WEATHER IN THE MEDITERRANEAN

VOL. II. PARTS 1-6

M.O. 391b

AIR MINISTRY

METEOROLOGICAL OFFICE
(NAVAL DIVISION)

WEATHER
IN THE
MEDITERRANEAN

VOLUME II

LOCAL INFORMATION

LONDON:
H.M. STATIONERY OFFICE
1936

Price 15s. 0d. net

INTRODUCTION

This volume is a catalogue of facts, to be used for reference and not for general reading: Volume I may serve as a general introduction to Mediterranean Meteorology. It has not been practicable to work up original observations, except for factors, such as visibility, regarding which no already summarised data were available.

The main object of the volume is to facilitate approximate estimates of the probable character of individual periods in individual years. The method employed, namely, the description of mean values over a period of years, is the usual one. It has decided limitations; for an individual period often differs widely from the mean of a number of periods. The idea of adding tables to indicate the amounts by which an individual year might deviate from the mean year was abandoned from considerations of bulk. To serve as a guide to the reliability of the mean values the total number of observations, the period of years, and the daily times of observations are given wherever possible.

The order in which the factors are discussed is different from that usually employed in meteorological publications. The reason for this lies in their relative importance for general Fleet purposes; the order of importance in this connexion seems to be: wind, visibility, low cloud; rain, hail, snow, temperature, humidity, and miscellaneous items, rather than the order which has been customary in the past.

The information is discussed chiefly from seasonal means, and not from monthly means. Two reasons may be given for this. In the first place, the summarised observations available are not sufficient to give reliable monthly normals for the factors which are of chief importance in the present connexion. Secondly, it was considered preferable to discuss the four seasons, and to make special references to individual months, rather than to discuss the twelve months individually, and then to sum them up under seasons.

When compiling the tables in some cases, e.g., gale frequencies, to avoid very small fractions, percentages were preferred to days per month, and in other cases, the difference between proportion of days per season (i.e. per 90 days approx.) and proportion of days per hundred was neglected in view of the various other limitations of the data.

The publication of the volume in twelve parts which have been printed and issued separately, has led to some overlap, duplication and lack of uniformity. In the tables which were first printed, e.g., the tables of Part 3, the symbols *, ‡, † were used to represent fractions less than 0·1, from 0·1 to 0·4, and 0·5 to 0·9. This was done because the printed page was not large enough to accommodate fractions written fully as 0·1 etc. It was found after printing, however, that such symbols were not convenient when making use of the tables, and a compromise was made in the parts issued later by printing ·1 instead of 0·1, etc.

There are a number of points relating to the sections of the text, which it is desirable to mention. They are as follows :—

Surface wind.— *Direction.*— i. To facilitate comparison, the data in all the tables and roses are given to eight points of the compass. The only observations given originally to 16 points are those of the *Annalen der Hydrographie und maritimen Meteorologie.*

ii. In some of the tables of wind directions to eight points published in the past, undue weight was given to winds from certain points of the compass by including with them all winds between these points and the two neighbouring points of the compass, instead of allotting half of the intermediate winds to each of the neighbouring points. Two outstanding examples are those of Malta and Pelagosa. In both cases (Part 6, Table XII, and Part 9, Table IX) undue weight was given to NE, SE, SW and NW winds. The bias is mentioned in the text, but the requisite footnote to the tables has escaped inclusion. In the case of Malta, supplementary data for a period of 14 years have been obtained free from this defect. These are given by a separate table in Part 6 (p. 65), and are used in Parts 7 and 8.

iii. Observations at sea are made chiefly along the main shipping routes, and are not distributed at all uniformly over the areas defined by the limits of latitude and longitude noted against the tables and the wind roses.

iv. The characteristics of surface winds indicated by observations made on the occasions of the measurements of upper winds by means of balloons are to be regarded as provisional. These observations are too few in number to give normal values, and they are in great part limited to the early morning at which time of day the surface wind of coast stations in the Mediterranean is often very local.

v. Exact accounts of the diurnal variation of wind direction are available for very few coast stations in the Mediterranean, but those in need of approximate information may get it from the tables of visibility at 0700, 1300 and 1800 ; the totals running horizontally in these tables give the wind frequencies.

Surface wind.—*Speed.*—i. Daily observations of the speed or force of the surface wind independently of direction are published in the daily weather reports of the countries of the Mediterranean, but there are few summaries of wind speed in relation to the direction of the wind ; such as are available are included in the tables, and they are supplemented by summaries of the surface observations made on occasions of upper wind measurements.

ii. In order to furnish complete information, as far as possible, regarding wind speed (or force) over the sea, it has been necessary to include summaries in which the grouping of the wind forces differs appreciably. It was considered that the disadvantage of non-homogeneity would be less than the disadvantage of incompleteness.

Upper Winds.—In using the data relating to upper winds it is desirable continually to bear in mind three special points. In the first place there are not enough observations of upper winds to give good normal values; for some places the data are very inadequate, but they are all that can be given at present. Secondly, the observations of upper winds are made mainly in the early morning, and in consequence the wind at the ground may differ appreciably from the prevailing wind of the day, owing to the effect of diurnal variation. The winds at higher levels up to about 3000 feet are affected progressively less with increasing height, and much less in some parts of the region and at some seasons (e.g. in the north during the winter) than in other parts and seasons (e.g. in the south during the summer). Thirdly, all observations of upper winds by means of balloons are liable to interruption before the desired height is reached, sometimes owing to strong winds which carry the balloon beyond the range of vision, and sometimes owing to obscuration by cloud. The winds at high levels during disturbed weather are therefore not fully represented.

Gales and Special Winds.—i. The discussion of gales suffers from variations in the standard of wind force adopted to define a gale at different times and in different places; some authorities in the past adopted Beaufort force 7, others adopted force 6, while the now generally accepted standard is force 8. Information is specially lacking in definiteness for the Adriatic, the Aegean, and the east Mediterranean in the vicinity of Cyprus and Palestine.

ii. As a rule, winds of force 8 and over do not occur sufficiently often in most places to be shown by tables and wind roses which do not give frequencies smaller than one per 100 days (1 per cent.); it is necessary to prepare special tables and roses from the original observations in order to show frequencies of winds of force 8 in detail adequate to the importance of such winds. The only period for which it has been possible to prepare such special tables is that of 1900–14.

iii. In discussing the tables of gales, although only 14 years of observations are available, the frequencies of some gales are given as " once per 30 years ". Clearly the number of gales per 30 years cannot be shown specifically by observations extending over only 14 years, and such statements are to be taken to mean that, judging from the proportion of the number of gales to the total number of observations during this 14-year period, it would be reasonable to anticipate about one gale per 30 years. A more accurate interpretation would be that at stations for which three observations a day are available, the wind reached force 8 at one of the times of observation on one day in 10 years. On many such occasions the wind no doubt was nearly force 8 at the other times of observation also.

Visibility.—i. No published summaries of measured visibility being available, it was necessary to make summaries of the daily observations in order to give any exact information at all. Five-year means were therefore computed ; they give an approximate idea of the conditions which may be expected.

ii. Two forms of table are given. One includes the actual number of observations of the various degrees of visibility, and the actual number of observations of the various wind directions. The other indicates the probable frequencies of the various degrees of visibility, if all the wind directions occurred equally often. In practice the visibility depends on other factors besides wind direction, so that the characters of the winds as indicated by the second form of table are only approximate.

iii. No systematic data are at present available regarding visibility in a vertical direction.

Cloud.—i. As in the case of visibility, the summaries have had to be compiled from the daily observations.

ii. The data given in the tables and text relating to overcast sky are designed for use in aviation. Some additional data are given in the text for general use. It should be borne in mind that in the Mediterranean the amount of cloud at a given station varies considerably and often irregularly in the course of a day ; days of persistent overcast skies are rare. The amount of reliance which can be placed on the frequencies of overcast sky at 0700, 1300, and 1800, as representing extended periods of overcast sky, is therefore small. The data in the form available do not enable us to distinguish how often the observations of overcast sky at 0700, 1300 and 1800 occurred on the same day, but the number of occasions on which they did so would be small, especially in the south and east Mediterranean.

iii. In the section on visibility a table has been given to indicate what the frequencies of the various ranges would be for each wind direction if the wind directions occurred equally often. This has not been done in the case of overcast sky ; it would involve the preparation of a special table of wind frequency from the original observations, whereas in the case of visibility it does not.

Sea and Swell.—i. As in the case of visibility the tables have had to be compiled from the daily observations.

ii. Some of the tables have been affected by a change in the international scale of sea disturbance from 1930 onwards, which was not sufficiently indicated in the daily weather reports to prevent its being overlooked in the course of extraction of the data. It has therefore been necessary to prepare supplementary corrected tables and text for C. Croisette, Nice, Malta and Gabes (Parts 3 and 6). The revised tables and text are issued herewith, and should be pasted over the existing tables and text of Parts 3 and 6.

iii. No special table is given to indicate what the relative frequencies of rough sea, etc., would be if all wind directions were equally frequent, i.e., the relative character of the winds independent of their frequency. Anyone in need of this information can work out the figures, as has been done for visibility in the table headed " Character of winds in relation to visibility ", since the totals of the columns in the table " Sea and swell in relation to wind direction " represent wind frequencies.

Rainfall, Temperature and Humidity.—Only brief summaries have been given for these elements ; they are of minor importance in the present connexion. The information regarding humidity is in any case scanty, especially that relating to absolute humidity. No data of upper-air temperatures have been included, as practically none are available in already summarised form.

TABLE OF CONTENTS

Introduction.

Strait of Gibraltar to Sardinia Channel .. .. Part 1.

East Coast of Spain to Corsica and Sardinia .. .. .. Part 2.

Gulf of Lions and French Riviera .. .. Part 3.

Gulf of Genoa and Ligurian Sea .. .. Part 4.

Tyrrhenian Sea .. .. Part 5.

Sicily and Malta Channels and the east coast of Tunisia .. .. Part 6.

Ionian Sea .. .. Part 7.

Sea of Sidra (Sirte) .. .. Part 8.

Adriatic Sea .. .. Part 9.

Aegean Sea .. .. Part 10.

Crete to Palestine and Syria .. .. Part 11.

Red Sea .. .. Part 12.

Index of Subjects. Volume II.

Index of Geographical Names. Volume II.

PART 1

STRAITS OF GIBRALTAR TO SARDINIA CHANNEL

STRAITS OF GIBRALTAR TO SARDINIA CHANNEL

CONTENTS

		Page
I.	General	5
II.	Wind	
	1. Surface wind, direction and speed	8
	2. Upper wind	29
	3. Gales and special winds	44
III.	Visibility	57
	1. General	58
	2. Visibility according to the international scale	59
IV.	Cloud	
	1. Mean cloudiness	64
	2. Overcast sky	65
V.	Sea and swell	
	1. General	69
	2. The seasons	69
VI.	Rain, hail and snow	71
VII.	Temperature	
	1. Air temperature	73
	2. Sea temperature	76
	3. Difference between air and sea temperatures	77
VIII.	Humidity	80
IX.	Miscellaneous	
	1. Thunderstorms	81
	2. Waterspouts	82
	3. Mirage	82
	Bibliography	84

LIST OF ILLUSTRATIONS

Fig.		
Frontispiece	—Straits of Gibraltar to Sardinia Channel	2
1.	Seasonal pressure distribution	6
2.	Frequency of wind direction and speed—winter	12
3.	Frequency of wind direction and speed—spring	16
4.	Frequency of wind direction and speed—summer	20
5.	Frequency of wind direction and speed—autumn	26
6.	Upper wind—Melilla	30
7.	Upper wind—Oran	31
8.	Upper wind—Almeria	32
9.	Upper wind—Algiers	33
10.	Upper wind—Bizerta	34
11.	Upper wind—Tunis	35
12.	Levanter cloud at Gibraltar, October 25, 1934	*facing* 53
13.	Eddies in the lee of the Rock of Gibraltar	54

LIST OF APPENDED TABLES

TABLE — PAGE

I.—Monthly wind direction at the surface. Land stations .. 86
Tarifa — Nemours
Tangier

II.—Monthly wind direction and force at the surface. Land stations 87
Gibraltar — C. Carbon
Jebel Krichel — C. Bougaroni
Jebel Buzarea — C. Garde

III.—Seasonal wind direction at the surface. Land stations .. 90

IV.—Seasonal wind direction and force at the surface. Land stations. 91

V.—Seasonal wind direction and force at sea 93

VI.—Monthly wind direction and speed in the upper air 94
Oran — Algiers

VII.—Seasonal wind direction and speed in the upper air 99
Melilla — Algiers
Oran — Bizerta
Almeria — Tunis

VIII.—Visibility and accompanying wind direction 105
Gibraltar — Oran
Tangier — Algiers
Melilla

IX.—Character of the winds in relation to visibility 110
Gibraltar — Oran
Tangier — Algiers
Melilla

X.—Overcast sky and type of cloud in relation to wind direction 115
Gibraltar — Oran
Tangier — Algiers

XI.—Sea and swell in relation to wind direction 119
Gibraltar — Oran
Tangier — Algiers
Melilla

XII.—General climatological tables 121
C. Spartel — Bizerta
Gibraltar — Malaga
Oran — Cartagena
Algiers

STRAITS OF GIBRALTAR TO SARDINIA CHANNEL

I—GENERAL

This region includes the Straits of Gibraltar, the channel between Spain and north Africa, and, roughly speaking, the area between the north coast of Africa and a line parallel to the African coast from C. Gata in Spain to C. Spartivento in south Sardinia.

As elsewhere in the southern Mediterranean, the year in this region comprises a hot, dry season, and a cool, rainy season, with shorter transition seasons. The hot season may be said to extend from June to September (September being hotter than June) and the cool season from December to February—October, November, March, April and May being transition months. The changes of weather between one season and the next vary considerably in date and degree from year to year, so that in any given year the recorded observations may differ a good deal from the means. For general purposes, however, the year may be treated under the heads: winter, December to February; spring, March to May; summer, June to August; and autumn, September to November.

The mean pressure distributions of the seasons over the Mediterranean as a whole are illustrated in Fig. 1 by the isobars for the representative months January, April, May, July and October. These pressure distributions indicate approximately the directions of the prevailing winds. In winter, the chief feature of the mean distribution is the trough of low pressure extending the whole length of the Mediterranean and thence continuing down the Red Sea; in this trough an individual centre of low pressure is situated over Corsica and Sardinia, and there is a constriction of the trough where the Balkan Peninsula juts southwards towards Cyrenaica. The trough is partly the result of the tendency for pressure over the relatively warm sea to be lower than over the surrounding cool land, and partly the result of travelling depressions. The depressions are apt to halt for a few days in the neighbourhood of the Gulf of Genoa, subsequently moving down the Adriatic to the east Mediterranean where they may halt again for a day or two in the vicinity of Cyprus.

In summer, the controlling factors are: first, the continental depression over Asia, which tends to give low pressure over the east Mediterranean and isobars running approximately north and south across the sea; secondly, the depression over the Sahara; and thirdly, travelling depressions of the same type as the depressions of winter. These last, as in winter, are apt to halt in the vicinity of the Gulf of Genoa; subsequently, the majority fill up over north Italy or move eastwards across Hungary, but a few move down the Adriatic. The combined effect of these three factors in summer is

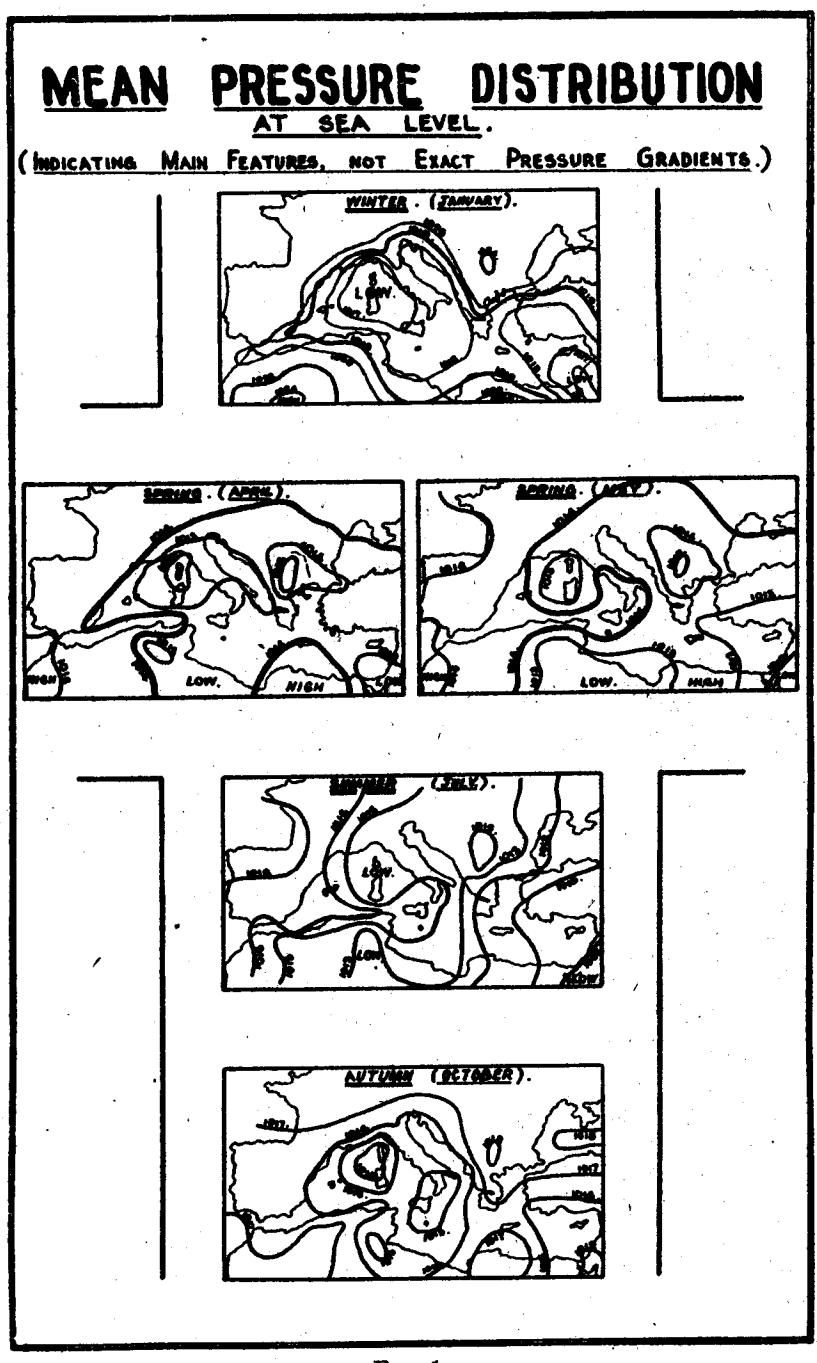
MEAN PRESSURE DISTRIBUTION
AT SEA LEVEL.
(INDICATING MAIN FEATURES, NOT EXACT PRESSURE GRADIENTS.)
WINTER. (JANUARY).
LOW.
SPRING. (APRIL).
LOW.
HIGH
SUMMER. (JULY).
LOW.
HIGH
AUTUMN (OCTOBER).

FIG. 1.

to give (*a*) low pressure over the east Mediterranean, with isobars running roughly north and south as far west as the mid-Ionian Sea; (*b*) low pressures over Corsica, Sardinia and north Italy; (*c*) low pressure over the western Sahara; and (*d*) a ridge of higher pressure extending from east Spain along the coast of Algeria and Tunisia, and over Sicily to south Italy.

In spring and autumn, the mean distributions of pressure are intermediate between those of winter and those of summer.

The short-period variations of weather during the cool season in the western part of the region, i.e., west of about Oran, are chiefly controlled by depressions moving eastwards via the Straits of Gibraltar or further north or south across Spain or Morocco respectively. The warm and cold fronts of these disturbances are often difficult to follow in detail as they enter the Mediterranean, the air movement in the lower levels being greatly affected by the land barriers. For example at Gibraltar, it has been found by a forecaster, located for a time at the station itself, that although it is usually easy for an observer at the station to determine the type of air that is present, the passage of a front is seldom detectable, the change-over being very gradual; also winds may blow through the Straits at right angles to the isobars, and continue on the surface for some little time after the pressure gradient has ceased to be discernible on the synoptic chart. The depressions which pass near Gibraltar are apt to move somewhat north-eastwards after entering the Mediterranean, so that gales are rather more frequent in the western part of the region than they are in the central part round Algiers. The short-period variations in the east during the cool season are controlled chiefly by depressions which start over the north Mediterranean, and move from the Gulf of Genoa or north Italy towards the south-east. Such depressions give strong winds and squally weather with heavy showers over the area to west and south of Sardinia.

In the summer, large-scale depressions do not greatly disturb the centre and west of the region, though the eastern parts in some years experience frequent strong north-westerly winds due to depressions of the winter type from north Italy. But in most parts of the region, especially near the coast, shallow local depressions, imperceptible in the isobars of the ordinary synoptic chart, produce winds of gale force at times over the limited area which they control. The favourable conditions for these local depressions arise when the rapid increase of temperature during the spring and early summer leads to large local contrasts of temperature. Other characteristic disturbances of the hot season are short-lived westerly thundersqualls which travel eastwards near the African coast against the prevailing easterly winds. At the onset of these squalls the wind shifts suddenly to W., and, after an interval of varying duration, returns as suddenly again to E. At times also, more extensive shallow depressions which have developed over the west Sahara, instead of

following their usual eastward track to the Sea of Sidra with little effect on the Algerian coast, move northwards across the coast and give disturbed weather there.

II—WIND

1—Surface wind, direction and speed

General.—During the winter as represented by January, the mean run of the isobars in Fig. 1 favours the prevalence of westerly winds along the whole length of the north coast of Africa—W. in the western part, and more NW. in the east. Off the south and south-east coasts of Spain, however, the mean run of the isobars favours winds from somewhat N. of E. Consequently, the winds over the southern and northern parts of the sea area between Africa and Spain are often from opposite directions; these form one example of the well-known opposed winds or "contrastes" of the region. During the summer as represented by July in Fig. 1, the mean pressure distribution favours easterly winds following the general trend of the coasts.

Details of the actual winds at various coast stations and over the open sea are given to eight points of the compass in Tables I to V, and in the maps of Figs. 2–5; additional details based on figures for sixteen points of the compass as given in Bibliography, No. 5 have been included in the text where felt to be desirable. No summarised observations of surface winds are available for places on the south coast of Spain between Gibraltar and C. Gata, or for places on the African coast between Tangier and Nemours. For some of the coast stations information regarding wind force is not available; for others the wind force is obtained from Bibliography, No. 4. The information regarding wind force over the sea is drawn from Bibliography, Nos. 2 and 5. The differences in the methods of grouping the wind forces in the roses should be noted (Figs. 2–5).

It should be borne in mind that the characters of the prevailing winds indicated for different stations depend on the local surroundings of the stations and also on the periods of observation. For example, at Gibraltar the site of the station was changed in 1922 from the middle of the ridge to beyond its northern face, and the predominating winds, as shown by Table IV, changed from W.–NW. towards SW.–W. Judging from the lie of the land relative to the two sites, and from the results quoted on pp. 53–4 from Bibliography, No. 14, it appears that at the position of the new station W. winds may be diverted towards SW., and NW. winds towards W. The speeds of the winds recorded at the new station are lower than those at the old station; the latter is likely to have recorded higher speeds than exist at sea level. A further change of site was made in 1935 to the Windmill Flats beyond the south face of the Rock.

Similarly on the coast of North Africa there are marked local effects. Strong westerly winds at the exposed and elevated points, Jebel Krichel and Bougaroni, and NW. winds at C. Garde, are stronger than over the open sea at sea level. The excess in strength of these winds at exposed stations over the winds of the open sea is due partly, if not entirely, to the heights of the stations; their heights vary from several hundred to nearly 2,000 feet above sea level. These effects of differing exposure are additional to the differences between the results for one period of years and another. Tables III and XII give the results of observations at Gibraltar for the period 1908–32, and Tables II and IV the results for the periods 1909–14 and 1921–30; these tables indicate the magnitude of the differences which may be expected between periods of these durations.[1]

The directions of the actual winds shown by the wind roses over the sea are found to agree in a general way with the tendencies outlined above. The prevailing directions are on the whole W. and E. or WSW. and NE., roughly following the trend of the African coast, except in the east (long. 5° to 10° E.) where, except in the autumn, the winds tend to be NW. and E. Winds from due N. and S. are relatively infrequent during the whole year; they are especially so in long. 5° to 0° W., while in long. 5°–10° E. during some of the months N. winds are fairly frequent. The westerlies are most frequent in the cool months. They are said to persist later in the spring near the African coast than out at sea where, in some years, easterly winds begin to predominate as early as April. The easterlies are predominant as a rule during the two months July and August over the whole sea area, and during the four months June to September in the centre and east. Over most of the region the direction of the easterly winds may vary from E. to NE. but not as a rule to SE. except close in along the African shore at night; in the east, however, through the Sardinia Channel towards the Sicily Channel, SE. winds are more common, especially in autumn. These south-easterly winds are very warm, moist and enervating.

The characteristic W. and E. winds are known in the west by the names "ponente" and "levante" respectively. They are very different in character. The ponente usually brings clear sky, good visibility and cessation of dew; though when it blows strong it is often murky and accompanied by heavy squalls and thunder. The levante brings a moist, thick atmosphere which may give mist, fog, very heavy dew, drizzle, or overcast sky with heavy rain; it shows no diurnal variation itself, and interrupts the ordinary alternation of land and sea breezes along with the diurnal variation of

[1] The minimum number of years which is ordinarily accepted as giving good mean values is 10; where possible a period of 25 years is desirable. The periods of 5 years' observations of visibility, cloud and sea summarised in Tables VIII to XI are short.