frequency of a three day rainfall over 75 mm is much greater in this district than elsewhere in Victoria. Rainfall in the east is fairly evenly distributed throughout the year.

Average annual rainfall is less than 600 mm in the Sale-Maffra area, which lies between the influence of western cold fronts and eastern depressions. Over the higher parts of the south Gippsland hills, the average annual rainfall exceeds 1,400 mm. Along the upper valleys of the Mitchell, Tambo, and Snowy Rivers, rainfall is much less than on the surrounding highlands.

Most of the closely settled areas are within reach of the sea breeze on summer days and the frequency of high temperatures is less than in other parts of Victoria of similar elevation.

On some winter days, however, the coastal areas of east Gippsland have the highest temperatures in the State, due to the Föhn effect of north-westerly winds descending from the mountains.

Circulation patterns

The general weather of southern Australia is determined primarily by the behaviour of high pressure systems, which move from west to east on a more or less latitudinal track. The mean track is centred south of the continent from November to April, but is located between latitudes 30°S and 35°S from May to October. These anticyclones are separated by low pressure areas, which usually contain active frontal surfaces separating air masses of different characteristics. The low pressure areas are often rain bearing systems and their most northerly influence occurs in winter.

Rainfall in most districts is higher in winter and spring than in other seasons. This effect is most marked in the south-west quarter of the State, where the average rainfall in July is three times that of January. East Gippsland, however, receives little rain from cold fronts and depressions approaching from the west. The heaviest rain in that district is produced by intense depressions to the east of Bass Strait which have usually developed to the east of New South Wales or further north, and moved southwards along the coast. Rainfall in East Gippsland is fairly evenly distributed through the year.

On occasions, in late autumn, winter, or spring, an anticyclone develops a ridge of high pressure to southern waters and a depression intensifies east of Tasmania. This causes cold and relatively dry air to be brought rapidly across Victoria, bringing windy, showery weather with some hail and snow. On other occasions, when an anticyclone moves slowly over Victoria or Tasmania, a spell of fine weather with frost or fog results. These spells can last as long as a week.

In summer, the more southerly location of the anticyclone belt frequently brings a light east to north-east wind flow over Victoria with sea breezes near the coast. When anticyclones move into the Tasman Sea, where they sometimes stagnate for several days, winds tend northerly and increase in speed. This situation results in heat wave conditions, which persist until relieved by the west to south-west winds associated with the next oncoming depression. The fall in temperature associated with the wind change can be quite sharp.

The weather over south-eastern Australia in summer is occasionally influenced by the penetration of moist air of tropical origin. Although an infrequent event, this is responsible for some of the heaviest rainfalls over the State.

Rainfall

The distribution of average annual rainfall in Victoria is shown in Figure 7 on page 73. Average rainfall ranges from 250 mm for the driest parts of the Mallee to 2,600 mm at Falls Creek in the Alps. There will be other locations in the Alps with similar rainfall, but where the rain is not measured.

Except for east Gippsland, more rain falls in winter than in summer. Summer rainfall is more variable and the higher evaporation of this season greatly reduces the effectiveness of the rainfall.

All parts of Victoria are occasionally subject to heavy rain and monthly totals exceeding three times the average have been recorded. Monthly totals have exceeded 250 mm on several occasions in Gippsland and the north-east, and rarely along the west coast. The highest monthly total recorded in the State is 891 mm at Tanybryn in the Otway district in June 1952.

Intense rainfall of short duration is usually the result of a thunderstorm. On 17 February 1972, 78 mm fell within one hour over an area of about 3.5 square kilometres in central Melbourne. Falls of similar intensity and duration occur from time to time in Victoria, but because such a small area is affected, not all are officially recorded.

The average annual number of days of rain (0.2 mm or more in 24 hours) is over 150 on the west coast and west Gippsland, and exceeds 200 over the Otway Ranges. The average number of wet days a year is reduced to 100 at a distance of approximately 160 kilometres inland from the coast.

An estimate of the area, distribution of average annual rainfall, and the actual distribution of rainfall in Victoria as shown by area is given in the following table, and the table on page 75.

VICTORIA—DISTRIBUTION OF AVERAGE AND ANNUAL RAINFALL

Rainfall (mm)	Area ('000 square kilometres) (*a*)					
	Average	1972	1973	1974	1975	1976
Under 300	18.4	55.2	..	..	1.4	49.6
300–400	36.5	38.5	..	..	29.7	32.7
400–500	27.5	35.0	..	18.5	25.1	21.3
500–600	34.9	40.7	22.6	23.5	22.1	31.4
600–800	52.3	40.9	76.2	81.7	64.2	51.9
800–1,000	29.0	12.9	65.2	38.1	35.8	29.6
Over 1,000	29.0	4.4	63.6	65.8	49.3	11.1

(*a*) Total area of Victoria is 227,600 square kilometres.

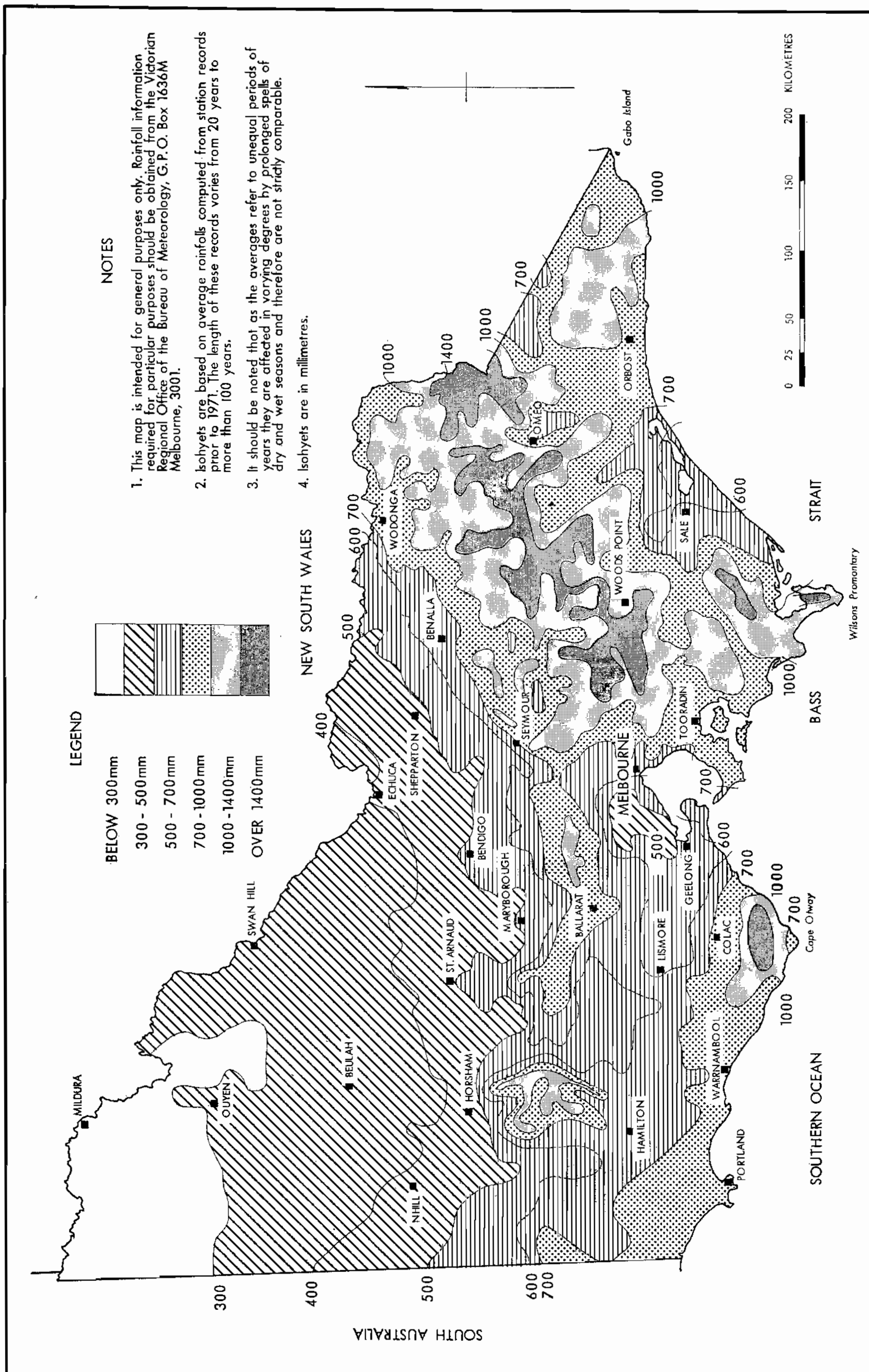

FIGURE 7. Average annual rainfall map of Victoria.

VICTORIA—DISTRICT MONTHLY RAINFALL: AVERAGE AND 1976

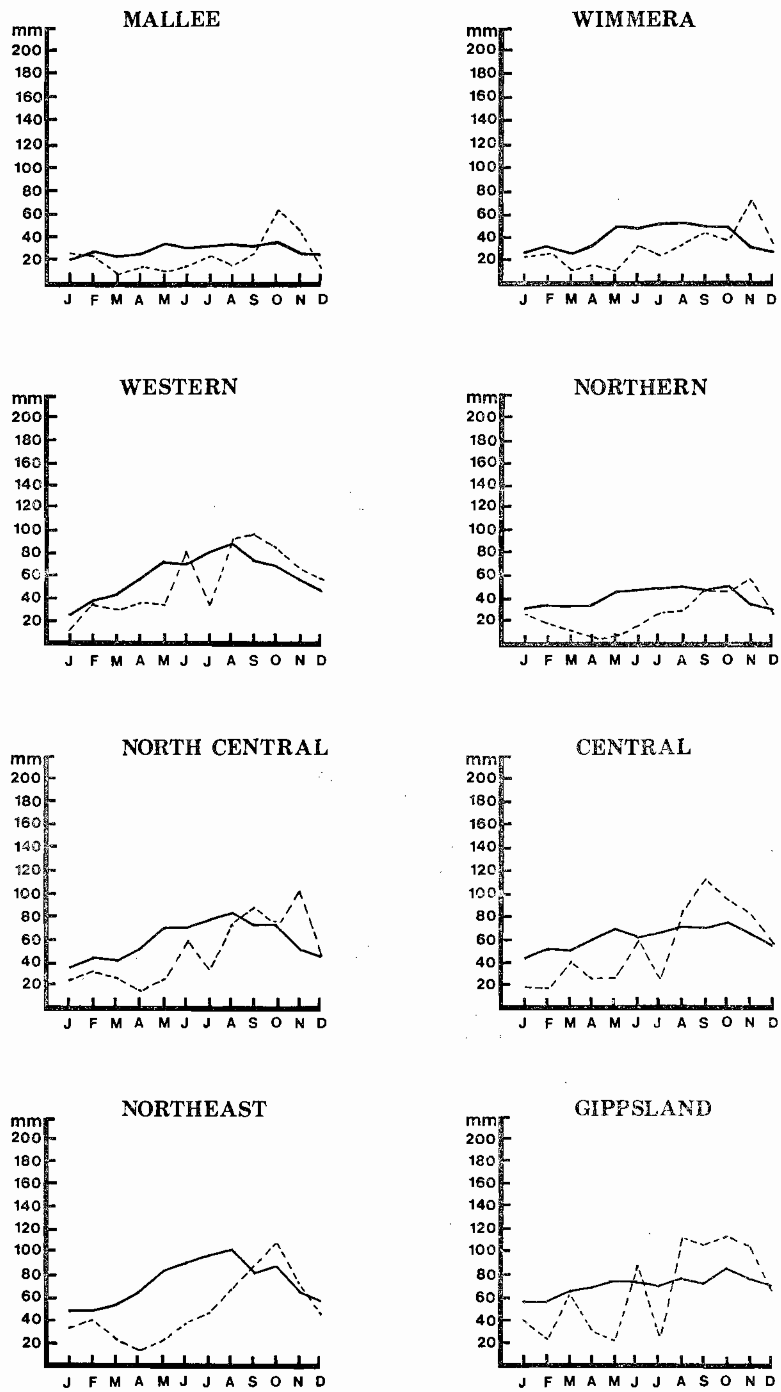

FIGURE 8.

VICTORIA—RAINFALL IN DISTRICTS
(mm)

Year	District							
	Mallee	Wimmera	Northern	North Central	North-Eastern	Western	Central	Gippsland
1967	130	221	240	408	448	417	434	593
1968	348	500	532	880	1,004	852	733	865
1969	408	443	481	690	878	679	664	915
1970	367	474	515	843	993	857	937	1,122
1971	384	568	529	891	888	905	849	872
1972	261	365	331	576	522	600	564	601
1973	634	764	905	1,144	1,307	856	933	908
1974	530	692	763	993	1,254	805	895	1,102
1975	406	531	618	885	1,081	818	787	920
1976	268	362	307	599	594	667	640	792
Average (*a*)	339	468	483	721	875	730	742	860

(*a*) Average for 64 years 1913 to 1976.

Rainfall reliability

It is not possible to give a complete description of rainfall at a place or in a district by using a single measurement. The common practice of quoting the annual average rainfall alone is quite inadequate in that it does not convey any idea of the extent of the variability likely to be encountered. Examination of rainfall figures over a period of years for any particular place indicates a wide variation from the average ; in fact it is rare for any station to record the average rainfall in any particular year. Thus for a more complete picture of annual rainfall the variability, or deviation from the average, should be considered in conjunction with the average.

Rainfall variability assumes major importance in some agricultural areas. Even though the average rainfall may suggest a reasonable margin of safety for the growing of certain crops, this figure may be based on a few years of heavy rainfall combined with a larger number of years having rainfall below minimum requirements. Variability of rainfall is also important for water storage design, as a large number of relatively dry years would not be completely compensated by a few exceptionally wet years when surplus water could not be stored.

Although variability would give some indication of expected departures from normal over a number of years, variability cannot be presented as simply as average rainfall.

Several expressions may be used to measure variability, each of which may have a different magnitude. The simplest measure of variability is the range, i.e., the difference between the highest and lowest annual amounts recorded in a series of years. Annual rainfall in Victoria is assumed to have a " normal " statistical distribution. These distributions can be described fully by the average and the standard deviation. To compare the variability at one station with that at another, the percentage coefficient of variation $\left(\frac{\text{standard deviation}}{\text{the average}} \times 100\right)$ has been used. This percentage coefficient has been calculated for the fifteen climatic districts of Victoria (see Figure 9) for the 63 years 1913 to 1975 and the results are tabulated in the following table in order of rainfall reliability:

VICTORIA—ANNUAL RAINFALL VARIATION

District	Average annual rainfall (a)	Standard deviation	Coefficient of variation
	mm	mm	per cent
1 West Gippsland	919	147	16 0
2 West Coast	778	126	16.2
3 East Central	895	150	16.8
4 Western Plains	635	114	18.0
5 East Gippsland	779	153	19.6
6 West Central	614	121	19.7
7 South Wimmera	506	109	21.5
8 North Central	725	168	23.2
9 North Wimmera	418	98	23.4
10 Upper North-east	1,119	273	24.4
11 Lower North-east	784	209	26.7
12 South Mallee	357	99	27.7
13 Upper North	522	145	27.8
14 Lower North	439	133	30.3
15 North Mallee	310	96	31.0

(a) Average for 63 years 1913 to 1975.

The higher the value of the percentage coefficient of variation of the rainfall of a district, the greater the possible departure from the average and hence the more unreliable the rainfall.

Droughts

The variability of annual rainfall is closely associated with the incidence of drought. Droughts are rare over areas of low rainfall variability and more common in areas where this index is high.

Since records have been taken, there have been numerous dry spells in various parts of Victoria, most of them of little consequence but some widespread and long enough to be classified as droughts. The severity of major droughts or dry spells is much lower in Gippsland and the Western District than in northern Victoria.

The earliest references to drought in Victoria appear to date from 1865 when a major drought occurred in northern Victoria, and predominantly dry conditions prevailed in the Central District. Another dry spell of lesser intensity occurred in 1868.

The most severe and widespread drought recorded since European settlement in Australia occurred in the period from 1897 to 1902. Victoria was most affected in the south in 1897–98 and in the north in 1902.

The next major drought commenced about June 1913 and continued until April 1915 in the north and west and until August 1916 in Gippsland. The worst period was from May to October 1914.

Droughts of shorter duration and lower intensity occurred in 1877, 1888, in 1907–08 in Gippsland, and in the 1920s, particularly in 1925, 1927, and 1929.

The period from 1937 to 1945 was marked by three major droughts. The first commenced in February 1937 and continued with a break in the succeeding spring and summer until January 1939, the effects being felt much more severely in northern districts than elsewhere. Good rains in 1939 were followed by another dry period from December 1939 to December 1940. The third drought of the period extended from 1943 to 1945 in which the worst period was from June to October 1944. The drought from 1967 to 1968 is described on pages 53 and 67 of the *Victorian Year Book* 1969 and other effects noted on pages 309–12 of the *Victorian Year Book* 1970.

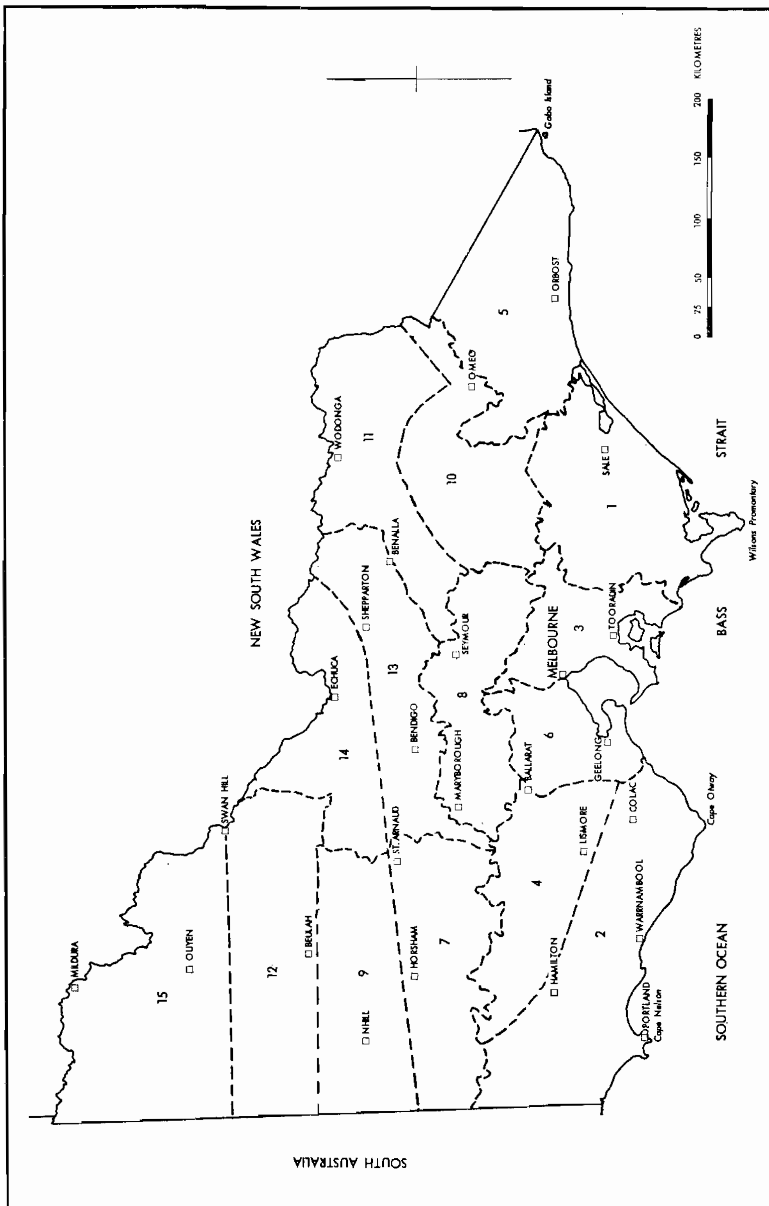

FIGURE 9. Relative rainfall variability by districts. Names of climatic districts are shown in the table on page 76.

Drought prevailed in east Gippsland in 1971. In 1972 this drought extended westwards to affect most parts of the State by the end of the year, before ending after heavy rain in February 1973.

Northern Victoria experienced drought conditions for about 10 months until September 1975, while in 1976 the failure of summer and early autumn rains in the south led to severe rainfall deficiencies, particularly in south Gippsland. The drought had extended to most of Victoria before ending with good rains in September and October.

Bushfires

Records of early Victorian life already describe fires in the developing colony. For example, the chronicler " Garryowen " (Edmund Finn) noted that in the summer of 1846 " bushfires raged," and the Plenty area was " laid waste ". The explorer George Bass, on New Year's Day 1798 was said to have noted " many large smokes behind the beach " as his whaleboat made its way along the east Gippsland coast.

The first really devastating fire in the colony that is documented in detail is the " Black Thursday " occurrence of 6 February 1851. This day followed a familiar pattern—very high temperatures and strong northerly winds. Since that time there have been many similar conflagrations, Gippsland in 1898 and " Black Friday " on 13 January 1939 being two of great moment. In more recent years, the Lara fires on 8 January 1969 and the fires in the Dandenong Ranges in January 1962 were serious and caused loss of life and property.

Weather plays an important role in the development and spread of bushfires. Factors of greatest importance are relative humidity, wind, temperature, and fuel condition. The condition of this fuel, in turn, depends upon rainfall and evaporation in the time prior to the fire. In the 1851 " Black Thursday " episode, for example, previous floods had led to excessive vegetation growth, increasing the amount of available fuel.

The Bureau of Meteorology maintains a forecasting service for the various fire authorities in the State (Country Fire Authority, Forests Commission, and others). On the basis of Bureau advices, fire bans are issued when weather conditions are expected to become extreme. In order to provide this service, about 45 voluntary observers in various parts of Victoria report weekly, throughout the fire season (usually from December to March), on the amount of available grass fuel, its degree of curing, and its drying rate. As well as this, a drought index is computed year round for some 25 stations throughout the State. This index is based on rainfall and maximum temperature.

The amount of moisture present in forest fuels has a large bearing on its inflammability. Heat is required to raise the temperature of the trapped water to boiling point, to separate it from the fuel, then to vapourise it, finally raising the vapour temperature to that of the flame.

Once a fire has started, heat is transported away by four different methods: radiation, convection of the air, conduction through the fuel, and by wind blown embers (usually referred to as spotting). Pre-heating of the fuel ahead of the fire is accomplished mostly by intense radiated heat. Entrapped oils may vapourise in this way, resulting in an explosive mixture with the air.

Wind speed has an important bearing on burning and spreading rates. As the wind speed increases, oxygen is supplied at a faster rate, and pieces of burning debris may be carried vertically and horizontally by the stronger winds and land long distances ahead of the main fire location, causing further outbreaks.

A very important meteorological parameter in relation to bushfire behaviour is the low-level wind jet. The *Manual of Meteorology* (Bureau of Meteorology, 1963) states that " extreme fire behaviour is associated with low-level jets at a height of 500 m or less above the fire ", and that although a " low-level jet is not a necessary condition for a major fire to maintain its intensity, it is a necessary condition for a small fire to build up and reach conflagration proportions. It acts as a ' bridge ' which enables a low intensity forced convection fire to overcome the wind-field barrier and convert to a free-convection fire of much higher intensity ".

A combination of strong gusty winds, low relative humidity, and high temperatures is most dangerous for fire spread. Dead fuel is dried out rapidly in this situation, and even live vegetation will lose moisture more quickly, particularly if the soil moisture is nearing depletion. In addition, high initial air temperatures and strong solar radiation ensure maximum air convection, enabling flames to rise quickly to the forest crown level. A direct result of the interaction of the fire, ambient weather conditions, and topography is the phenomenon known as a fire whirlwind. A typical fire whirlwind frequently has a central tube made visible by whirling smoke and debris and often causes unusually rapid fire spread due both to direct fanning of the fire and to spotting. Extreme variations in height, diameter, and intensity are common. Witnesses have described fire whirlwind diameters from a metre or two to 100 metres or more and heights from one or two metres to about 1200 metres. The intensity varies from that of a dust devil to a whirlwind that pitches logs about and snaps off large trees. Velocities in the vortex are extremely high, and, as in other forms of whirlwinds, the greatest speed occurs near the centre. A strong vertical current at the centre is capable of raising burning debris to great heights. The most favourable condition for fire whirlwind occurrence is over a hot fire near the top of a steep lee slope with strong winds over the ridge top.

Another example of weather modification attributable to a bushfire influence is the development of cumulus cloud over the area of the fire, with some convergence of winds into the fire area. Precipitation or thunder from the clouds does not occur, but the changes in meteorological conditions associated with fires are similar to those associated with severe thunderstorms and tornadoes. It is possible that cloud condensation nuclei injected into the atmosphere by the bush fires also influence the development of clouds.

Cold frontal passages are a major problem on bad fire days during any Victorian summer. First, the prediction of the front's arrival at any point is difficult, since its movement is not uniform. Second, the approach of the front means an increase in wind speed and gustiness, and fires may become uncontrollable. Finally, the wind direction change may cause the fire to burn on a much longer front.

The climate of Victoria guarantees that some summers will result in periods of very high to extreme fire risk, whilst others may not be so dangerous. Only continued co-operation throughout the community and continuing research into the problems of fire weather can minimise the risk.

Climate of Victoria's forest areas

Climate plays an important role in determining the distribution of forest types, and the most important components of climate in this regard are radiation and rainfall. Thus as there is a lower bound to temperature and moisture availability in the growing season for each forest species, spatial and temporal variations in these elements limit the extent of forest varieties.

Most Victorian forests are composed of native varieties in which stringybark eucalypts and associated species play a major role. In addition to a large proportion of the extensive forests of east Gippsland, they make up most of the coastal forests of the Otways, the far south-west and west Gippsland, and the forests on both the northern and southern slopes of the Great Dividing Range to about 400 metres altitude. The mountain forests take over at higher altitudes. Between 1000 and 1400 metres there are pure stands of Alpine Ash and above these, snow gum stands and treeless areas. Red gum forests are widely distributed with extensive stands along the flood plains of the Murray River. Other forests of minor economic importance but of significance in soil stabilisation and erosion control are located in the central north and north-west.

Standard weather records are obtained from instruments carefully placed to avoid the influence of trees—and so do not represent the climate within a forest. With the background given in this article on Victoria's climate one can examine variations which a forest imposes. The experimental work in this field in Victoria is limited; thus, observations tend to be confined to general comments.

A forest affects solar radiation, wind, air, and soil temperatures, atmospheric moisture and precipitation to varying degrees. A percentage of incoming solar radiation is reflected from the upper surfaces of a forest and—depending on the species and condition of the foliage—this amount of reflected radiation lies in the range from 5 to 20 per cent. The remainder represents the radiation which is absorbed by, or penetrates through, the crowns. Reduction in visible energy is much greater and depends on foliage type and stand density.

One of the chief effects of a forest is reduction in wind speed, both horizontally and vertically. This can be as great as 90 per cent. Wind and radiation reduction together with transpiration (loss of water vapour from foliage) cause variations from the open air measurement of other climatic indicators. As a general rule, maximum temperatures in the forest are lower and minima are higher at the standard level, with the magnitude of the difference being related to the prevailing weather pattern and seasonal considerations.

Researchers in the USA have suggested that the vertical temperature profile within a forest is basically opposite to that over open terrain; this may explain such phenomena as frost formation in the top of a forest canopy where radiation loss is greatest overnight. During an experiment in a eucalypt forest near Daylesford the mean daily maximum for the ten hottest January days was found to be 2.3°C lower than in the open air. On these days, a reversal of the 'average' trend occurred with the minima. They were higher in the open due to stronger wind and hence less radiational cooling. On the coolest days, maxima did not show significant variation but the mean daily minimum was almost 1°C higher in the forest.

Soil temperatures are greatly affected by the reduction of solar radiation as well as insulation of the forest floor. Maxima at fairly shallow levels are normally significantly lower than those in the open, while minima are higher and some effect attributable to the forest can usually be noted up to a soil depth of about 30 cm.

Atmospheric moisture in absolute terms is usually greater in the forest, for although evaporation is less as a result of lower temperatures and wind speed, transpiration overcompensates for this, especially in the growing season. This fact has important consequences in water conservation. The effect of precipitation is very important in that much of the rain is intercepted by the foliage and a certain percentage of this reaches the ground by flow down the stem. The result is to increase soil moisture and decrease runoff, an effect which is also enhanced by the ability of the forest canopy to regulate precipitation intensity.

In forest areas prone to fog an interesting and not altogether insignificant phenomenon known as fog drip occurs. Fog droplets which move horizontally collect on the tree crowns and form drops that fall to the ground. In a mature stand of eucalypts near Melbourne it was found that this process was responsible for 44 per cent of the winter precipitation in the forest.

Floods

Flooding occurs in all districts but is most frequent in the North-East and in Gippsland. The occurrence of flooding in place and time is highly variable since it depends on the location and intensity of rainfall. In general, in Victoria, flooding is most likely in late winter or early spring, since this is the time of maximum rainfall and maximum catchment wetness, but floods can occur at any time of the year. On many streams, particularly in east Gippsland, some of the most severe events have been in January or February.

The extent and effect of flooding is dependent not only on rainfall but also on topography, land-use, water control structures, and the location of towns.

All districts of Victoria have experienced disastrous flooding, although it is relatively unusual for major floods to occur on several catchments at once. East Gippsland suffered major flooding in 1971. In 1973, 1974, and 1975 widespread flooding, varying from serious to major, occurred throughout Victoria, particularly in the Northern, North Eastern, West Central, and east Gippsland districts.

Snow

Snow in Victoria is confined usually to the Great Dividing Range and the alpine massif, which at intervals during the winter and early spring months may be covered to a considerable extent, especially over the more elevated eastern section. Falls elsewhere are usually light and infrequent. Snow has been recorded in all districts except the Mallee, Wimmera, and northern country. The heaviest falls in Victoria are confined to sparsely populated areas and hence general community disorganisation is kept to a minimum. Snow has been recorded in all months on the higher Alps, but the main falls occur during the winter. The average duration of the snow season in the alpine area is from three to five months.

Temperatures

January and February are the hottest months of the year. Average maximum temperatures are under 20°C on the higher mountains and under 24°C along the coast, but exceed 32°C in parts of the Mallee.

Average maximum temperatures are lowest in July, when they are below 10°C over most of the Dividing Range, and less than 3°C on the higher mountains. Over the lower country there is little variation across the State, ranging from 13°C near the coast to 16°C in the northern Mallee.

In summer, high temperatures may be experienced throughout the State except over the alpine area. Most inland places have recorded maxima over 43°C with an all time extreme for the State of 50.8°C at Mildura on 6 January 1906. Usually such days are the culmination of a period during which temperatures gradually rise, and relief comes sharply in the form of a cool change when the temperature may fall as much as 17°C in an hour. However, such relief does not always arrive so soon and periods of two or three days or even longer have been experienced when the maximum temperature has exceeded 38°C. On rare occasions, extreme heat may continue for as long as a week with little relief.

Night temperatures, as gauged by the average minimum temperature, are, like the maximum, highest in January and February. They are below 9°C over the higher mountains, but otherwise the range is chiefly 13°C–15°C. The highest night temperatures are recorded along the Murray and on the east Gippsland coast. Average July minima exceed 6°C along parts of the coast, but are below 0°C in the Alps. Although three or four stations have been set up at different times in the mountains, none has a very long or satisfactory record. The lowest temperature on record to date is −12.8°C at Hotham Heights (station height 1,760 metres) at an exposed location near a mountain. However, a minimum of −22.2°C has been recorded at Charlotte Pass (station height 1,840 metres)—a high valley near Mt Kosciusko in New South Wales—and it is reasonable to expect that similar locations in Victoria would experience similar temperatures, although none has been recorded due to lack of observing stations.

VICTORIA—MEANS OF CLIMATIC ELEMENTS : SELECTED VICTORIAN TOWNS

District	Locality	Legend (a)	Years of record	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
MALLEE	Mildura	1	28	19	25	25	22	29	23	26	29	27	31	25	20	301
		2	28	32.1	30.8	28.2	23.4	18.7	16.0	15.2	17.0	20.1	23.6	26.8	29.7	23.5
		3	28	16.8	16.3	13.9	10.4	7.4	5.2	4.4	5.3	7.2	9.8	12.0	14.6	10.3
	Swan Hill	1	90	21	24	24	25	34	36	31	35	32	34	26	24	346
		2	74	31.4	29.7	27.8	22.8	18.2	14.8	14.3	16.1	19.3	22.9	26.7	29.9	22.9
		3	68	15.4	15.3	12.9	9.6	6.7	4.7	4.0	4.8	6.5	8.8	11.5	13.8	9.6
WIMMERA	Horsham	1	101	22	27	25	34	47	50	46	48	45	43	34	28	449
		2	66	30.0	29.8	26.1	21.5	17.1	13.9	13.3	15.0	17.7	21.0	24.9	27.7	21.5
		3	67	13.4	13.6	11.5	8.7	6.3	4.6	3.8	4.6	5.7	7.5	9.8	11.9	8.5
	Nhill	1	88	22	25	23	31	41	48	46	48	43	41	30	28	426
		2	70	29.6	29.3	26.3	21.5	17.3	14.3	13.6	15.1	17.8	21.1	24.8	27.7	21.5
		3	71	12.7	13.2	11.0	8.3	6.0	4.2	3.4	4.1	5.4	7.2	9.3	11.6	8.0
WESTERN	Ballarat	1	65	38	50	47	57	70	63	69	77	73	68	56	52	720
		2	65	25.0	24.7	22.0	17.3	13.3	10.6	9.9	11.3	13.8	16.6	19.4	22.3	17.2
		3	64	10.8	11.7	10.0	7.7	5.8	4.1	3.4	3.9	5.0	6.4	7.7	9.5	7.2
	Hamilton	1	104	33	33	43	56	69	73	74	77	72	66	51	46	693
		2	87	25.7	25.5	23.0	18.8	15.2	12.7	12.0	13.2	15.3	17.7	20.5	23.3	18.5
		3	88	11.4	11.9	10.5	8.6	6.8	5.2	4.5	5.0	6.0	7.1	8.4	10.0	7.9
	Warrnambool	1	77	32	36	47	61	77	75	86	83	72	65	53	45	732
		2	70	22.0	22.1	21.0	18.5	15.9	13.8	13.2	14.0	15.6	17.3	18.8	20.5	17.7
		3	70	12.7	13.2	12.2	10.3	8.5	6.8	6.1	6.6	7.6	8.9	10.0	11.5	9.5
NORTHERN	Bendigo	1	113	33	35	37	41	54	61	55	56	53	52	37	33	547
		2	109	29.4	29.0	25.9	20.9	16.1	12.9	12.2	13.8	16.7	20.3	24.1	27.3	20.7
		3	107	14.1	14.3	12.3	9.2	6.5	4.8	3.7	4.4	6.0	8.1	10.3	12.4	8.8
	Echuca	1	96	27	29	34	35	43	45	40	43	39	43	32	29	439
		2	92	30.8	30.4	27.1	22.1	17.4	14.1	13.3	15.1	18.2	22.0	26.0	29.0	22.1
		3	90	15.3	15.3	13.1	9.6	6.7	4.9	4.1	5.0	6.6	8.9	11.3	13.6	9.6

NORTH CENTRAL	Alexandra	1	95	41	40	52	53	65	72	71	74	66	70	56	48	708
		2	48	29.3	29.3	26.0	20.5	15.8	12.0	11.7	13.8	17.0	20.3	23.8	27.3	20.6
		3	48	11.2	11.7	9.4	6.3	4.3	2.9	2.5	2.9	4.4	6.0	8.0	9.9	6.6
	Kyneton	1	100	39	42	47	56	76	89	82	84	75	70	52	50	762
		2	76	27.1	26.6	23.5	18.2	13.8	10.7	9.9	11.5	14.8	17.9	21.6	24.9	18.4
		3	70	10.0	10.3	8.5	5.7	3.6	2.3	1.6	2.0	3.3	4.9	6.6	8.5	5.6
CENTRAL	Geelong	1	104	32	39	42	45	50	49	46	48	51	51	47	40	540
		2	64	25.1	24.9	23.2	19.9	16.6	13.9	13.6	14.8	16.9	19.2	21.2	23.3	19.4
		3	65	13.3	13.8	12.5	10.3	8.0	6.0	5.2	5.7	6.9	8.4	10.0	11.9	9.4
	Mornington	1	85	45	45	52	64	71	71	69	70	70	69	58	53	737
		2	41	25.0	24.3	23.2	19.4	16.1	13.5	12.8	13.8	15.9	18.1	20.3	23.1	18.8
		3	39	13.4	13.8	12.9	10.9	9.1	7.2	6.5	6.8	8.5	9.4	10.7	12.1	10.0
NORTH-EASTERN	Omeo	1	95	51	54	54	47	55	57	52	56	62	72	63	62	685
		2	89	25.2	25.1	23.6	20.7	17.4	14.9	14.6	15.6	17.6	19.5	21.1	23.5	19.9
		3	90	12.8	13.3	11.8	9.2	6.8	5.0	4.0	4.5	5.9	8.1	9.8	11.6	8.6
	Wangaratta	1	95	38	40	48	49	56	72	64	64	59	63	47	42	642
		2	71	31.0	30.6	27.3	22.0	17.3	13.6	12.7	14.5	17.6	21.1	25.3	28.9	21.8
		3	70	15.0	14.9	12.2	8.4	5.5	3.8	3.3	4.1	5.8	8.2	10.7	13.3	8.7
WEST GIPPSLAND	Yallourn	1	25	50	61	56	66	97	76	81	97	88	87	85	68	912
		2	25	24.8	24.3	22.6	18.3	14.7	12.6	11.8	12.9	15.2	17.6	19.5	22.1	18.7
		3	25	12.7	13.3	12.1	9.7	7.5	5.9	4.8	5.3	6.5	8.3	9.5	11.1	8.9
	Sale	1	31	47	46	55	47	59	46	42	55	50	66	66	58	637
		2	29	25.1	24.9	23.2	20.1	16.3	14.0	13.5	14.6	16.7	18.9	20.7	23.0	19.2
		3	29	12.5	13.2	11.4	8.6	6.1	4.2	3.4	4.2	5.4	7.6	9.6	11.1	8.1
EAST GIPPSLAND	Bairnsdale	1	70	61	52	64	51	55	57	50	51	57	69	66	69	702
		2	68	24.6	24.7	23.1	20.4	17.1	14.4	13.5	15.3	17.5	19.6	21.6	23.5	19.6
		3	67	12.4	12.7	11.2	8.6	6.1	4.2	3.4	4.2	5.9	7.8	9.4	11.2	8.1
	Orbost	1	91	70	61	68	71	73	82	67	60	68	79	70	76	845
		2	33	25.2	25.1	23.6	20.7	17.4	14.9	14.6	15.6	17.6	19.5	21.1	23.5	19.9
		3	31	12.8	13.3	11.8	9.2	6.8	5.0	4.0	4.5	5.9	8.1	9.8	11.6	8.6

(*a*) Legend : 1. Average monthly rainfall in mm (for all available years of record to 1974).
2. Average daily maximum temperature (°C) (for all years of record to 1974).
3. Average daily minimum temperature (°C) (for all years of record to 1974).

Frosts

Frosts may occur at any time of the year over the ranges of Victoria, whereas along the exposed coasts frosts are rare and severe frosts (air temperature 0°C or less) do not occur. Frost, however, can be a very localised phenomenon, dependent on local topography. Hollows may experience frost while the surrounding area is free of frost.

The average frost-free period is less than 50 days over the higher ranges of the north-east while it exceeds 200 days within 80 kilometres of the coast and north of the Divide. The average number of severe frosts (air temperature 0°C or less) exceeds 20 per year over the ranges. The average number of light frosts (air temperature between 0°C and 2°C) varies from less than 10 per year near the coast to 50 per year in the highlands of the north-east.

The first frosts of the season may be expected in April in most of the Mallee and northern country and in March in the Wimmera. Over the highlands of the north-east, frosts may be severe from March to November. Severe frosts on the northern side of the Divide are twice as frequent as on the southern side at the same elevation.

Humidity

Generally, humidity in the lower atmosphere is much less over Victoria than over other eastern States. This is because the extreme south-east of the continent is mostly beyond the reach of tropical and sub-tropical air masses. The most humid weather in Victoria occurs when light north-easterly winds persist for several days in summer, bringing moist air from the Tasman Sea or from further north. On these occasions the dew point can rise to 20°C.

When north-westerly winds blow over Victoria in summer and dry air arrives from central Australia, the dew point can fall to 0°C or lower. When combined with high temperatures, the relative humidity can fall below 10 per cent. The cold air which arrives over the State from the far south from time to time in winter can also be very dry, with a dew point of about 3°C.

Evaporation

Since 1967 the Class A Pan has been the standard evaporimeter used by the Bureau of Meteorology. This type is being progressively installed at evaporation recording stations in Victoria; there were 63 in mid-1976, 61 of which were owned by the Bureau of Meteorology.

Measurements of evaporation have been made with the Australian tank at about 30 stations, about half of which are owned by the Bureau of Meteorology. Results from these stations show that evaporation exceeds the average annual rainfall in inland areas, especially in the north and north-west, by about 1,000 mm. In all the highland areas and the Western District the discrepancy is much less marked, and in the Central District and the lowlands of east Gippsland annual evaporation exceeds annual rainfall by 200 to 400 mm. Evaporation is greatest in the summer months in all districts. In the three winter months rainfall exceeds evaporation in many parts of Victoria, but not in the north and north-west.

Winds

The predominant wind stream over Victoria is of a general westerly direction, although it may arrive over the State from the north-west or south-west. Easterly winds are least frequent over Victoria, but are often associated with widespread rain in Gippsland. There are wide variations from this general description, however, and this is shown by the wind roses for selected towns, which are shown in Figures 10 and 11 on pages 85 and 86. For example, Melbourne has a predominance of northerlies and southerlies, while Sale has an easterly sea breeze on most summer afternoons.

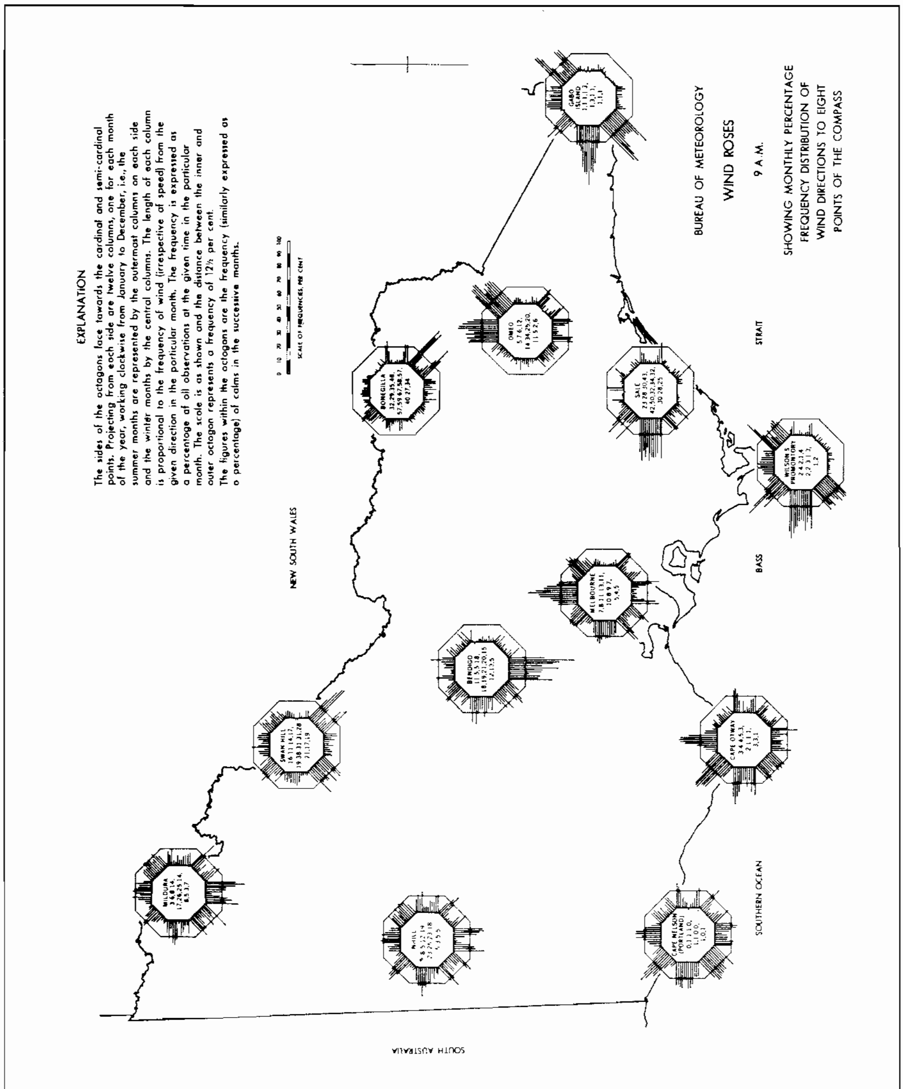

FIGURE 10. Victoria—wind roses for 9 a.m.

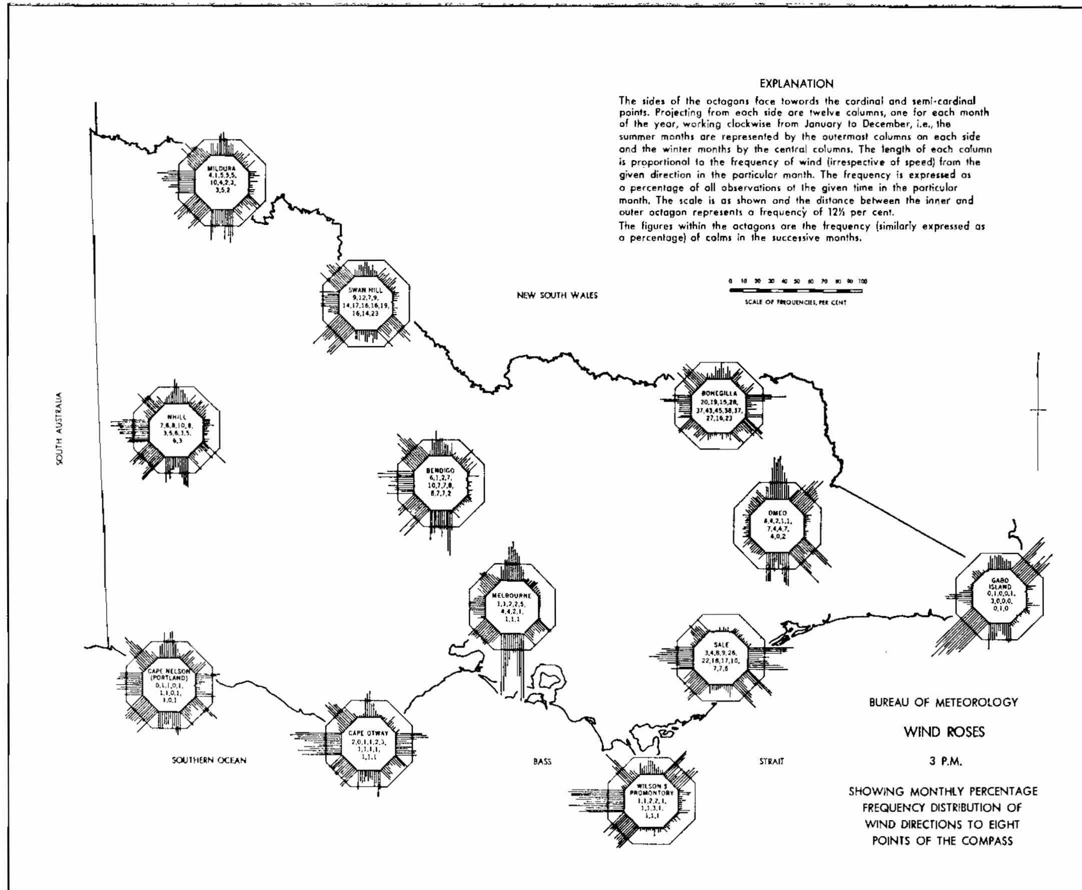

FIGURE 11. Victoria—wind roses for 3 p.m.

The wind is usually strongest during the day, when the air in the lower atmosphere is well mixed. As the ground cools after sunset, stratification of the air above it takes place, and the wind near the surface dies down. In valleys, however, the cooler air near the ground begins to flow down the slope, and the valley or katabatic breeze may blow through the night, to die down after sunrise.

At the surface of the earth the wind is rarely steady, particularly over land where there are obstructions to its flow. In the central areas of large cities, where there are tall buildings, there are many gusts and eddies. The mean wind speed for meteorological purposes is taken as the average over a period of ten minutes. In this time the actual speed can vary considerably, reaching much higher levels in gusts which last for only a few seconds.

The sensitive equipment required to measure extreme wind gusts has been installed at only a few places in Victoria and the highest gust recorded to date is 164 km/h at Point Henry near Geelong in 1962, although here the anemometer is 23 metres above ground level compared to the standard 10 metres for meteorological anemometers. It is considered that any place in Victoria could feasibly experience at some time a local gust of 160 km/h or more.

Thunderstorms

Thunderstorms occur far less frequently in Victoria and Tasmania than in the other two eastern States. They occur mainly in the summer months when there is adequate surface heating to provide energy for convection. Between ten and twenty storms occur each year in most of Victoria, but the annual average is about thirty in the north-eastern ranges. Isolated severe wind squalls and tornadoes sometimes occur in conjunction with thunderstorm conditions, but these destructive phenomena are comparatively rare. Hailstorms affect small areas in the summer months, and showers of small hail are not uncommon during cold outbreaks in the winter and spring.

WORLD WEATHER WATCH

The first International Meteorological Conference took place in Brussels during August 1853, at the instigation of Lieutenant M. F. Maury, of the United States Navy. Ten of the twelve delegates were naval officers, and it was natural that the topics discussed were mainly of a maritime nature. Twenty years later, another significant event took place: the First International Meteorological Congress, held in Vienna. Representatives of twenty governments discussed such items as instrument calibration, observation times, and the mutual exchange of information by telegraph. The International Meteorological Organization was formed as a result of the Congress.

The World Meteorological Organization, formed in 1951 as a specialised agency of the United Nations Organization, followed in the footsteps of the International Meteorological Organization. The United Nations General Assembly, in 1960, called upon the World Meteorological Organization to develop a plan which would ensure that modern advances, such as computers and earth-orbiting satellites, would be used to extend the knowledge of the atmosphere, and that this knowledge would be applied to the benefit of all nations. The plan so devised is called World Weather Watch.

Major concerns of World Weather Watch are global observing, data processing, and telecommunications systems. The provision of any weather service is firmly based upon an adequate supply of high quality data. High speed computers are capable of processing data in massive quantities, and using mathematical simulation to predict the state of the atmosphere at some future time. The global observing system encompasses all of the standard observing systems as well as others developed over recent years, particularly those which are satellite-based. The latter include the use of satellites orbiting in the equatorial plane, permanently located above a single point on the earth's surface. Such geostationary satellites are capable of transmitting to earth cloud patterns at frequent intervals. Another innovation is the estimation of vertical temperature profile from satellite radiation measurements.

The simultaneous observation of many thousands of different quantities is a basic necessity. However, the observations are of little use without an efficient, world-wide data processing, and telecommunications network. Data processing operates through the three World Meteorological Centres (Washington, Moscow, and Melbourne), as well as many other regional and national centres. The three world centres provide analyses and prognoses (forecast charts) which are distributed in graphic and numerical form to other centres.

The global telecommunications system has the task of collecting and distributing the basic observational data, as well as the processed " products " between all the different centres. This system is organised at different levels. First, a main trunk circuit connecting the three world centres transmits messages at a rate many times faster than that of an ordinary teleprinter. Second, there are regional and national networks for more restricted exchange of data and processed information.

Although strictly not a part of the World Weather Watch system, the Global Atmospheric Research Programme (GARP) is noteworthy. This programme, like World Weather Watch, resulted from a resolution of the United Nations General Assembly, which invited the international scientific community " to develop an expanded programme of atmospheric science research which will complement the programmes fostered by the World Meteorological Organization ". One of the major projects planned is entitled the First GARP Global Experiment, which will attempt to define the circulation of the whole atmosphere up to a height of 30 kilometres, and to develop more realistic mathematical " models " for extended range forecasting and climatic study.

Australia plays an important role in international meteorology. One of the three world meteorological centres is located in Melbourne. In addition, Darwin and Melbourne are both regional meteorological centres. The Bureau of Meteorology observational and telecommunication systems form part of the corresponding World Weather Watch systems, and the close involvement with the World Meteorological Organization contributes to the raising of standards of meteorological observations and practice throughout the world.

Past special articles on meteorology are listed on page 93.

CLIMATE IN MELBOURNE

General conditions

Temperature

The proximity of Port Phillip Bay bears a direct influence on the local climate of the metropolis. The hottest months in Melbourne are normally January and February, when the average maximum temperature is 26°C. Inland, Watsonia has an average of 27°C, while along the Bay, Aspendale and Black Rock, subject to any sea breeze, have an average of 25°C. This difference does not persist throughout the year, however, and in July average maxima at most stations are within 1°C of one another at approximately 13°C. The hottest day on record in Melbourne was 13 January 1939, when the temperature reached 45.6°C. This is the second highest temperature ever recorded in an Australian capital city. In Melbourne, the average number of days per year with maxima over 38°C is about four, but there were fifteen in the summer of 1897–98 and there have been a few years with no occurrences. The average annual number of days over 32°C is approximately nineteen.

Nights are coldest at places a considerable distance from the sea, and away from the city where heat retention by buildings, roads, and pavements may maintain the air at a slightly higher temperature. The lowest temperature ever recorded in the city was –2.8°C on 21 July 1869, and the highest minimum ever recorded was 30.6°C on 1 February 1902.

In Melbourne the overnight temperature remains above 20°C on about four nights per year. During the early years of record, temperatures below 0°C were recorded during most winters. However, over more recent years, the urban " heat island " effect has resulted in such low temperatures occurring only once in two years on average. Minima below –1°C have been experienced during the months of May to August, while even as late as October extremes have been down to 0°C. During the summer, minima have never been below 4°C.

Wide variations in the frequencies of occurrences of low air temperatures are noted across the Melbourne metropolitan area. For example, there are approximately ten annual occurrences of 2°C or under around the Bay, but frequencies increase to over twenty in the outer suburbs and probably to over thirty a year in the more frost susceptible areas. The average frost free period is about 200 days in the outer northern and eastern suburbs, gradually increasing to over 250 days towards the city, and approaching 300 days along parts of the bayside.

The means of the climatic elements for the seasons in Melbourne, computed from all available official records, are given in the following table :

MELBOURNE—MEANS OF CLIMATIC ELEMENTS

Meteorological element	Spring	Summer	Autumn	Winter
Mean atmospheric pressure (millibar)	1,014.8	1,013.2	1,018.3	1,018.4
Mean temperature of air in shade (°C)	14.4	19.4	15.3	10.1
Mean daily range of temperature of air in shade (°C)	10.3	11.6	9.5	7.7
Mean relative humidity at 9 a.m. (saturation=100)	64	61	72	80
Mean rainfall (mm)	187	156	169	148
Mean number of days of rain	40	25	34	44
Mean amount of evaporation (mm) (*a*)	261	441	208	97
Mean daily amount of cloudiness (scale 0 to 8) (*b*)	4.8	4.2	4.7	5.2
Mean daily hours of sunshine (*c*)	6.0	7.7	5.2	3.9
Mean number of days of fog	1.4	0.6	6.1	11.2

(*a*) Measured by Australian Sunken Tank (prior to 1967).
(*b*) Scale : 0 = clear, 8 = overcast.
(*c*) Measured at Melbourne (prior to 1968).

In the following table the yearly means of the climatic elements in Melbourne for each of the years 1972 to 1976 are shown. The extreme values of temperature in each year are also included.

MELBOURNE—YEARLY MEANS AND EXTREMES OF CLIMATIC ELEMENTS

Meteorological element	1972	1973	1974	1975	1976
Mean atmospheric pressure (millibar)	1,018.2	1,017.0	1,015.7	1,015.8	1,016.9
Temperature of air in shade (°C)—					
Mean	15.5	15.5	15.6	15.6	15.5
Mean daily maximum	20.3	19.8	19.7	19.8	19.6
Mean daily minimum	10.8	11.2	11.4	11.4	11.1
Absolute maximum	39.9	40.5	36.5	39.6	40.6
Absolute minimum	0.0	–0.5	0.6	0.9	0.9
Mean terrestrial minimum temperature (°C)	8.9	9.6	9.7	9.7	9.2
Number of days maximum 35°C and over	5	11	3	7	7
Number of days minimum 2°C and under	7	10	5	3	3
Rainfall (mm)	566	817	804	710	504
Number of days of rain	120	150	165	169	143
Total amount of evaporation (mm) (*a*)	1,587	1,496	1,421	1,393	1,390
Mean relative humidity at 9 a.m. (saturation=100)	69	69	65	71	70
Mean daily amount of cloudiness (scale 0 to 8) (*b*)	4.3	5.1	5.1	4.9	4.7
Mean daily hours of sunshine (*c*)	6.7	6.3	6.2	6.1	6.4
Mean daily wind speed (km/h)	12.7	9.7	9.4	10.3	10.9
Number of days of wind gusts 63 km/h and over	58	79	59	43	51
Number of days of fog	9	8	5	13	6
Number of days of thunder	11	7	11	10	10

(*a*) Evaporation measured by Class A Pan.
(*b*) Scale : 0 = clear, 8 = overcast.
(*c*) Sunshine measured at Laverton.

Rainfall

The average annual rainfall in the city is 660 mm over 143 days. The average monthly rainfall varies from 48 mm in January to 67 mm in October. Rainfall is relatively steady during the winter months, when the extreme range of monthly rainfall is from 7 mm to 180 mm, but variability increases towards the warmer months. In the latter period, monthly totals range between practically zero and over 230 mm.

Over 75 mm of rain have been recorded in 24 hours on several occasions, but these have been restricted to the warmer months—September to April. Only twice has over 50 mm during 24 hours been recorded in the cooler months.

The average rainfall varies considerably over the Melbourne metropolitan area. The western suburbs are relatively dry and Deer Park has an average annual rainfall of only 500 mm. Rainfall increases towards the east, and at Mitcham averages 900 mm a year. The rainfall is greater still on the Dandenong Ranges, and at Sassafras the annual average is 1,376 mm.

The number of days of rain, defined as days on which 0.2 mm or more of rain falls, exhibits marked seasonal variation ranging between a minimum of seven in February and a maximum of fifteen each in July and August. This is in spite of approximately the same total rainfall during each month and indicates the higher intensity of the summer rains. The relatively high number of days of rain in winter gives a superficial impression of a wet winter in Melbourne which is not borne out by an examination of total rainfall.

The highest number of wet days ever recorded in any one month in the city is twenty-seven, in August 1939. On the other hand, there has been only one rainless month in the history of Melbourne's records—April 1923. On occasions, each month from January to May has recorded three wet days or less. The longest wet spell ever recorded was eighteen days and the longest dry spell forty days.

Fogs

Fogs occur on an average of four or five mornings each month in May, June, and July, and average twenty days for the year. The highest number ever recorded in a month was twenty in June 1937.

Cloud and sunshine

Cloudiness varies between a minimum in the summer months and a maximum in the winter, but the range, like the rainfall, is not great compared with many other parts of Australia. The number of clear days or nearly clear days averages two to three each month from May to August, but increases to a maximum of six to seven in January and February. The total number for the year averages forty-eight. The high winter cloudiness and shorter days have a depressing effect on sunshine in winter and average daily totals of three to four hours during this period are the lowest of all capital cities. There is a steady rise towards the warmer months as the days become longer and cloudiness decreases. An average of more than eight hours a day is received in January; however, the decreasing length of the day is again apparent in February, since the sunshine is then less despite a fractional decrease in cloudiness. The total possible monthly sunshine hours at Melbourne range between 465 hours in December and 289 in June under cloudless conditions. The average monthly hours, expressed as a percentage of possible hours, range between 55 per cent for January and February and 35 per cent in June.

Wind

Wind exhibits a wide degree of variation, both diurnally, such as results from a sea breeze, and as a result of the incidence of storms. The speed is usually lowest during the night and early hours of the morning just prior to sunrise, but increases during the day, especially when strong surface heating induces turbulence into the wind stream, and usually reaches a maximum during the afternoon. The greatest mean wind speed at Melbourne for a 24 hour period was 36.7 km/h, while means exceeding 30 km/h are on record for each winter month. These are mean values; the wind is never steady. Continual oscillations take place ranging from lulls, during which the speed may drop to or near zero, to strong surges which may contain an extreme gust, lasting for a period of only a few seconds up to or even over 95 km/h. At the Melbourne observing site, gusts exceeding 95 km/h have been registered during every month with a few near or over 110 km/h, and an extreme of 119 km/h on 18 February 1951. At Essendon, a wind gust of 143 km/h has been measured.

Thunder, hail, and snow

Thunder is heard in Melbourne on an average of 14 days per year, the greatest frequency being in the summer months. On rare occasions thunderstorms are severe, with damaging wind squalls. Hail can fall at any time of the year, but the most probable time of occurrence is from August to November. Most hail is small and accompanies cold squally weather in winter and spring, but large hailstones may fall during thunderstorms in summer.

Snow has occasionally fallen in the city and suburbs; the heaviest snowstorm on record occurred on 31 August 1849. Streets and house-tops were covered with several centimetres of snow, reported to be 30 centimetres deep at some places. When thawing set in, floods in Elizabeth and Swanston Streets stopped traffic and caused accidents, some of which were fatal.

VICTORIAN WEATHER SUMMARY 1976

Anticyclonic conditions predominated over Victoria for the first seven months of the year. The first consequence of this was the failure of summer and early autumn rains in the south resulting in severe to serious rainfall deficiencies about parts of the west coast, the East Central District, and west Gippsland by April. During the winter months the mean track of low pressure systems was well south of normal with only the northern tip of associated frontal zones affecting southern Victoria. This led to drought conditions extending to the rest of the State with the marginal regions of predominantly winter rainfall, the Mallee and the Wimmera, being the worst affected by early August. Rainfall during August and early September brought relief to most of southern Victoria and above or near average September and October rains throughout Victoria alleviated rainfall deficiencies over the remainder of the State.

Nevertheless stock losses were substantial and by September dairy production had dropped 20 to 25 per cent below normal. Many places and districts experienced record dry periods; for example, the six month period from December to May was the driest on record for west Gippsland, the Central District, and the western plains. The area within the triangle bounded by Wodonga, Seymour, and Kerang recorded the driest autumn–winter period on record. In Melbourne only 216.4 mm of rain fell up to 31 August, making this the driest first eight months of the year since records commenced in 1856.

Rainfall in November was above average in all districts for the first time in 1976 with the North Wimmera experiencing one of its wettest Novembers on record. The effect of the timely spring rain was reflected in good wheat harvests, although the yearly rainfall totals for these areas were between 70 and 85 per cent of normal. District rainfalls in December were mainly within 20 per cent of normal, the main exception being the Northern Mallee which only received one third of its average rainfall.

January was a month of below average temperatures and generally below average rainfall except for parts of the north-west; February's average temperatures were above normal but in neither month were there heat wave conditions affecting the whole State nor temperature registrations in excess of 40°C. February was an unusually dry month with district rainfall totals up to 80 per cent below average. A particularly humid airmass led to the formation of extensive fog areas on the western coast and plains on 17 February.

Both March and April had below average rain in all districts with almost no significant falls north of the ranges. With the prevalence of high pressure, fogs were more frequent and widespread than normal, particularly in April when they occurred in some parts of the State on most days. Frost incidence was widespread on several days after 19 April, with none reported prior to that date. The first snowfalls occurred on the highlands on 27 and 29 April. The absence of strong to gale force winds was notable.

On only two occasions in May, on 16 and 23 May, were cold fronts sufficiently active to cause rainfall north of the ranges, migratory high pressure systems continuing their strong influence on Victoria's weather. June, too, was dry for the most part but rainfall in the south during the last few days resulted in the monthly district averages for east and west Gippsland, the West Central, and the Western District being above average for the first time in many months.

Hail occurred in the Melbourne suburb of Croydon on 2 June. A vigorous depression brought storm force winds to Bass Strait and Gippsland waters in the night of the 6–7 June giving the Empress of Tasmania a particularly rough passage during which the Captain was injured, and swell heights averaging almost 7 metres (the highest for the year) were experienced at the oil rigs working in East Bass Strait. Both months showed a high incidence of fogs and frost. Melbourne airport was closed by fog from 8.25 a.m. on 21 June to 7.30 a.m. on 22 June. Falls of snow were light and infrequent, and confined to the higher peaks until the last two days of June when some heavier falls were registered. In June, daily maximum temperatures were generally 1 or 2°C above normal for the first three weeks but rose to between 3 and 9°C above toward the end of the month. On Friday 25 June Melbourne's recorded maximum of 20°C was the warmest June day for 15 years.

July was a particularly dry month with district averages ranging from about 35 per cent below normal in the Mallee to 70 per cent below in west Gippsland. It was the driest July on record for west Gippsland and the West and East Central Districts. August rainfall was above average in the south but again below average in the north. July experienced above average maxima on a large percentage of days; and August experienced two unseasonable spells of warm weather on 22 and 30–31 August when daily temperatures were 7 to 10°C above average. The forerunner of August's highest rainfall in southern Victoria was a depression which developed south of the Great Australian Bight on the last day of July and moved rapidly to a position just south of Cape Otway and deepened. Associated gale to storm force winds were to result in widespread structural damage, especially in the vicinity of Lorne, Anglesea, Airey's Inlet, and Fairhaven.

Small craft experienced difficulties on Port Phillip and Western Port Bays and light aircraft operations were interrupted. The highest reported wind gust was estimated as 170 km/h at Point Lonsdale and the storm's influence extended as far as the Mallee where wheat crops were flattened. There was little interruption to "stream" weather and frontal passages till the middle of the month, thus producing regular rain in the south and significant snowfalls on the ranges. Snow resorts reported the best skiing conditions since 1970. Then followed a regular succession of highs and frontal passages but with little rain penetrating to northern districts. A considerably greater incidence of hail and thunderstorm activity was experienced in August than in preceding months with the return to stronger frontal activity. Frosts and fog occurrences were mainly confined to inland parts by August.

Early September saw the passage of vigorous cold fronts which resulted in snow to low levels on 4, 8, and 9 September. Widespread thunderstorm activity and hail in the south accompanied these changes and there were gale to storm force winds following the latter front. On Sunday 19 September a low developed over north-west Victoria and subsequently intensified. Very unstable conditions prevailed over the State on Monday 20 and Tuesday 21 September, and significant rain had fallen over the whole State by Wednesday. Minor flooding resulted on the La Trobe River between Yallourn and Rosedale and in the middle reaches of the Barwon River. The predominance of low pressure over the Tasman Sea and anticyclones south of the continent during October caused the average monthly maximum temperatures throughout the State to fall significantly below normal. This is reflected in Melbourne's average maximum of 16.3°C which was almost 3°C below normal and was the lowest October maximum since 1905. Generally, monthly rainfall totals were above normal with fairly frequent occurrences of hail and thunderstorms, especially on 3, 4, and 5 October. A severe hail storm at Manangatang caused about $50,000 damage with associated stock and crop losses in the area. Heavy rain associated with a low over south-east Australia caused flooding on most southern Victorian rivers and serious flooding occurred on the Barwon, Thompson, Macalister, and Mitchell Rivers on 15 and 16 October. Walhalla recorded the State's highest rainfall of 219 mm between 15 and 18 October.

For about two-thirds of November cold fronts, troughs, or lows dominated the weather pattern over Victoria. In addition to substantial rain totals, thunderstorm activity occurred over some or all of the State on eleven days and hail storms on five. Particularly severe activity occurred on 2 and 13 November. On 2 November there was widespread flash flooding in the Melbourne metropolitan area and a tornadic squall at Mortlake in the Western District unroofed houses, killed livestock, and destroyed farm buildings. On 13 November, a tornado, associated with severe thunderstorm activity, occurred at Sandon, near Castlemaine. Several houses and farm buildings were either destroyed or badly damaged and two occupants of a car in the tornado's path were killed. Crops in the Wimmera and fruit-trees in the Goulburn Valley were damaged by hail. Coastal areas experienced strong to gale force winds on 12 days of the month and areas of blowing dust in the Mallee on 29 November were associated with high winds. December experienced two hot periods from 20 to 22 and on 30 and 31 December, except in the extreme east, maxima ranged from around 35°C in most of the State to around 45°C in the far north-west. Large bushfires occurred in the Ballarat area on 22 December, and near Wodonga, on 31 December. Average monthly maximum and minimum temperatures were, however, within 1°C of normal. In the west the month's rainfall ranged from above average in the south to below average in the North Mallee. Elsewhere it was about average.

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