

INTRODUCTION

With the increased tempo of U.S. Navy operations in the Indian Ocean, there has been a matching increase in concern over the environmental support available to the Fleet meteorologists. As part of the NAVENVPREDRSCHFAC effort to improve that support, this Command has reprinted a series of meteorological handbooks -- collectively titled Weather In The Indian Ocean -- that were originally issued by the British Government in the 1940-44 time frame.

These handbooks, published as three volumes in a total of twelve parts, were prepared by the Meteorological Office, Air Ministry, in cooperation with the Naval Meteorological Branch, Admiralty, London. Titles of all volumes/parts in the series are given below.

Because the series has long been out of print, the NAVENVPREDRSCHFAC has obtained permission to reprint and distribute the handbooks to U.S. Navy units. As in the original publication, this new reprinting ultimately will comprise twelve individual books, each marked with volume and part number; the reprint set is distributed as NAVENVPREDRSCHFAC Technical Bulletin 80-02, April 1980. The books are three-hole-punched for collection into ring binders. There has been no editing or changing of the original material.

Users of the series should be alert to the fact that a number of place names used in the original writing have changed over the intervening years.

Volumes/parts titles in the series are as follows:

- Vol. I ---- Weather In The Indian Ocean - General Information (in one part)
- Vol. II --- Weather In The Indian Ocean to Latitude 30°S and Longitude 95°E including the Red Sea and Persian Gulf (in nine parts; see parts titles below)
- Vol. III -- Weather In The Indian Ocean - Aids To Forecasting (in two parts:
1, Indian Ocean; and 2, North Indian Ocean)

Parts titles, Volume II (local information):

1. Red Sea
2. The Gulf of Aden and West Arabian Sea to Longitude 00°E
3. The Persian Gulf and Gulf of Oman
4. The Makran Coast from Gwadar to Karachi and the West Coast of India to Latitude 20°N
5. West Coast of India from Latitude 20°N to Cape Comorin, with an Appendix on Conditions at Bombay
6. A. East Coast of India from Cape Comorin to the Ganges Delta -- B. Ceylon
7. The Coast of Burma
8. The South Indian Ocean to Latitude 30°S.
9. Coast of East Africa from the Equator to Cape Delgado

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PART 5
 WEST COAST OF INDIA
 FROM
 LAT. 20° N. TO CAPE COMORIN
 WITH AN
 APPENDIX
 ON CONDITIONS AT
 BOMBAY

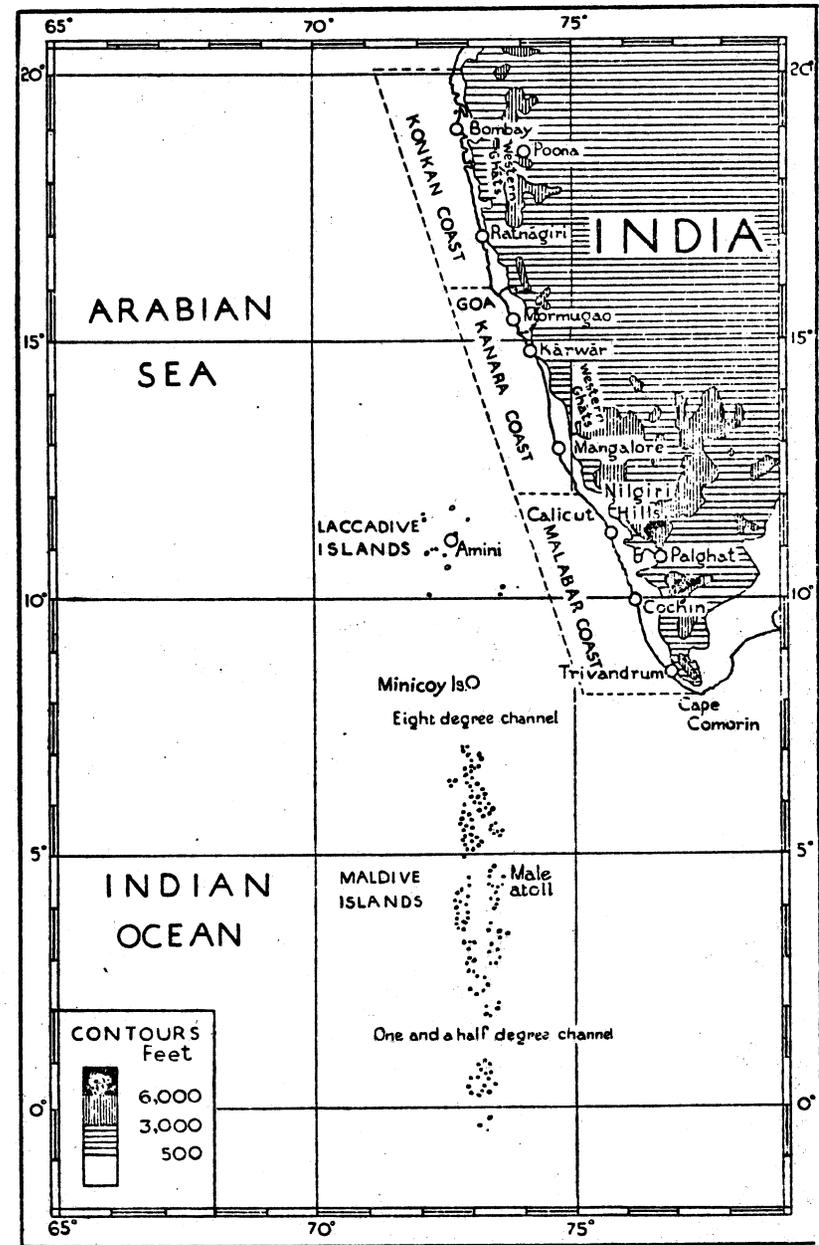


FIG. 1.—THE WEST COAST OF INDIA FROM LAT. 20°N. TO CAPE COMORIN INCLUDING THE MALDIVE AND LACCADIVE ISLANDS

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WEST COAST OF INDIA

FROM

LAT. 20° N. TO CAPE COMORIN

INCLUDING

THE MALDIVE AND LACCADIVE ISLANDS AND THAT PORTION
OF THE INDIAN OCEAN AND ARABIAN SEA WITHIN THE AREA
0°—20° N., 60°—77° 33' E.

I—GENERAL

The west coast of India from Lat. 20° N. to Cape Comorin, a coast-line about 800 nautical miles in length, is known to mariners generally as the Malabar coast though in local usage this name designates only that part of the coast which lies to the south of Lat. 12° N. It consists of a strip of hilly and undulating country situated at the foot of the mountains of the western Ghats. These mountains extend the whole length of the western coast at distances of from 20 to 100 miles inland and have a general elevation of 3,000 feet, rising at places in the south to heights of 7,000 or 8,000 feet.

For convenience this coast has been divided into three sections namely:—the Konkan coast, the Kanara coast and the Malabar coast proper. The Konkan coast is the northern section and lies between latitudes 20° N. and 16° N., the Kanara coast is the middle section and lies between latitudes 16° N. and 12° N., and the Malabar coast which is the southern section stretches from latitude 12° N. to Cape Comorin. The limits of these coasts are depicted in the Frontispiece, Fig. 1.

The climate of this region is about the wettest in the whole of the Indian peninsula. The coast is exposed to the westerly winds of the Arabian sea which tend to mitigate the intense tropical heat and help to maintain the verdure of the land and evergreen forests that clothe the slopes of the western Ghats; the country is also shielded by these mountains from the very dry winds of the Deccan tableland. The vegetation that covers the strip of land that borders the coast is luxuriant and tropical whilst the gorges and slopes of the higher mountains are covered with dense forests.

The SW. and NE. monsoons are the outstanding features of the climate, the winds of the SW. monsoon being stronger than those of the NE. In the southern part of the Indian peninsula, on the coast of Malabar, the SW. monsoon usually sets in in the latter part of May and generally lasts until the beginning of October. Further

north in the vicinity of Bombay it may be expected to arrive somewhat later, about the first or second week in June, and it ends there by the end of September.

The only type of depression met with in this area is a tropical depression and these may sometimes develop into tropical cyclones. They are most frequent in the transition periods between the monsoons.

The rainfall during the SW. monsoon is very heavy all along the coast and is still heavier on the slopes of the western Ghats. The heaviest falls occur in the south, and rainfall decreases northwards from about Lat. 15° N.; from June to October at Mangalore (12° 52' N., 74° 51' E.) the rainfall on the average amounts to about 2,900 mm. (115 in.) but at Bombay (18° 54' N., 72° 49' E.) it has decreased to about 1,750 mm. (69 in.). As far south as latitude 14° N., the southern limit of the Bombay Presidency, the season from the latter part of October to the end of May may be practically rainless. On the south Kanara and Malabar coasts showers occur in the months that precede the arrival of the SW. monsoon and continue in the post-monsoon months, the rains often lasting until the end of November.

Although the part of the west coast of India under consideration here extends through 12 degrees of latitude the annual mean temperature is almost the same throughout the region, being between 79° and 80° F. In the northern part of the area, in January and February, the nights may be cool and the usual damp heat of the day is sometimes tempered by northerly winds. On the south Kanara and Malabar coasts the day temperatures of January and February are seldom lower than those of the other months of the year. In the early morning the temperature does not fall much below 70° F. at places near the sea.

Owing to the domination of the weather by the SW. and NE. monsoons, the year, for meteorological purposes, can best be divided into the following four seasons:—

- (i) The cool season (December to March).
- (ii) The hot season (April and May).
- (iii) The SW. monsoon or rainy season (June to September).
- (iv) The post SW. monsoon or interim period (October and November).

During the cool season the surface winds are mainly north-easterly over the sea and are north-easterly to north-westerly on the coast. This is a dry season when the cloud amount is small and there is very little rain except in the extreme south. Although it is called the cool season the temperatures experienced throughout the area never fall very low.

In the hot season of April and May the surface winds are variable with land and sea breezes prevailing on the coast. Some of the highest temperatures of the year are experienced during these months, and tropical cyclones may be experienced in the Arabian sea.

During the months of the SW. monsoon the winds at the surface over the sea are generally between SW. and W. but on the coast they usually blow from WNW. or NW. This is the season with the greatest amount of rain, and owing to the increase in cloud amount the average temperature is from 3° to 5° F. lower than in May whereas the relative humidity is higher and may reach or even exceed 90 per cent in July.

In the post SW. monsoon months of October and November the surface winds again become variable with land and sea breezes in evidence near the coast, and by the middle of November the prevailing wind changes to the north-easterly winds of the NE. monsoon. Tropical cyclones may be experienced in the Arabian sea during these months.

II—TROPICAL CYCLONES AND DEPRESSIONS

A more detailed description of tropical cyclones of the Indian ocean, their origin and formation, is given in Volume I.

In practice the India Meteorological Department uses the term "depression" for those cyclonic circulations in which the wind does not reach gale force, i.e. when it is Beaufort force 7 or less; the depression becomes a tropical cyclone when there is evidence, or reason to believe, that the wind in a part of the cyclonic area has risen to gale force, i.e. force 8; with a wind of force 10 or more the storm is said to be severe.

Cyclonic disturbances occur both in the Bay of Bengal and in the Arabian sea and in both regions they may develop into severe storms. In this part which deals with the portion of the Arabian sea and Indian ocean within the area 0°–20° N., 60°–77° 33' E., only those cyclones which form in that area and those which form in the Bay of Bengal and cross the Indian peninsula into the Arabian sea are dealt with. No storm that has originated in the Arabian sea has ever been known to cross into the Bay of Bengal.

The development of these tropical depressions is more likely to occur in the transition seasons between the SW. and NE. monsoons than during the months of the monsoons. In the cool season (December to March) tropical depressions of any sort are rare and disturbances are confined almost entirely to western depressions which travel across northern India and seldom affect the weather in the area under consideration here.

The following table gives the total number of tropical cyclones that have occurred in the Arabian sea during the period 1881–1937 and the number that were severe, i.e. those in which the wind rose to force 10 or more:—

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Total	3	0	0	3	11	15	4	0	4	13	16	3	72
Severe	0	0	0	3	9	10	0	0	0	4	11	1	38

Authorities.—Bibliography Nos. 17, 58.

Note.—This table includes a few storms that formed west of Long. 60° E.

In the years 1881 to 1937, 57 years in all, no storm reaching gale force was reported in thirteen of the years, whereas in 1902 no less than five such storms occurred. The average is about four storms in three years. If disturbances which do not attain gale force are included the most frequent number (according to figures for the period 1891-1935 compiled by Dr. Sen*) is two per year; in some years there may be none at all and the maximum figure is six in a year.

Severe cyclones with wind rising to force 10 or more may occur in any of the six months April to June and October to December, but they are very rare if not entirely unknown in the other months of the year.

Place of origin and tracks of storms in the Arabian sea in the different months.—In January tropical storms rarely if ever originate in the Arabian sea, but occasionally a storm after forming in the Bay of Bengal may travel westward from Ceylon or over the southernmost part of the Indian peninsula and cause rough seas on the Malabar coast and near the islands of Minicoy and Amindivi.

No tropical storms have been recorded in February and March or in the early part of April, but they may occur occasionally in the latter half of that month and may be severe. The usual course of any of these storms is towards north-west or north-north-west and on reaching the northern part of the Arabian sea they may curve either to north-west or to north-east.

In May storms become more frequent and when they occur they are very often severe. They may form in any part of the sea south of Lat. 14° N. The direction of travel is usually between west and north-north-west, but some begin by travelling towards north-north-east and may continue in that direction or recurve to north-west, whilst others may begin by travelling north-north-west and then recurve to north-north-east.

During June storms are comparatively frequent. They usually occur in the first half of the month, being not infrequently severe; a storm at the end of the month, however, though very rare, is not entirely unknown. The average frequency of storms in the early part of the month is about one in four years so that quite frequently the advance of the monsoon takes place without a storm forming. In 1907, however, two storms occurred, one on June 4th to 6th and the other on June 18th to 20th.

Storms during this month almost invariably originate east of Long. 67° E. and between Lat. 12° and 20° N. Their usual direction of travel in the early stages of their existence is towards north-north-west; storms which form in about Lat. 12° or 13° N., however, usually travel northwards before turning north-north-west in about

* See Bibliography No. 26.

Lat. 18° N. In the north of the Arabian sea most storms turn westward and dissipate off the coast of Arabia north-eastwards of the Kuria Muria islands, but a few may recurve north-eastwards and move towards the coasts of Kathiawar and Sind.

During July and September tropical cyclones are extremely rare in the Arabian sea and not one has been recorded in August. The few storms that have occurred in July and September are usually felt only in the northern portion of the sea, and either form north of Lat. 20° N., or travel across the northern part of the Indian peninsula from the Bay of Bengal. There is, however, one record of a depression that formed in Lat. 12° N., Long. 70° E., on 27th September, 1929. This depression moved north-westwards over the Arabian sea and crossed the Arabian coast between latitudes 19° and 20° N. after which it became unimportant.

There is an increase in the frequency of cyclonic storms in October, thirteen have occurred in the period 1881 to 1937 and of these two were in 1902. The storms not infrequently travel from the Bay of Bengal across the Indian peninsula south of Lat. 18° N.; after reaching the Arabian sea they usually intensify some distance from the west coast of India and continue their journey over the sea in a west by north direction, finally dissipating in about Long. 58° or 59° E. Those storms which form over the Arabian sea itself usually form south of Lat. 18° N. and frequently recurve towards north-east and cross the Kathiawar or Konkan coasts.

The northern part of the Arabian sea west of Long. 68° E. is probably free of storms in October but between latitudes 10° and 18° N. any part of the Arabian sea may be affected. The variability of the tracks is considerable and occasionally storms may travel towards the south-west.

In November storms are slightly more frequent than in any other month of the year, but even so in two years out of three there will probably be no storm with winds of gale force. A large number of the storms which affect the Arabian sea have formed originally in the Bay of Bengal and travel into the Arabian sea either from Ceylon or across the Indian peninsula south of Lat. 16° N. The proportion of those storms which arrive from the Bay of Bengal compared with those which form in the Arabian sea itself is probably greater in November than in any other month of the year. Of those storms which form in the Arabian sea the majority usually originate between latitudes 8° and 16° N. and to the east of longitude 68° E., but storms occasionally have their origin in the centre of the sea.

The tracks are variable; some of the storms travel west or west by north towards the island of Socotra and the coast of Arabia and fill up without recurving, while others travel north-west and recurve to the north and north-east in about Lat. 16° N., subsequently advancing towards the Kathiawar and Konkan coasts.

In December the frequency of storms in the Arabian sea is small. Only three storms have been recorded and two of these travelled into the Arabian sea from the Bay of Bengal whilst one formed in the middle of the Arabian sea approximately in position $9^{\circ} 30' N.$, $63^{\circ} 30' E.$ Both those which came from the Bay of Bengal travelled westward or west-north-westward at first, and one showed signs of recurving before it dissipated in Lat. $14^{\circ} N.$ The storm that formed in the Arabian sea followed a very unexpected track; it moved eastward immediately after its formation and then travelled rapidly northwards and subsequently north-east towards the Gulf of Cambay.

III—WIND

1—SURFACE WINDS

Wind-roses for each of the twelve months are reproduced in Figs. 2-7. On the roses for the sea areas both the direction and force of the wind are indicated, but for the places on the coast information only of the direction of the wind, at 0800 local time, is available. The corresponding data for the sea are given in Table II and for places on the coast in the general climatological tables.

In the general climatological tables for Bombay and Trivandrum on pages 78 and 83 the frequencies of wind direction in the afternoon are also given in order to show the diurnal variation of the wind on the coast.

The frequencies of winds of different forces for Bombay and Trivandrum at 0800 and 1630 local time, and for Ratnagiri, Mormugão, Mangalore, Cochin, Amini and Minicoy at 0800 local time are given in Table III.

In order to make the following description of the seasonal surface winds over the Arabian sea as clear as possible, that sea has been divided into sections as follows:—Arabian sea central (12° – $20^{\circ} N.$, 60° – $68^{\circ} E.$), Arabian sea east (12° – $20^{\circ} N.$, $68^{\circ} E.$ to west coast of India), Arabian sea south (5° – $12^{\circ} N.$, 60° – $68^{\circ} E.$) and Arabian sea south-east (5° – $12^{\circ} N.$, 68° – $80^{\circ} E.$). These divisions of the Arabian sea are indicated on the surface wind charts Figs. 2-7 by broken lines, the remainder of the area between the equator and Lat. $5^{\circ} N.$ being a portion of the Indian ocean.

Seasonal variation

Cool season (December to March).—In December the prevailing direction of the surface wind over the whole of the Arabian sea is between NNE. and NE. with an average force between 2 and 4 of the Beaufort scale; there may, however, be a considerable range of force in these winds; at times they may drop to force 1 and at other times rise to force 7. On the whole the force of the wind is greater than in November. One of the areas with the strongest

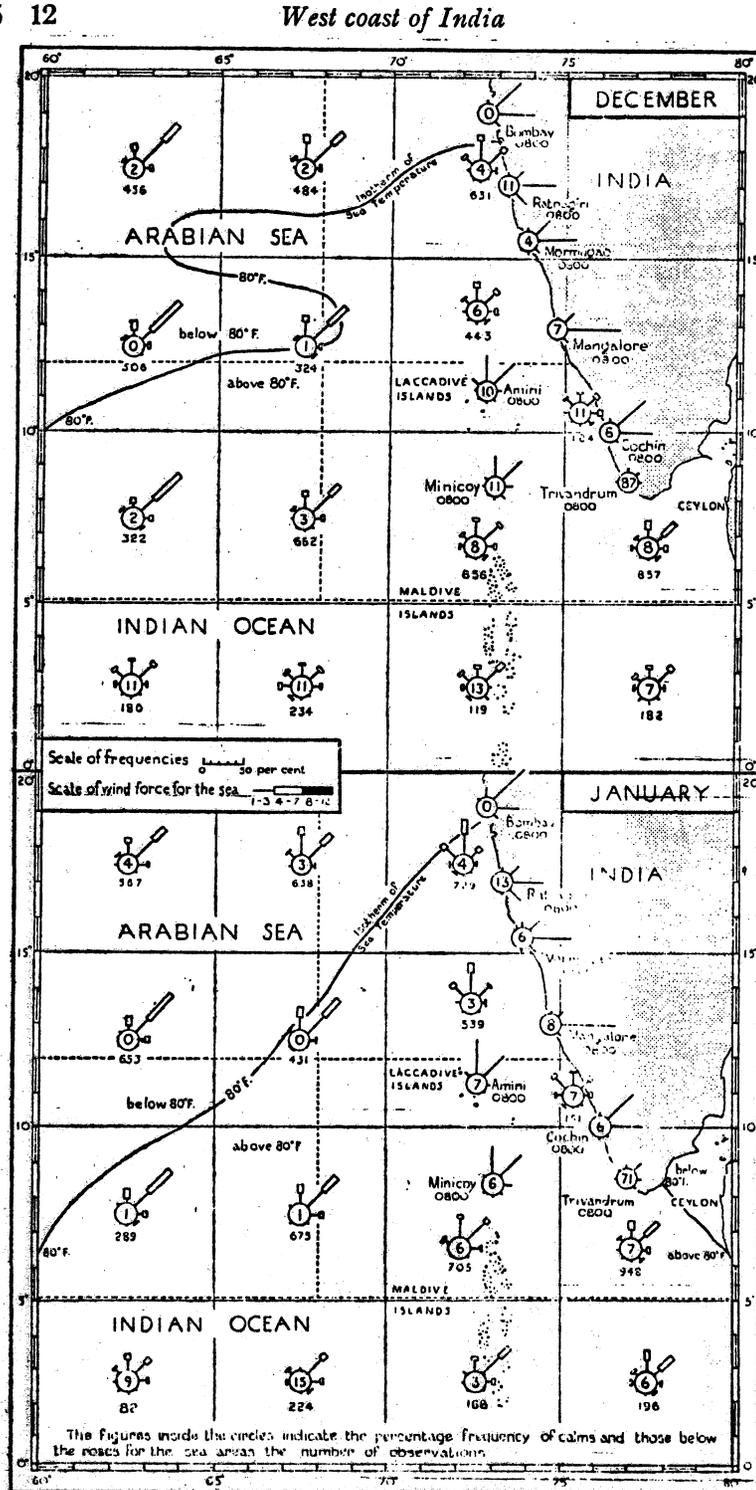
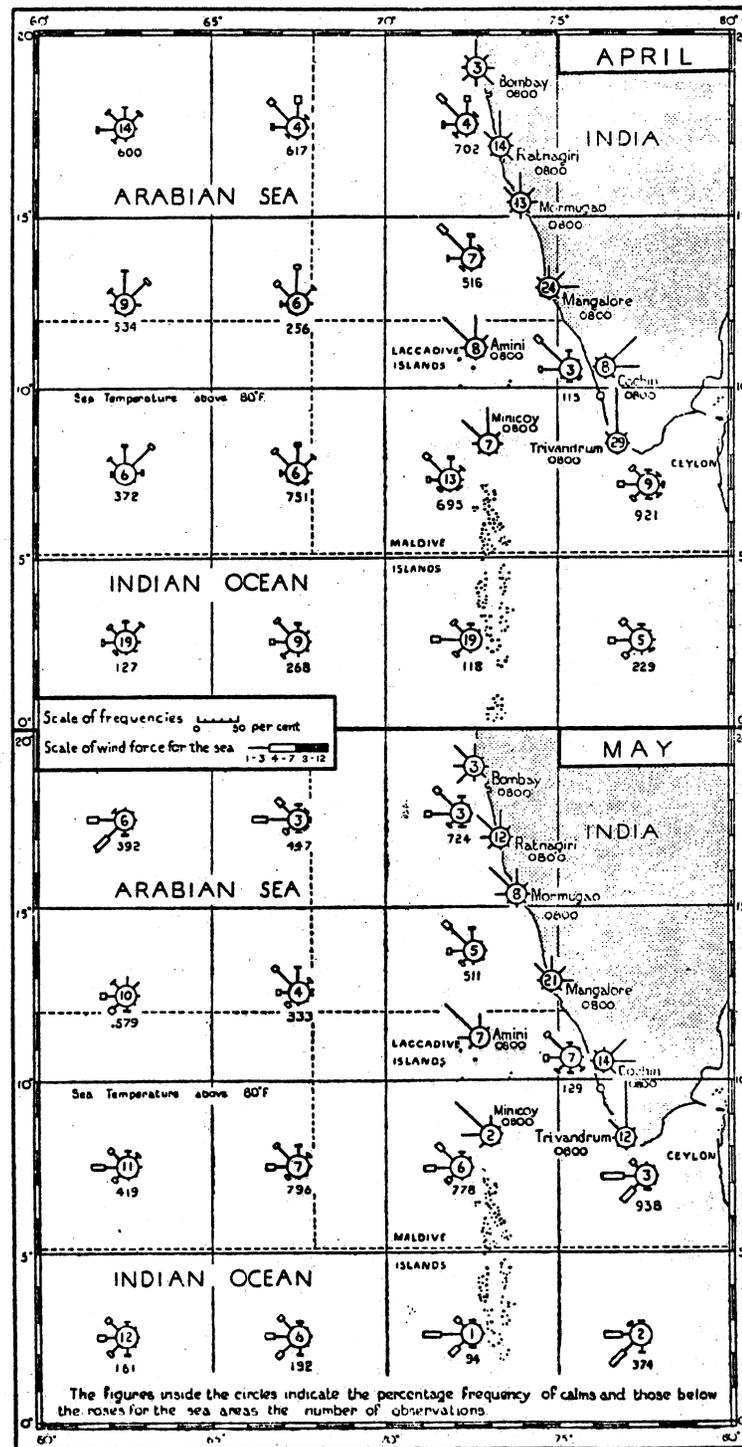
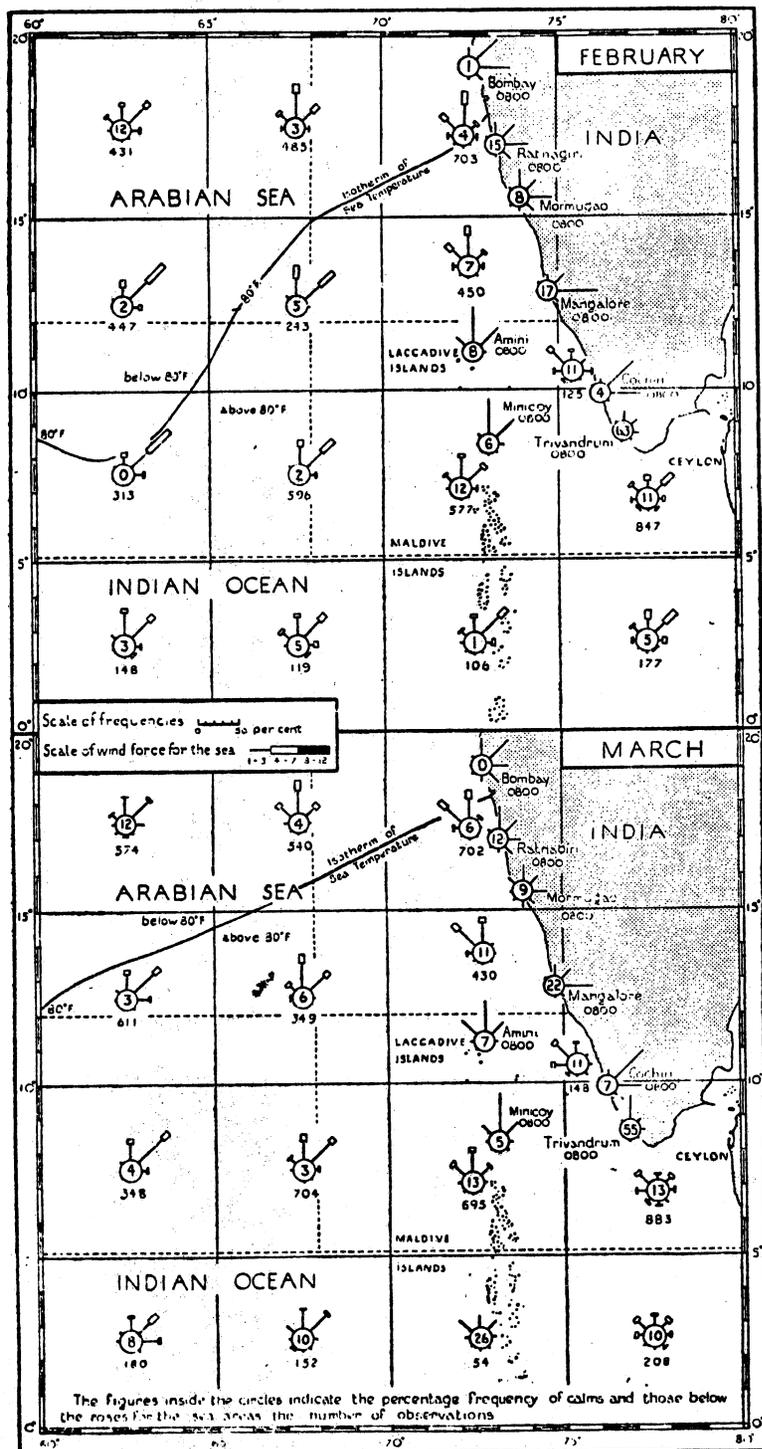


FIG. 2—SURFACE WINDS—MONTHLY



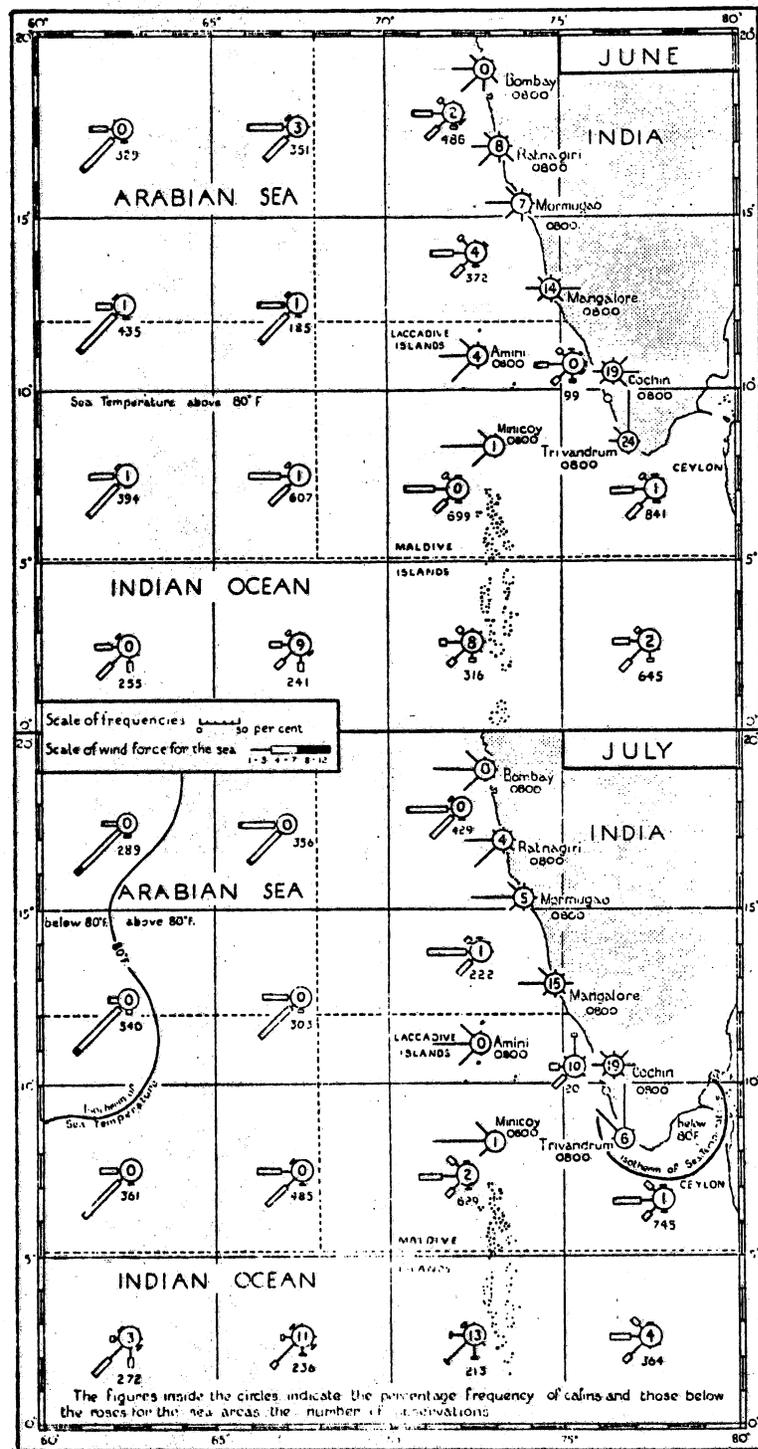


FIG. 5—SURFACE WINDS—MONTHLY

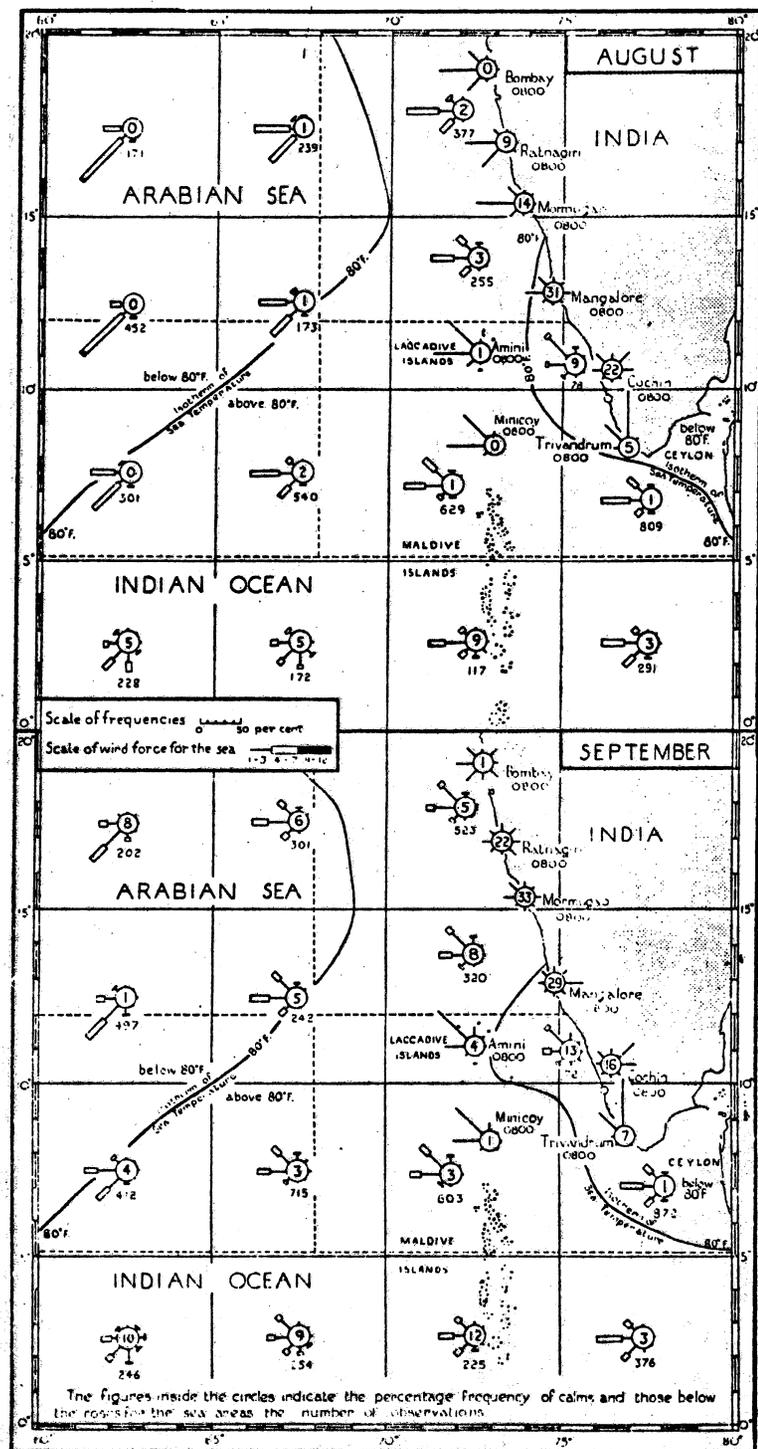
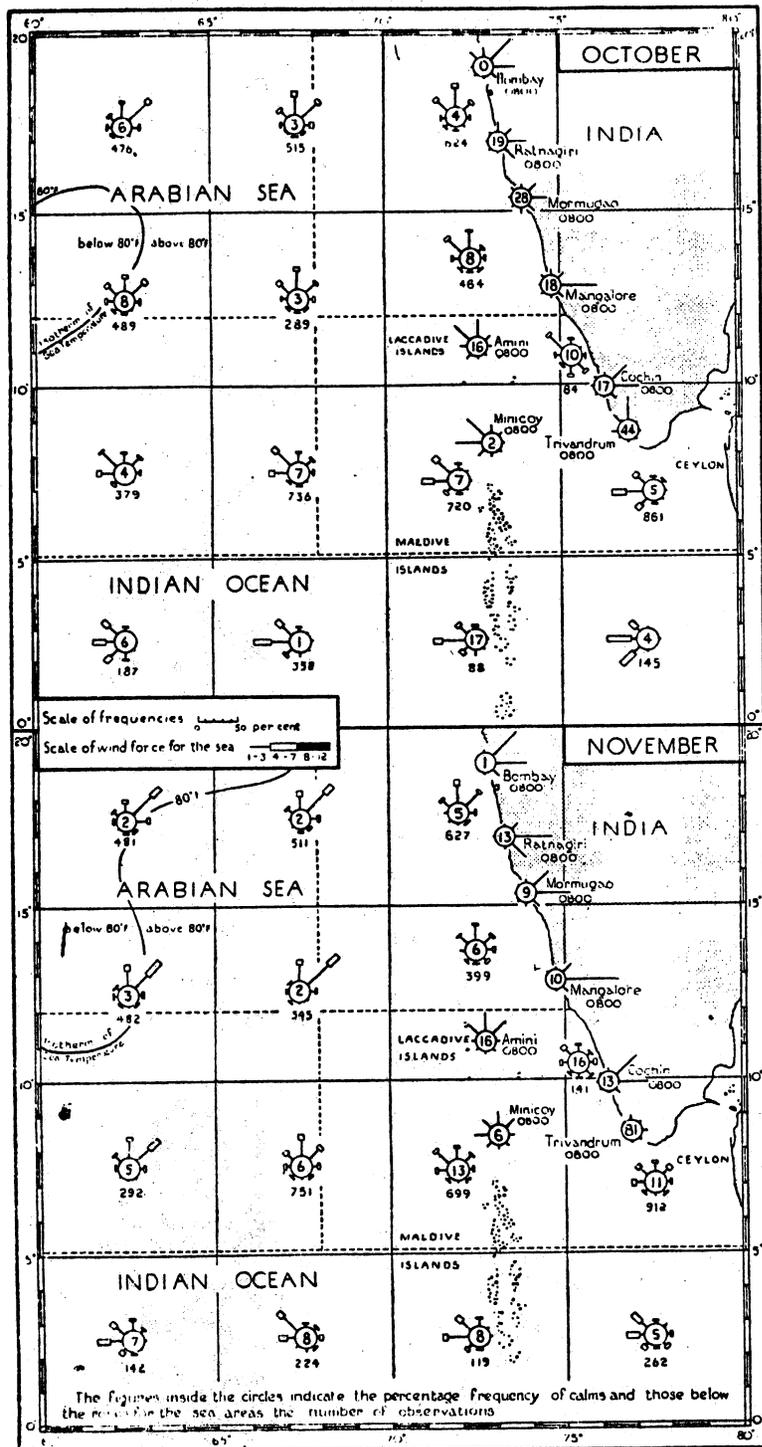


FIG. 6—SURFACE WINDS—MONTHLY



winds lies over the central portion of the Arabian sea where the average force is 4, and within this region the wind has been known sometimes to rise to gale force.

On the west coast of India the winds are mainly NE. or E., but all directions between NW. and E. are well represented owing to the land and sea breezes. The winds on the coast are lighter than over the open sea but they may be strong at times.

In the southern portion of the Maldive islands about the middle of December hard squalls and gales from W. and WNW. sometimes occur and may last for several days.

The approximate southern limit of the NE. monsoon during December, between longitudes 70° E. and 80° E., lies in about latitude 3° N.

In January the winds over the Arabian sea are chiefly north-easterly but to the east of the Maldive islands northerly winds varying in force between 2 and 3 of the Beaufort scale are frequent and to the west of those islands the winds may sometimes be easterly and of about Beaufort force 3.

The force of the NE. monsoon will be found generally to increase from north to south and the winds usually attain their maximum strength and constancy somewhere between latitudes 5° N. and 15° N.; the mean force in that region is about 4 of the Beaufort scale but forces of 6 and 7 are not uncommon. On the west coast of India the winds in this month are very similar to those of December and are mainly northerly, but land and sea breezes are very pronounced; any direction between NW. and E. may be experienced. In the early morning the wind-roses show a well marked predominance of E. winds along the greater part of the coast.

In this month in about longitude 70° E. the winds of the NE. monsoon extend as far south as the equator.

Winds mainly between NNE. and NE. prevail steadily over the Arabian sea in February, but as the land is beginning to warm up in this month the winds in the east tend to become more northerly than in January. The winds are generally lighter in force than in January and may be slightly stronger in the south than in the north. In the south Arabian sea the mean force of the wind varies between about 2 and 4 of the Beaufort scale but forces between 6 and 7 may be experienced during rain squalls. On the west coast of India land and sea breezes are still fairly well marked.

The southern limit of the NE. monsoon in about longitude 70° E. has retreated to about latitude 2° N. in this month.

During March the increasing temperature and consequent change in the general distribution of pressure over the land tends to make the winds more northerly and north-westerly off the coast of India. The NE. monsoon wind still continues to blow steadily but it is not so strong as in February. The main direction is northerly over the eastern part of the Arabian sea and north-easterly

over the centre of the sea. The force of the wind varies between about 2 and 3 of the Beaufort scale, and is moderate and steady over the central portion. Squalls are sometimes experienced off the Indian coast, and in the southern part of the Arabian sea they may be frequent.

On the west coast of India land breezes decrease in strength in this month and are uncertain. In March the southern limit of the NE. monsoon in about longitude 70° E. is approximately in latitude 3° N.

Hot season (April and May).—The winds become much more variable in April, and on the west coast of India and over the east and centre of the Arabian sea the mean direction of the wind varies between NNW. and NNE. with a mean force between about 2 and 3 of the Beaufort scale. Squalls may occur fairly frequently off the coast of India during this month and in the neighbourhood of the Maldivé and Laccadive islands the weather is squally and showery.

Tropical cyclones may occur in the latter part of April but they are rare, and gales are not unknown.

In May a change in the conditions occurs and the winds become more westerly in direction. Over the eastern part of the Arabian sea the winds are mainly north-westerly, but over the central part the northerly winds have almost disappeared and damp south-westerly and westerly winds begin to prevail generally.

The force of the wind in this month is mainly between force 2 and 3 of the Beaufort scale. In the southern part of the Arabian sea squalls and showers may be frequently experienced. On the west coast of India the winds tend to follow the contour of the coast and are mainly north-westerly, of Beaufort force between 2 and 3.

On the Malabar coast the SW. monsoon in some years sets in at the end of this month, and south of the Palghat gap in the Nilgiri hills it frequently sets in late in May with a SE. gale veering to SW. or with squalls from the south-west. The SW. monsoon also begins in the Laccadive and Maldivé islands in this month.

Tropical cyclones and gales may occur in the Arabian sea during May, and it is probable that these storms arise during a temporary but strong advance of moist southerly winds from south of the equator, they are not at all frequent however. SW. gales and hard squalls may also occur on the Kanara and Konkan coasts.

SW. monsoon (June to September).—By June the SW. monsoon has set in over the whole of the Arabian sea. The monsoon advances quickly over the sea, being usually preceded by severe and prolonged thunderstorms, and is ordinarily established along the west coast of India by the end of the first week of the month.

The arrival of the SW. monsoon causes a considerable change in the winds over the eastern part of the Arabian sea, the northerly components of the winds, which are characteristic of May, have

disappeared and the winds are now almost due west ; over the other parts of the Arabian sea the winds have also become more westerly and over the whole area north of the equator the direction of the wind is generally between SW. and W.

Over the open sea throughout the area dominated by the SW. winds the force of the wind is fairly uniform, except south of latitude 5° N. where the monsoon winds are less steady. Over the central portion of the Arabian sea the average wind force is about 5 of the Beaufort scale and over the eastern part and along the west coast of India it is about force 3 to 5. Over the open sea, by the time the monsoon has become fully established, forces of 6 to 8 may be experienced, but the wind is usually lighter in the neighbourhood of land. After the first burst of the monsoon the weather over the Arabian sea becomes cloudy and showery with strong squally winds with forces of 5 to 8.

In July and August there is very little change in the general direction of the wind from that of June, the mean direction over the central and eastern portions of the Arabian sea is WSW. and W. and close to the coast of India the wind blows from west or from slightly north of west ; near the equator in about latitudes 0° to 5° N. the winds are more southerly, and the weather is uninterruptedly cloudy, squally and showery the winds varying generally from force 2 or 3 during fine spells to 6 or 7 during squalls which may be very frequent in this area.

There are no doldrums during the summer months and a ship will pass from the SE. trades south of the equator to the SW. monsoon north of it through an area of southerly winds.

In the region of the south-westerly winds there is a slight general increase in the mean force of the wind northwards to about latitude 15° N. and then a decrease beyond. Over the centre of the Arabian sea the mean wind force varies between about 4 and 6 of the Beaufort scale, but SW. and WSW. gales and strong squalls with wind forces of from 8 to 10 may be occasionally encountered. Near the land the wind force is generally lower than over the open sea and off the coast of India it is usually between force 3 and 5.

Ships of low power on passage from Colombo to Aden have found that they experience a better passage if they take a more southerly course, through the 1½ degree channel, and keep in the area of lighter and more southerly winds between the equator and about latitude 5° N. until about as far west as longitude 55° E., before altering up for Cape Guardafui, than if they take the more northerly and direct course through the 8 degree channel, where they are liable to meet with strong south-westerly winds the whole way across the Arabian sea.

Over the Arabian sea in September the weather on the whole is much quieter than in July and August but is of the same general character.

Over the eastern part of the Arabian sea and near the west coast of India, the mean direction of the wind is W. to NW., but over the western part of the central portion the wind is still SW.

The average force of the wind is lower than in July and August and over the centre of the Arabian sea the mean force varies between about 3 and 4 of the Beaufort scale occasionally rising to 6 or 7. The wind is lighter in the eastern part of the sea where it is on the average between forces 2 and 3. A westerly gale has, however, been known to occur here in September.

The Malabar coast is often visited at the end of September by strong easterly squalls which are accompanied by rain and thunder. These bring the SW. monsoon to an end on this coast, and on the Konkan coast also the monsoon usually finishes at the end of this month.

Post SW. monsoon period (October and November).—In the month of October the SW. monsoon winds blow only occasionally over the Arabian sea. The prevailing winds in this month are north-easterly and are of land origin. The winds are on the whole lighter than in September but disturbed cyclonic weather sometimes occurs and then gales may be experienced.

Between the equator and about latitude 10° N. westerly and north-westerly winds prevail, but north of about latitude 10° N. the winds are mainly between N. and NE. and on the west coast of India northerly winds may predominate with a tendency to easterlies in the early morning. The average force of the wind over the whole area varies between force 2 and 4 of the Beaufort scale during this month.

If strong southerly or easterly squalls, sometimes called "Elephantas", do not visit the coast between Bombay and Cape Comorin at the end of September they are usually experienced at the beginning of October and are considered to be a sign of the end of the SW. monsoon. These "Elephantas" are often accompanied by rain or thunder.

By November the NE. winds which are the prevailing winds of the cool season have set in over most of the Arabian sea, and the average force of the wind is between 2 and 4 of the Beaufort scale.

The NE. monsoon also sets in off the extreme south of India in this month but this monsoon in longitude 70° E. does not extend further south than about latitude 8° N.

Land and sea breezes

The diurnal variation in the direction of the wind at Bombay and Trivandrum is shown in Fig. 8. Wind-roses are given showing the direction of the surface winds at 0800 and 1630 local time in four representative months: January representing conditions during the NE. monsoon, April the hot season, July the SW. monsoon and

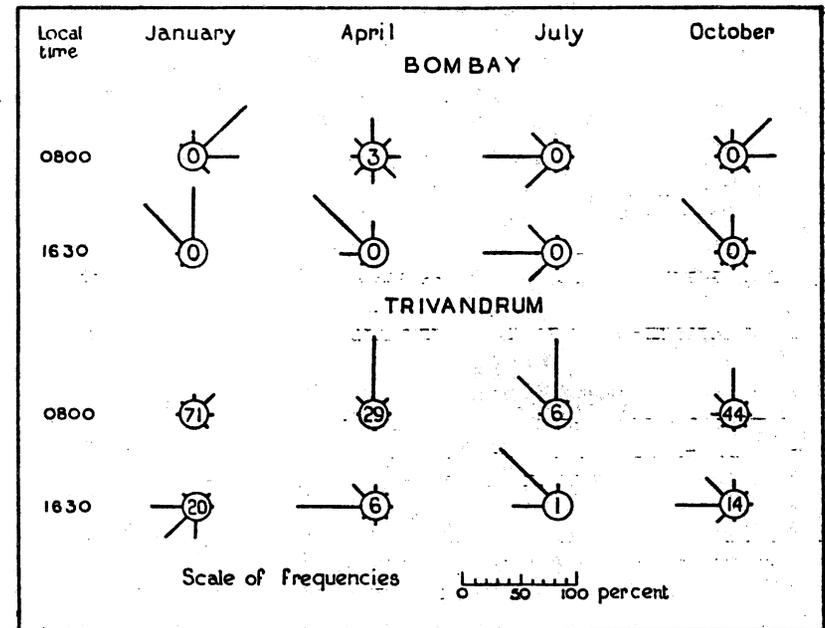


FIG. 8—SURFACE WINDS—MORNING AND AFTERNOON—JANUARY, APRIL, JULY AND OCTOBER—AT BOMBAY AND TRIVANDRUM

Figures inside the circles indicate the percentage frequency of calms.

October the post SW. monsoon period. The corresponding data are included in the general climatological tables. Details with regard to the land and sea breezes at Bombay are given on page 72.

Land and sea breezes are very pronounced along the west coast of India during the months of the NE. monsoon (November to March), and also during the hot season (April and May) and in October after the SW. monsoon has withdrawn. They are practically non-existent at most places on the coast during the SW. monsoon as the usual strong winds of that season completely mask any land and sea breeze effect, and these breezes in any case during this season will be by no means strong as the cloudy weather prevents the land from heating up by day or cooling at night.

Off the Konkan coast in the cool season the daily land and sea breezes are well marked, blowing from the north-eastward in the mornings and from the north-westward in the afternoons and evenings. During the period March to May the land breezes become very uncertain, seldom coming off until the morning and blowing for a very short time. The sea breeze during these months sets in at about noon and is sometimes strong, a feeble land breeze may follow it but more frequently light airs from the northward or calms may be expected from nearly midnight to about noon on the following day when the north-westerly sea breeze again sets in.

On the Malabar coast, except during the period of the SW. monsoon, the daily rhythm of the morning land breeze and the evening sea breeze is a marked feature. In October the land breeze is only occasional, light and uncertain, and the wind is generally weak and mostly from the sea. The land breezes are strongest and blow most regularly in December and January; they are also fairly well marked in November and February, but even in these months the afternoon sea breeze remains a regular feature in spite of the opposing influence of the NE. monsoon winds in the upper air. From March onwards the land breezes decrease in strength and duration and are not always regular. A breeze from the sea can be anticipated nearly all the year but regular land winds can only be expected for about four months.

The penetration of the sea breeze inland from the coast, particularly in the hot season, appears to be favoured by the topography of the west coast of India. When the sea breeze reaches the western Ghats it ascends and flows over the mountains especially where there are cols; once over the Ghats it meets the land air which has been heated by contact with the surface of the plateau and it spreads inland in the form of a cold front displacing the warmer air of the plateau. There are no observations available to the east of Bombay, but at Poona, which is about 80 miles to the south-east of Bombay and about 70 miles from the coast and nearly 2,000 feet above mean sea level, a westerly air current of relatively higher surface humidity sets in in the afternoon and attains occasionally a thickness of nearly 7,000 feet above Poona. It would appear from its speed and duration that it sometimes penetrates 40 to 50 miles to the east of Poona.

At places on the coast opposite gaps in the mountain chain, land winds may blow for more than a day without any intervening sea breeze. An example of this occurs at Palghat on the southern side of the Nilgiri hills, and also in a smaller degree at Kārṅwār where the valley of the Kālinadi river assumes a straight funnel shape eastward towards the interior. This is most likely to occur in December and January when these winds are helped by the NE. monsoon.

Gales, strong winds and squalls

The percentage frequency of gales for the sea areas, compiled from ships' observations taken over a long period of years, is shown in the wind-roses of Figs. 2-7 and in Table II on pages 86-93.

The strongest gales are associated with severe tropical cyclones which are, however, infrequent, but during squally weather, especially in the months of the SW. monsoon, the wind may at times reach gale force.

Winds of gale force are most frequent in the Arabian sea in June, July and August. Off the west coast of India between the latitudes of 10° and 15° N. they are recorded about twice in three years in both June and July and once a year in August, and between the

latitudes of 15° and 20° N. once in three years in June, once a year in July and twice in three years in August. Further westwards gales are much more frequent especially in the central part of the Arabian sea where the full force of the SW. monsoon is felt. In the area 10°-15° N., 65°-70° E., there are, on the average, one gale in June, two gales in July and two in August; still further west in the area 10°-15° N., 60°-65° E. gales average two to three in June, four in July and two in August.

In the neighbourhood of the Maldive islands winds of gale force have been recorded in June, August, October and November, whilst near the coast of India from about Lat. 10° N. southwards they have been recorded about twice in three years in June and once in three years in May, July, August, September, December and January.

When H.M.S. *Gloucester* visited Male atoll in the Maldive islands on 9th November, 1939, frequent heavy rain squalls lasting from 5 to 15 minutes were experienced. The wind on that day was westerly of Beaufort force 3 but it increased to between forces 4 and 5 during the squalls. The majority of the rain squalls had an area of about one square mile but some were very extensive; one particularly large one was estimated to be about 30 to 40 miles long and 2 to 3 miles wide.

2—UPPER WINDS

Observations of upper winds in this area are available for three places on the coast namely Bombay, Mangalore and Trivandrum. Poona has also been included as although this place is about 70 miles from the coast and nearly 2,000 feet above sea level it is considered that the data give interesting information of the upper winds in the vicinity of the western Ghats.

Wind-roses for these stations are reproduced in Figs. 9-24 and the corresponding data are set out in Table IV on pages 95-110.

In using the tables and diagrams it should be remembered that the results are based on observations of pilot balloons and that such balloons can seldom be followed to great heights on occasions of cloud, haze or strong wind, and never in rain. During the NE. monsoon when skies are clear the results are probably reliable up to the limits of height shown, though the number of strong winds at the higher levels is likely to be underestimated. During the SW. monsoon, on the other hand, the number of observations falls off so rapidly above 3,000 feet that the winds above that level cannot be regarded as representative.

In order to supplement the pilot balloon data, observations of the motion of low, middle and high cloud have been included in Table IV, but even in these on days when a large amount of low cloud is present, observations of middle and high cloud will generally be lacking. The cloud observations are limited to direction only and give no information about speed. The average height of the

low, middle and high clouds may be taken as about 6,500, 16,000 and 33,000 feet respectively.

Seasonal variation

Cool season (December to March).—During this season the winds at the surface are those of the NE. monsoon, north-easterly or easterly. In the north these winds extend up to heights of only about 2,000 feet, immediately above that height the winds are variable while at higher levels they become westerly forming part of the normal westerly circulation of temperate latitudes. In the south the easterly winds extend to the greatest height reached by the observations.

The surface of separation between the easterly winds of low latitudes and the westerlies of higher latitudes slopes upwards from north to south. In Lat. 20° N., which is the northern limit of the area under consideration here, this surface of separation is at about 4,000 feet and it rises higher and higher as the latitude decreases until in about Lat. 5° N. it is at a height of over 30,000 feet. This surface of discontinuity will probably be at a slightly higher level over the land than over the sea in the same latitude.

At Bombay in this season light NE. winds prevail at the surface. At 1,800 feet N. winds increase in frequency and strength, and from January to March are the prevailing winds at that level. Above that height winds are lighter and more variable, S. and SW. winds predominating at 6,500 feet in January and February and at 10,000 feet in March. At higher levels westerly winds gradually increase in frequency and strength up to at least 33,000 feet, the limit of height for which information is available.

At Poona, which is nearly 2,000 feet above sea level, the surface winds are light from S. or SW. and there are very frequent calms at the time of the observations; at 3,500 feet in December winds blow almost exclusively from E. or SE.; later in the season they are more variable but chiefly from between NE. and SE. in January and February, and between NW. and NE. in March. At 6,500 feet from December to February winds between SE. and SW. predominate, S. winds blowing on about 40 per cent of occasions in January, while in March winds at that height are variable but chiefly from N. At higher levels winds gradually become westerly or south-westerly and may be strong, speeds exceeding 40 knots having been recorded at 10,000 feet in February.

Further south at Mangalore in December and January easterly winds prevail from the surface up to at least 10,000 feet, the speed increasing with height in the lowest 1,800 feet. In February and March the light NE. and E. winds at the surface back to NW. and N. at 1,800 feet, though E. and NE. winds regain predominance at 6,500 and 10,000 feet, and probably persist up to 15,000 or 20,000 feet. There is some evidence that at heights above 20,000 feet W. winds prevail over Mangalore in January and February.

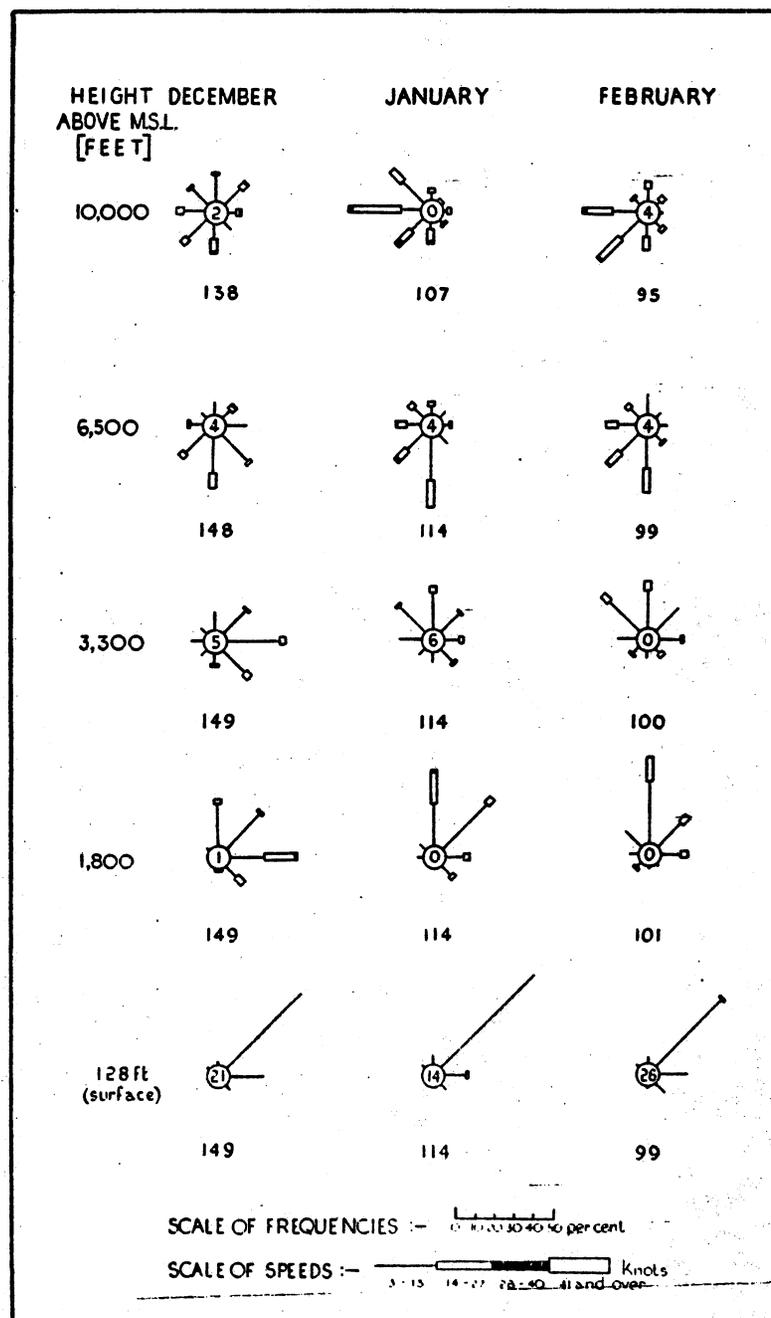


FIG. 9—UPPER WINDS—MONTHLY

Figures inside the circles indicate the percentage frequency of calms. Figures below the roses indicate the number of observations.

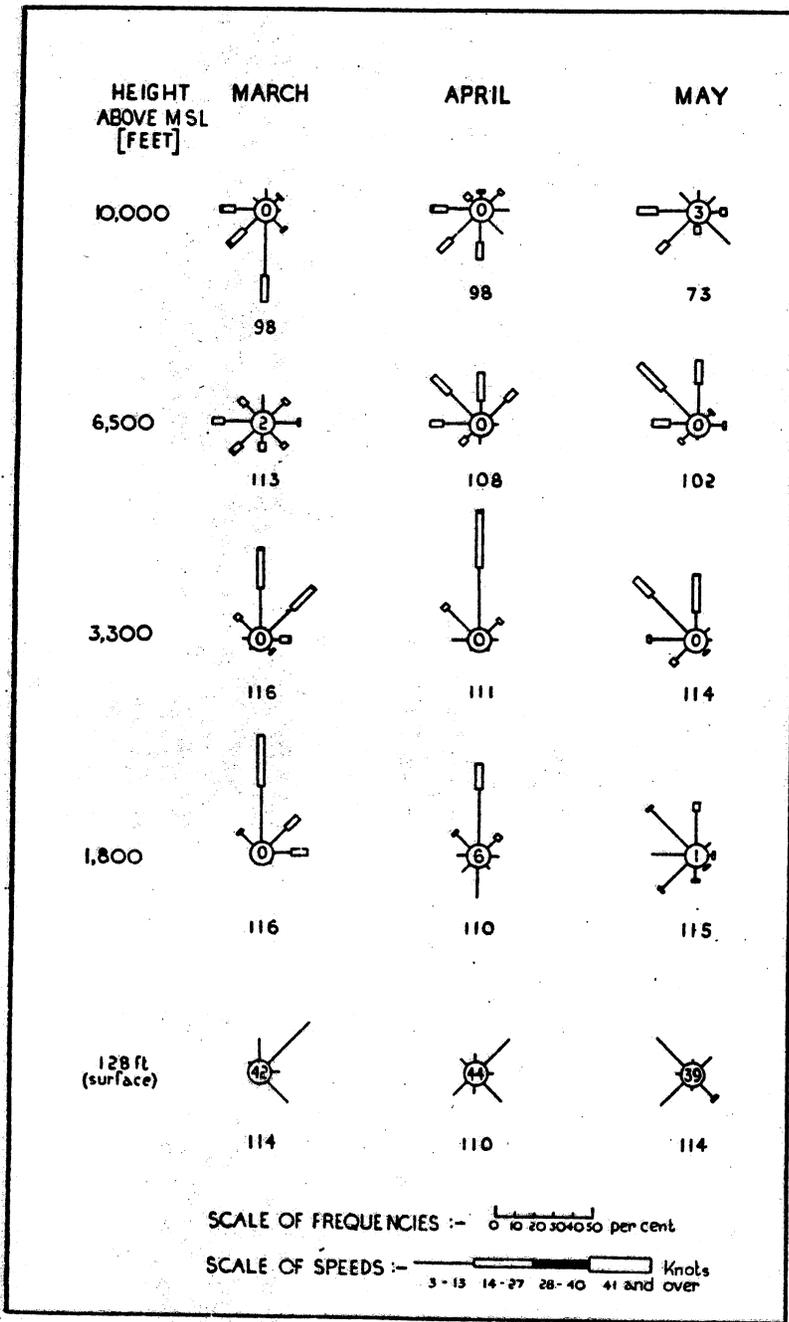


FIG. 10—UPPER WINDS—MONTHLY
 Figures inside the circles indicate the percentage frequency of calms.
 Figures below the roses indicate the number of observations.

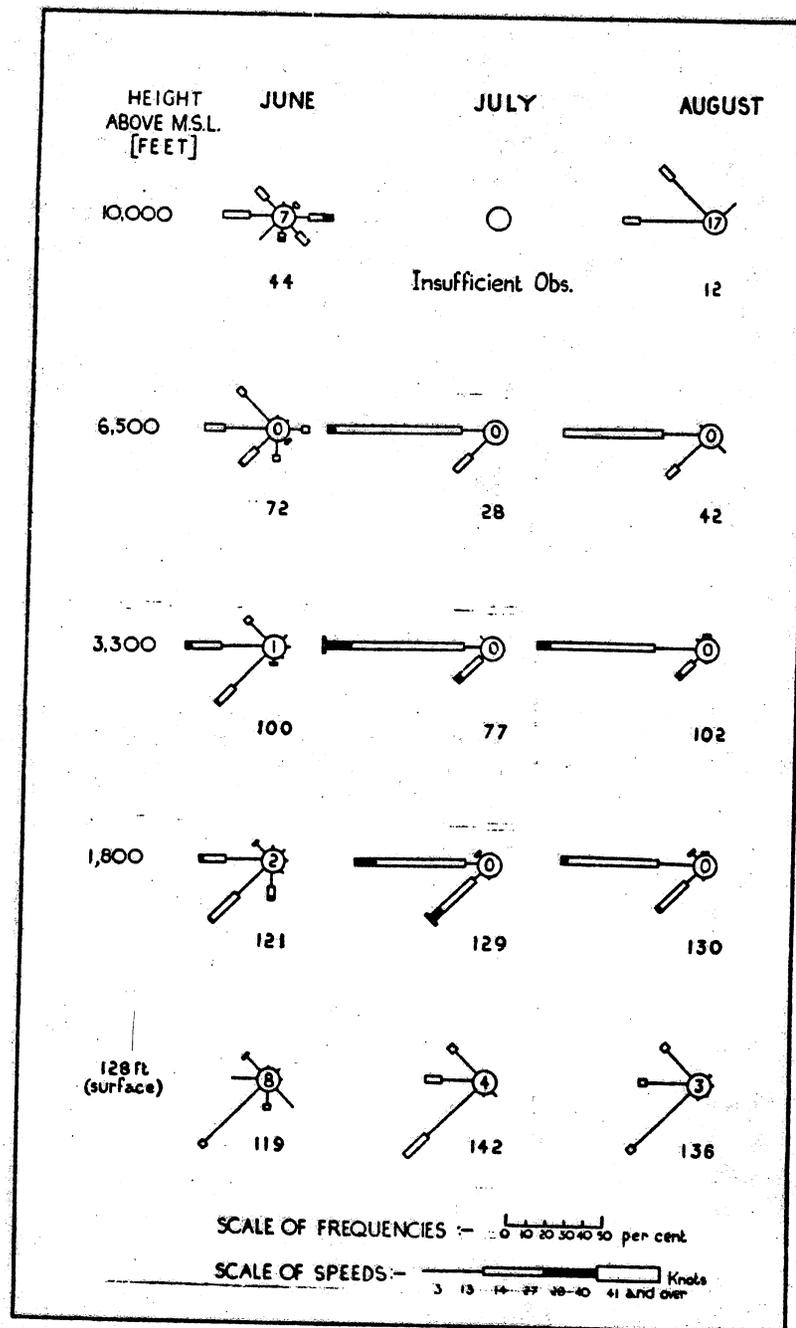


FIG. 11—UPPER WINDS—MONTHLY
 Figures inside the circles indicate the percentage frequency of calms.
 Figures below the roses indicate the number of observations.
 The decrease in the number of observations above 3,300 ft. should be noted.

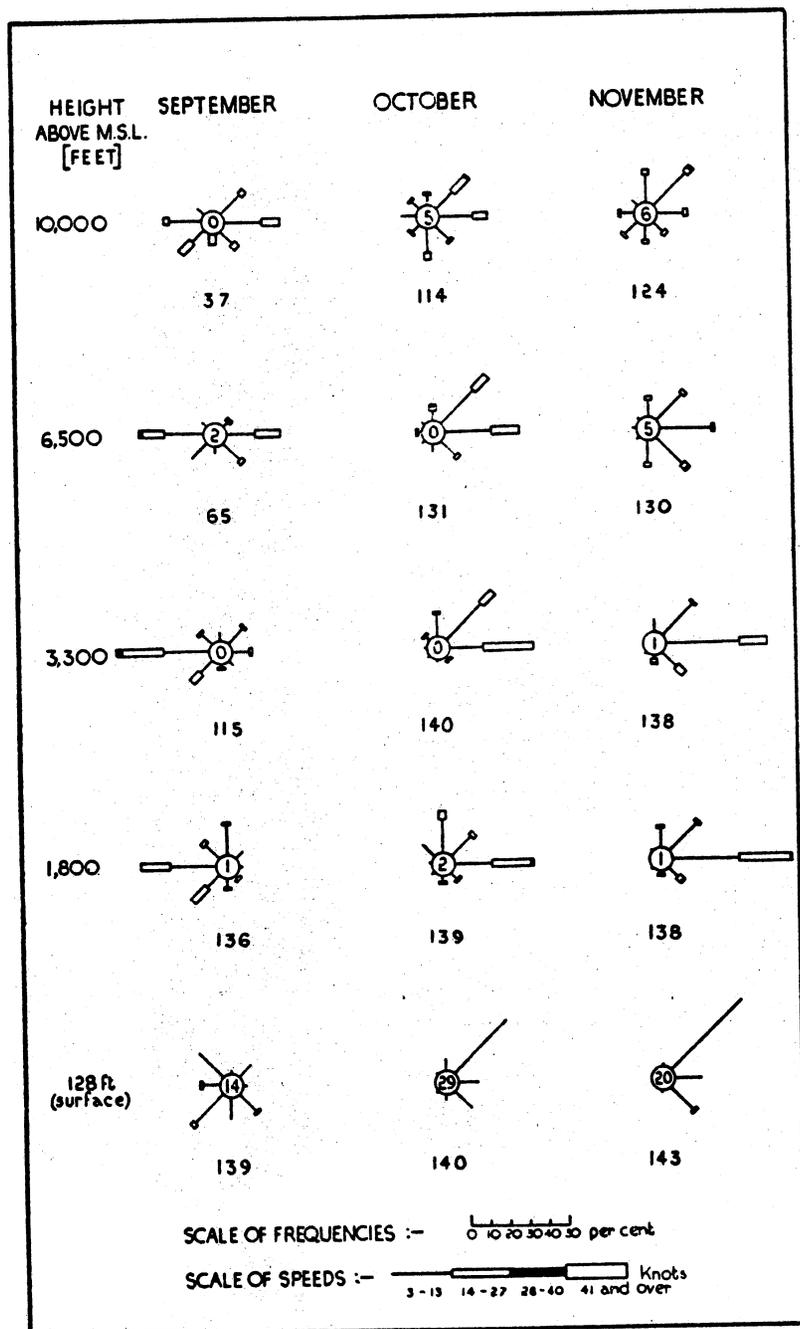


FIG. 12—UPPER WINDS—MONTHLY
 Figures inside the circles indicate the percentage frequency of calms.
 Figures below the roses indicate the number of observations.

POONA

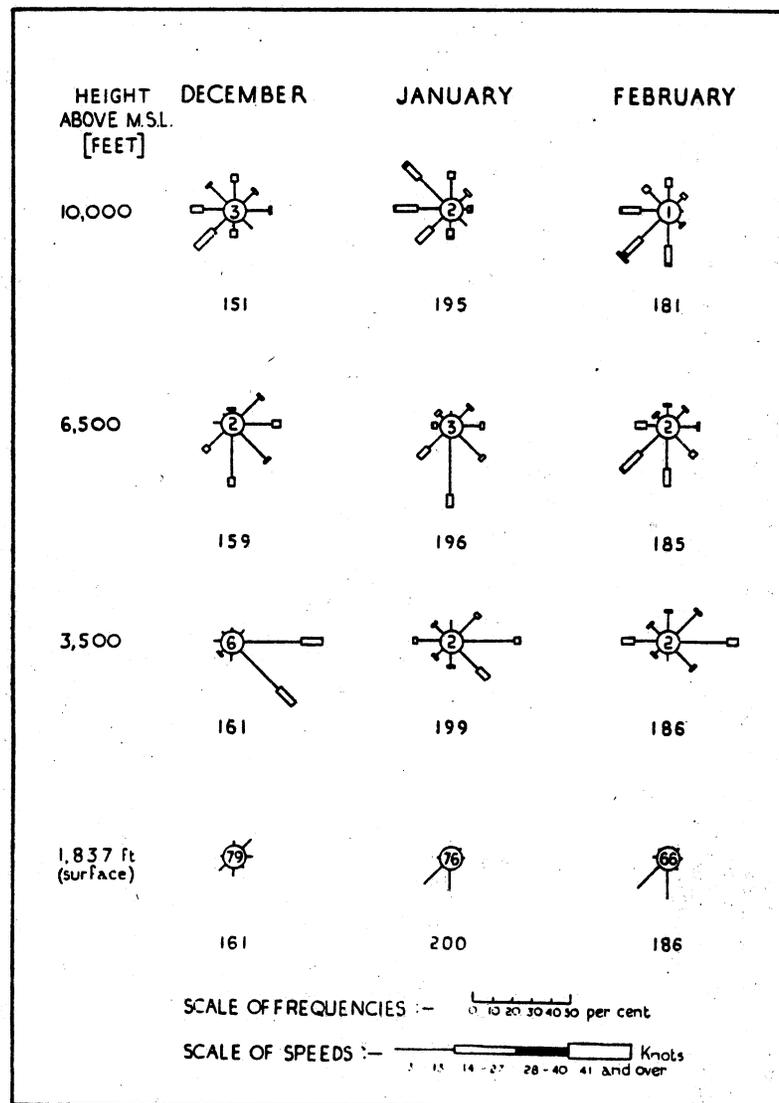


FIG. 13—UPPER WINDS—MONTHLY
 Figures inside the circles indicate the percentage frequency of calms.
 Figures below the roses indicate the number of observations.

POONA

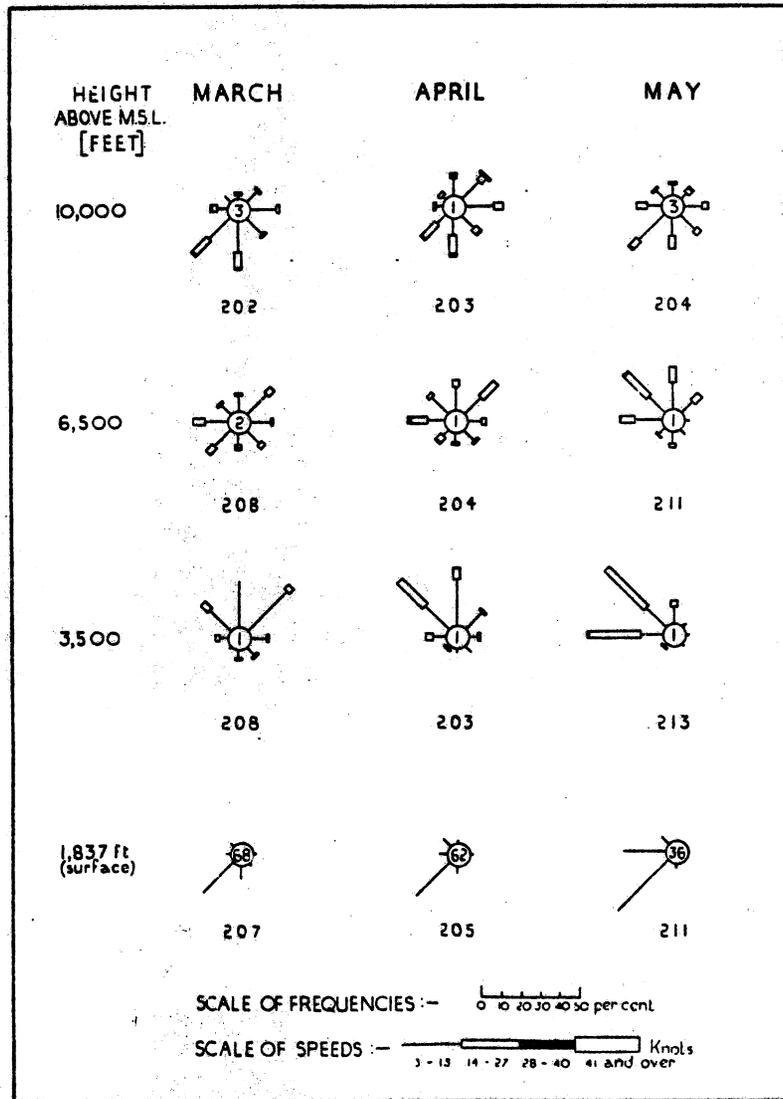


FIG. 14—UPPER WINDS—MONTHLY

Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.

POONA

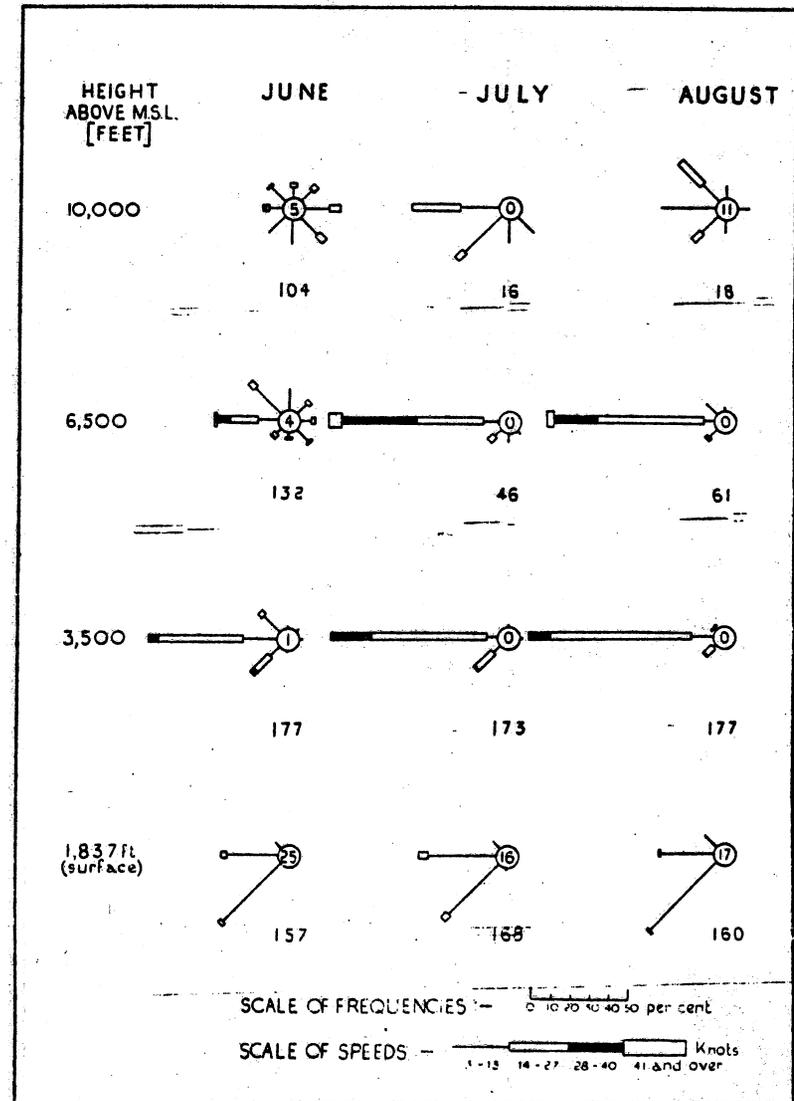


FIG. 15—UPPER WINDS—MONTHLY

Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.
The decrease in the number of observations above 3,300 ft. should be noted.

POONA

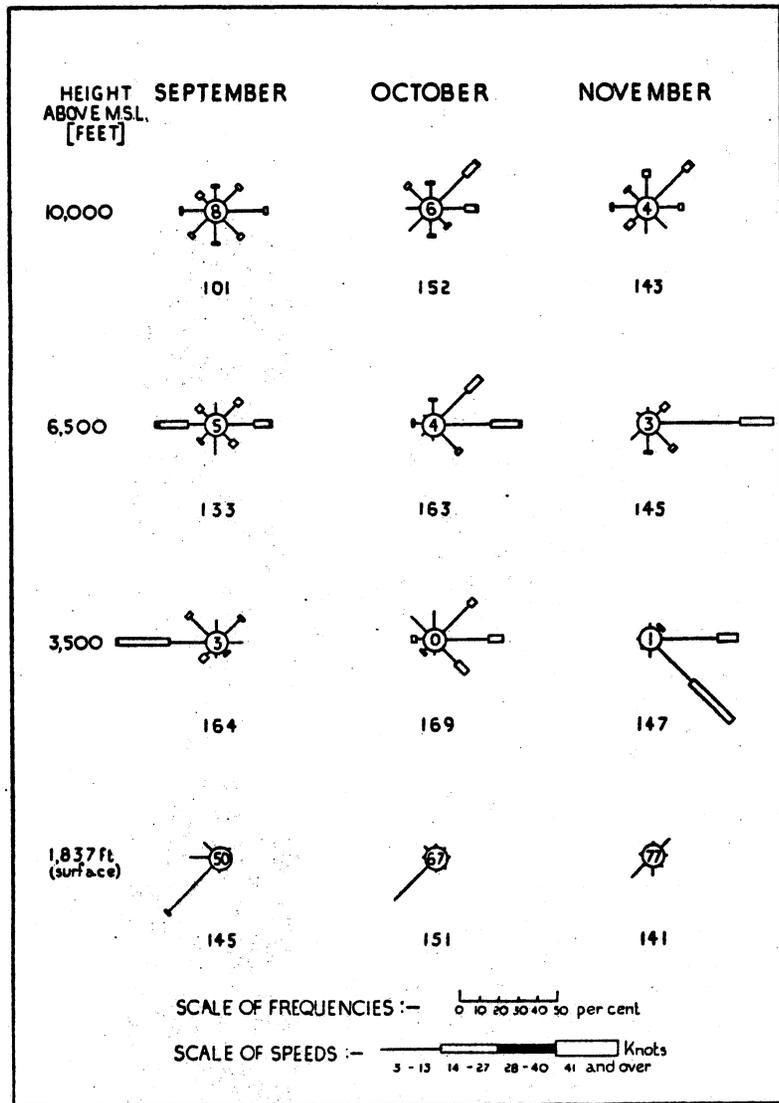


FIG. 16—UPPER WINDS—MONTHLY

Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.

West coast of India
MANGALORE

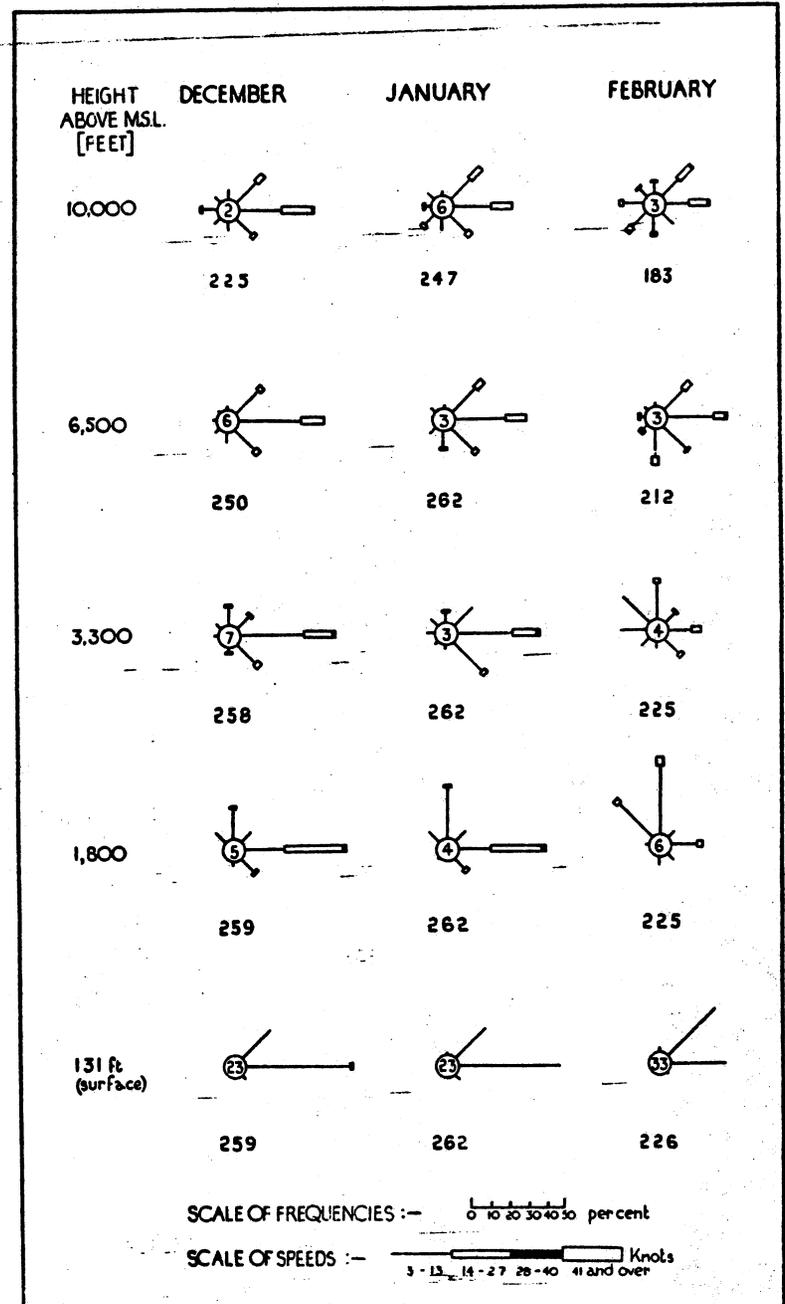


FIG. 17—UPPER WINDS—MONTHLY

Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.

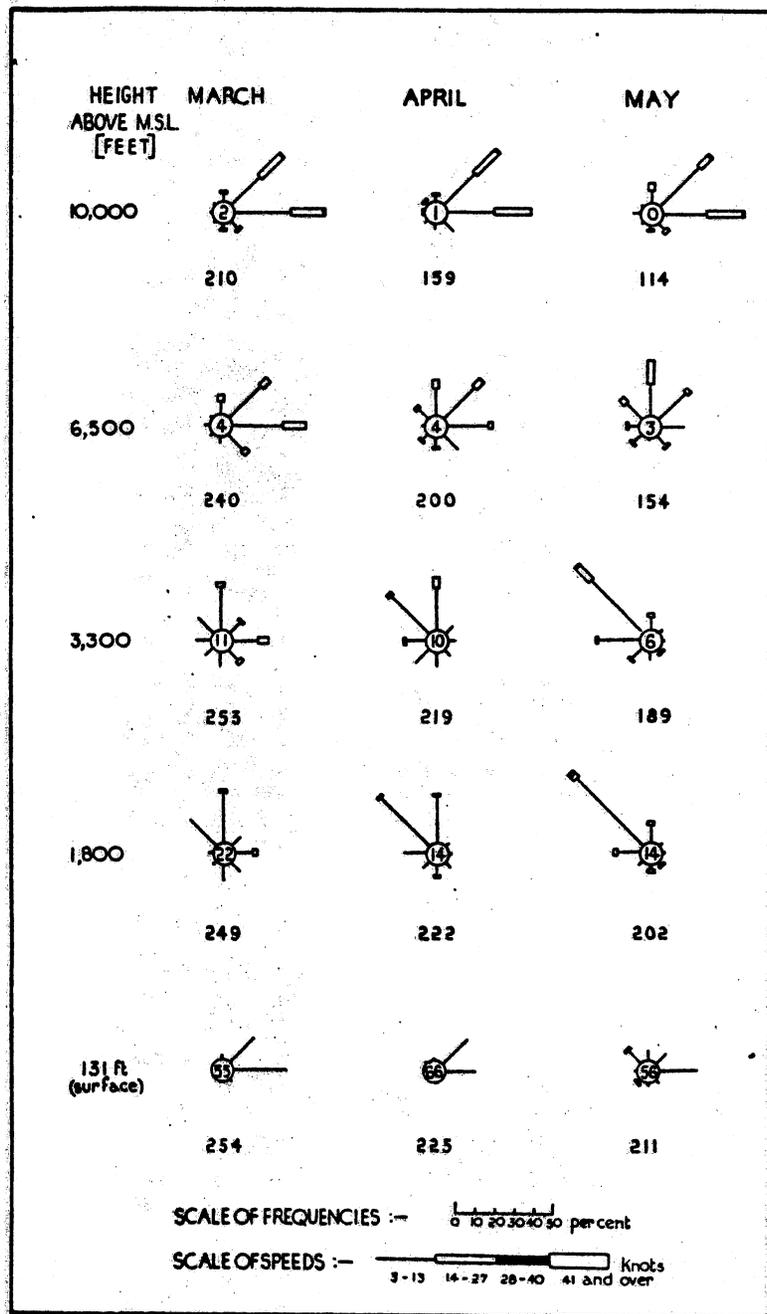


FIG. 18—UPPER WINDS—MONTHLY
 Figures inside the circles indicate the percentage frequency of calms.
 Figures below the roses indicate the number of observations.

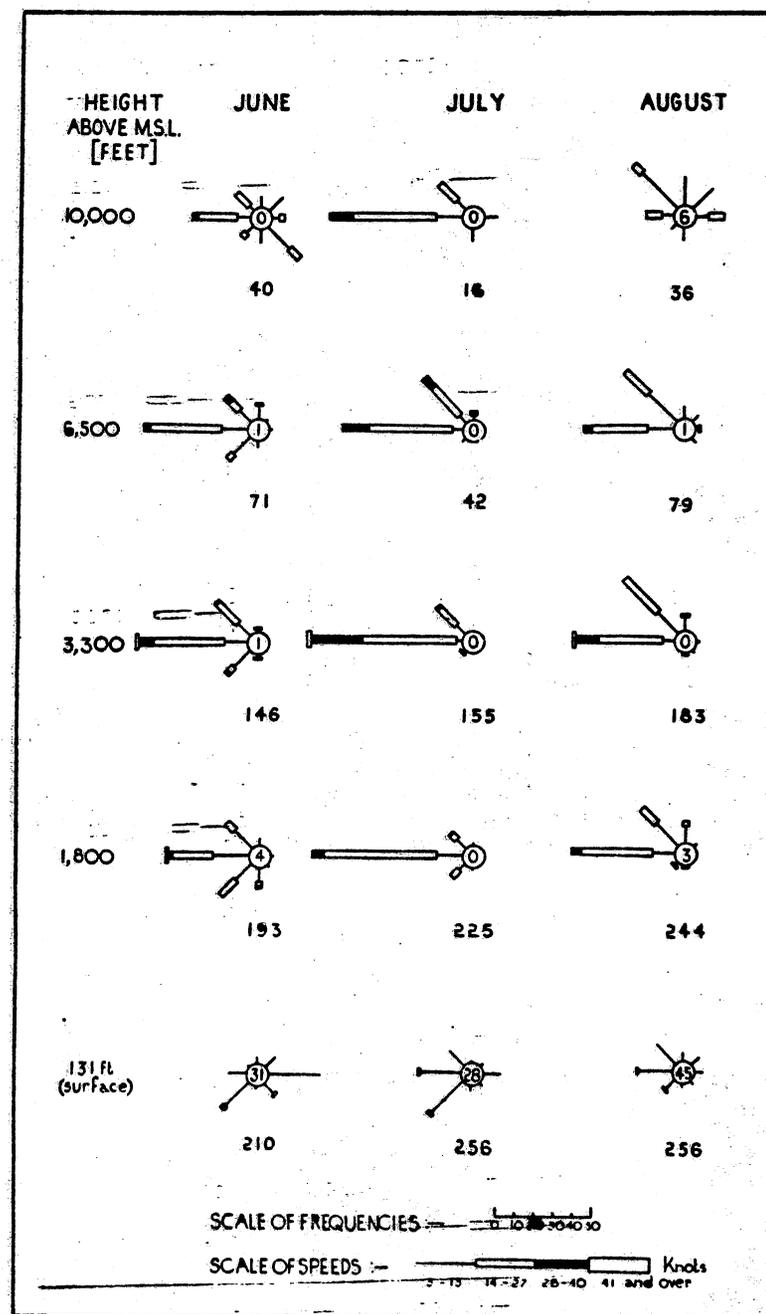


FIG. 19—UPPER WINDS—MONTHLY
 Figures inside the circles indicate the percentage frequency of calms.
 Figures below the roses indicate the number of observations.
 The decrease in the number of observations above 3,300 ft. should be noted.

Upper winds
MANGALORE

5 37

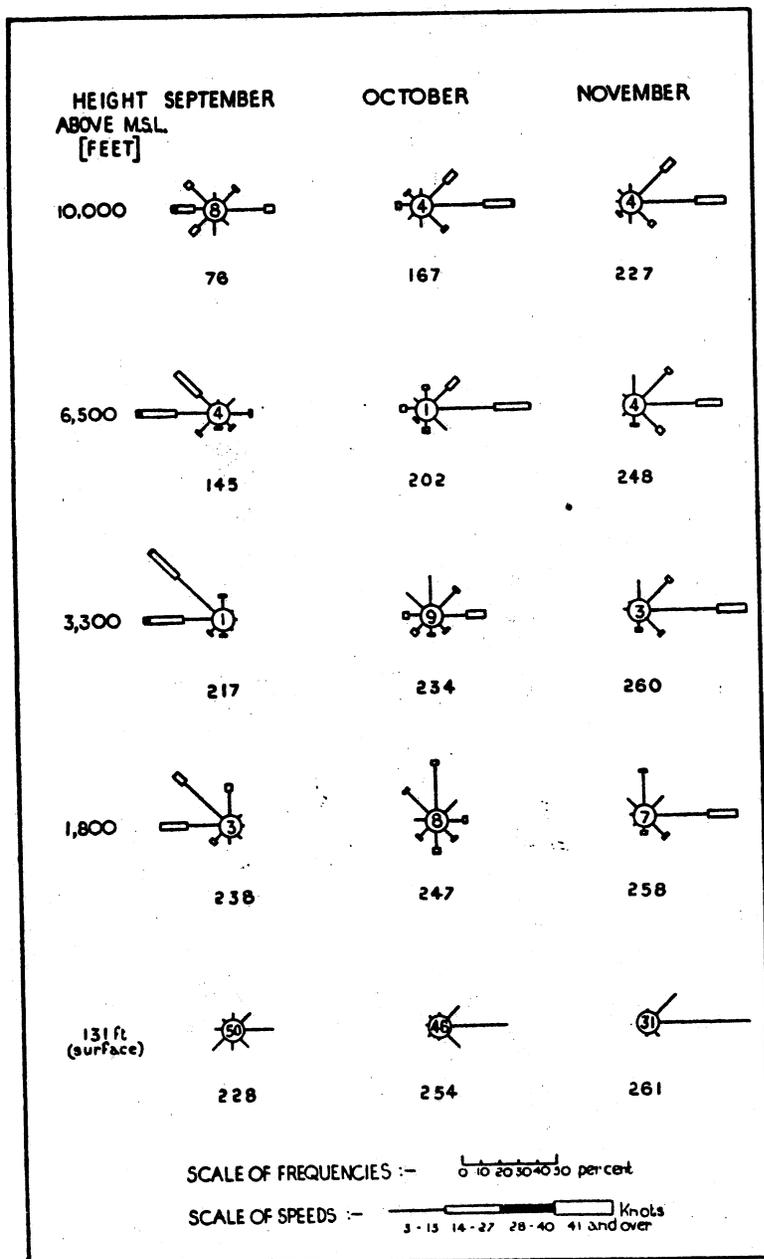


FIG. 20—UPPER WINDS—MONTHLY
Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.

West coast of India
TRIVANDRUM

5 38

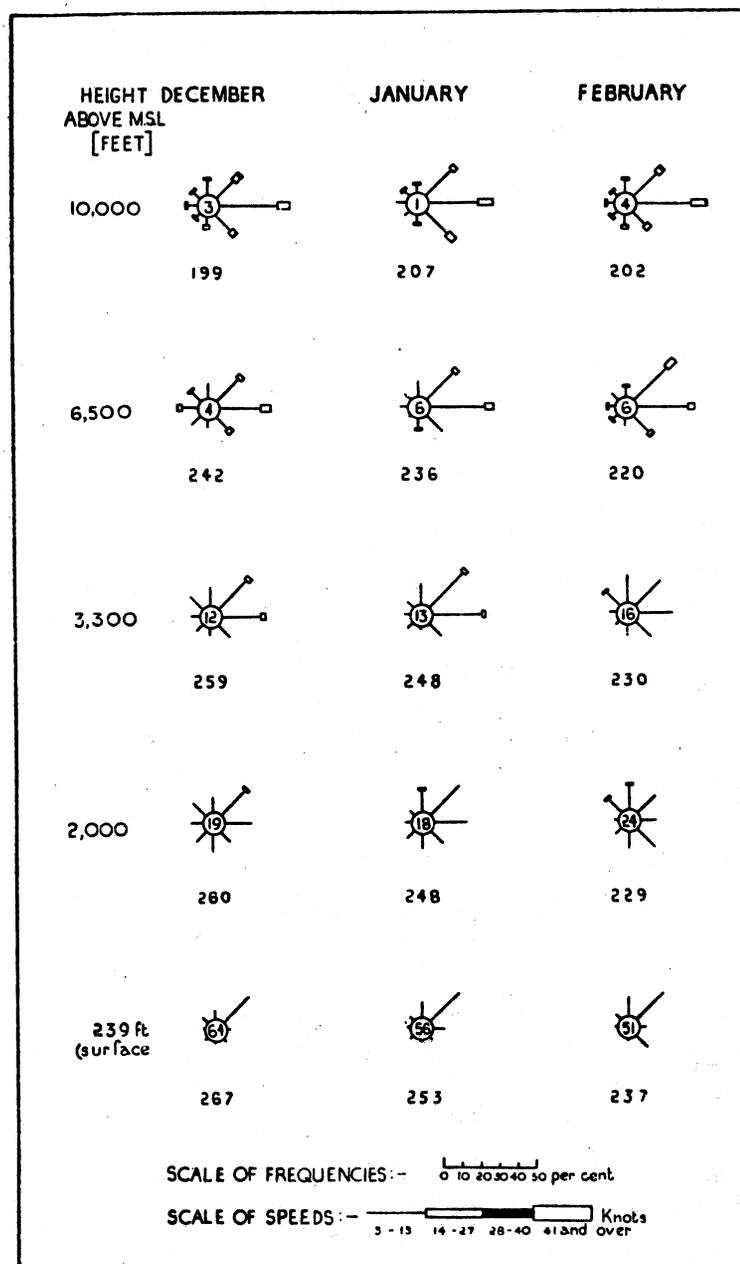


FIG. 21—UPPER WINDS—MONTHLY
Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.

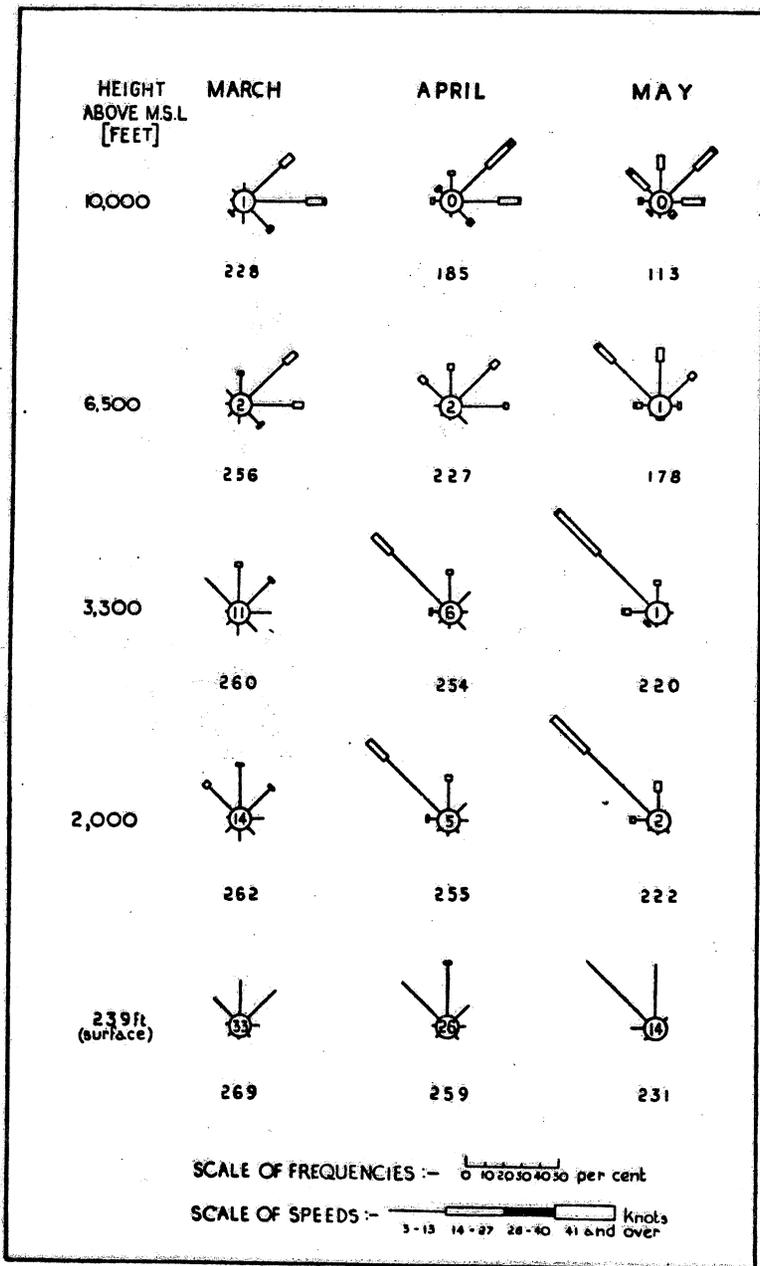


FIG. 22—UPPER WINDS—MONTHLY
Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.

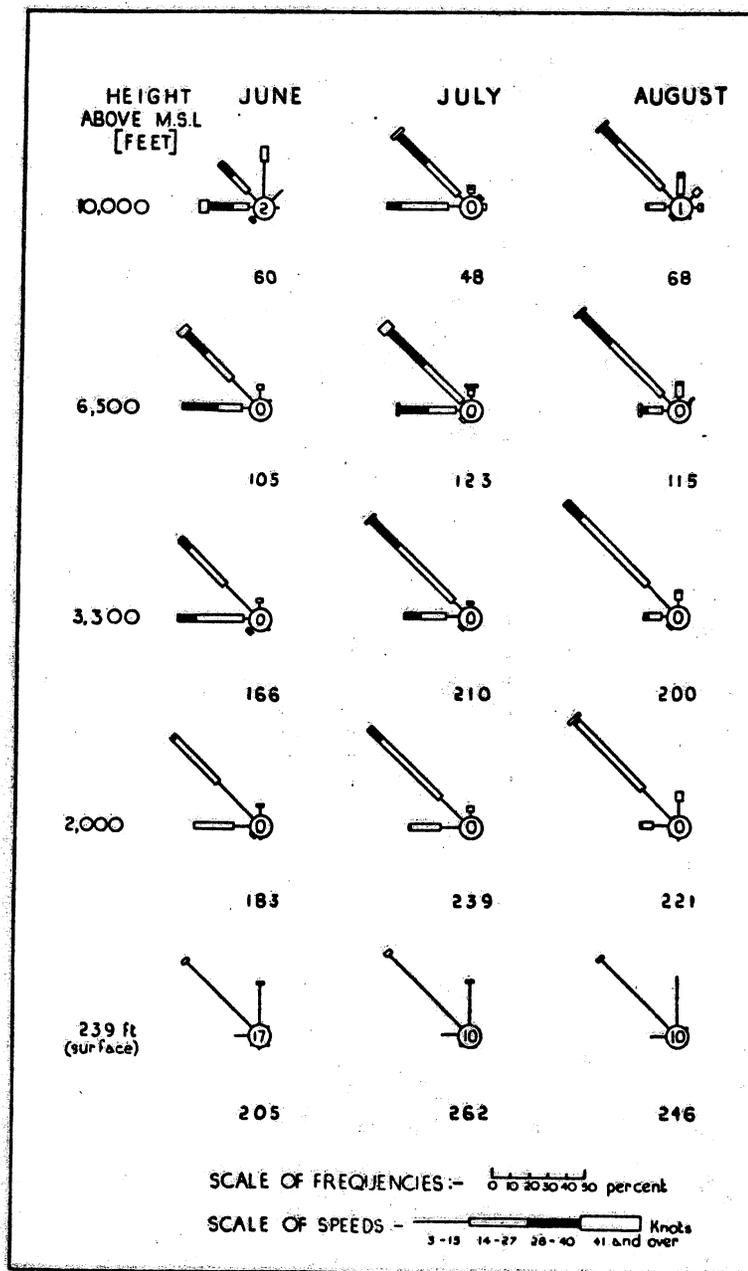


FIG. 23—UPPER WINDS—MONTHLY
Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.
The decrease in the number of observations above 3,300 ft. should be noted.

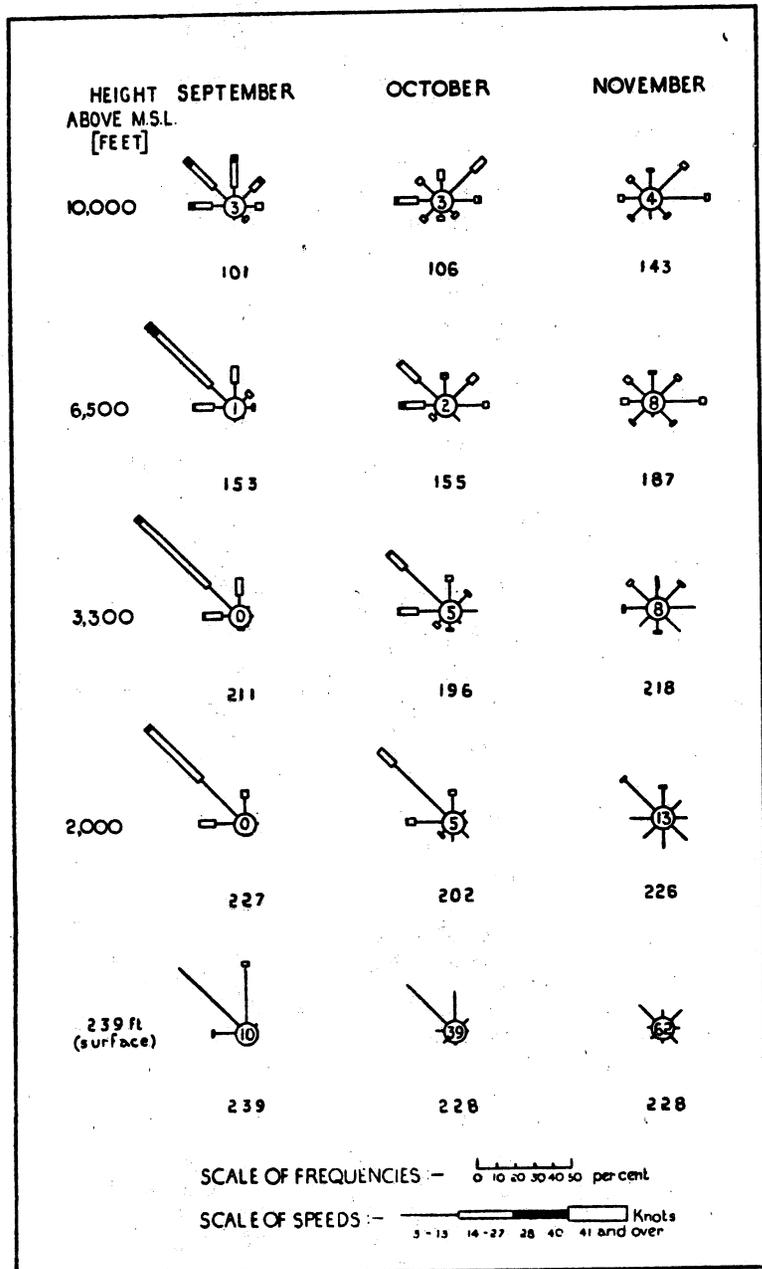


FIG. 24—UPPER WINDS—MONTHLY
Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.

At Trivandrum winds are light throughout the season. From December to February they are variable in the lowest 2,000 feet but in March they blow mainly from between NW. and NE. Above 3,000 feet easterly winds increase in frequency and strength and continue to prevail up to the highest levels for which observations are available.

Hot season (April and May).—The winds in the upper air over the region in April and May are usually light or moderate in strength and it is only occasionally that they exceed a speed of 27 knots.

At Bombay the winds at the surface are light and rather variable. At 1,800 and 3,300 feet N. winds prevail in April and NW. winds in May, and at greater heights in both months the wind gradually backs to W. and SW. It is probable that W. and SW. winds prevail up to great heights.

At Poona there are frequent calms at the surface (1,837 feet above M.S.L.) at the times of observation, otherwise the winds are light and blow mainly from SW. in April and SW. or W. in May. At 3,500 feet southerly winds have practically disappeared; NW. and N. winds are the principal winds at this height in April, backing to W. and NW. in May. Above 3,500 feet winds become variable.

At Mangalore there are frequent calms at the surface at the times of observation, whilst at Trivandrum the winds are light from NW. or N. At both places light or moderate NW. winds prevail up to 3,300 feet, they are stronger and more persistent at Trivandrum than at Mangalore and in May they account for 70 per cent of the observations. There is a well marked change in the wind direction above that level; at 6,500 feet winds are variable but mainly from some northerly direction and at 10,000 feet NE. and E. winds prevail.

SW. monsoon (June to September).—The winds at the surface are those of the SW. monsoon, south-westerly or westerly. It is not easy to fix the exact limit of height to which these SW. monsoon winds extend but on the average when fully established the monsoon is about 20,000 feet thick, although there will be considerable variations owing to variations in the intensity of the monsoon. North of Lat. 15°N. the thickness is probably somewhat less. In this season the easterly winds, characteristic of high levels over the equator, spread northwards over the whole of the region under consideration and are the prevailing winds above the monsoon.

At Bombay and Poona according to the observations the SW. monsoon winds in June do not extend much above 6,500 feet, but, as it is difficult to get observations when once the monsoon has set in, the data refer principally to the early part of the month. According to the few observations that have been obtained in July and August

the monsoon winds are found in those months at 10,000 feet, and probably extend much higher, whilst in September when the SW. monsoon is withdrawing they appear not to extend much above 3,500 feet. The SW. winds of the surface veer to W. at 1,800 feet and increase considerably in frequency and strength. In July and August, between 1,800 and 6,500 feet, W. winds account for about 90 per cent of the observations and the speed of the wind sometimes exceeds 40 knots. The W. winds are less persistent and weaker in September. Observations of high cloud show that at about 30,000 feet the wind is from E., indicating a complete reversal above the top of the monsoon.

At Mangalore in June, July and August W. winds predominate between 2,000 and 6,500 feet, but NW. winds increase in frequency as the season advances until in August they occur nearly as often as the W. winds. Further south at Trivandrum NW. winds predominate throughout the season at all heights up to 10,000 feet but whilst in June W. winds are also frequent, accounting for 30 or 40 per cent of the observations, in August their frequency is only 15 per cent. The winds at Mangalore are not quite so strong as those at Trivandrum but at both places winds of over 27 knots are common at all heights and the speeds may occasionally exceed 40 knots. In September at Mangalore the W. and NW. winds have decreased considerably both in frequency and strength but at Trivandrum NW. winds continue to prevail up to about 6,500 feet. The movement of high cloud indicates that the wind at very high levels is from E.

Post SW. monsoon period (October and November).—By October, at Bombay, NE. monsoon conditions have set in and the winds at the surface are mainly from NE.; light E. winds prevail at 1,800 feet, and above that level the direction is between E. and NE. becoming more variable at 10,000 feet. In both months the winds are light to moderate in strength at all heights up to 10,000 feet; it is probable that W. winds prevail at greater heights.

At Poona the surface winds are still blowing from SW. in October but they are light and there are frequent calms at the time of observation both then and still more in November. These SW. winds are very shallow and at both 3,500 and 6,500 feet the wind blows mainly from some easterly direction, from between NE. and SE. in October and from E. or SE. in November. At 10,000 feet winds are variable and above that level W. winds probably increase both in frequency and strength, especially in November.

At Mangalore the surface winds are light and easterly in October and November. In October winds at 1,800 and 3,300 feet are variable, but easterly winds predominate again at 6,500 feet and probably extend to very high levels. In November light to moderate E. winds prevail at all heights.

At Trivandrum conditions in the lower layers in October are similar to those during the SW. monsoon, with light NW. winds prevailing up to 3,300 feet. Above that height winds are variable. In November winds are variable at all heights shown by the observations, as the NE. monsoon winds do not appear here until December.

At both Mangalore and Trivandrum the observations of high clouds show that the wind in the upper levels is easterly.

IV—VISIBILITY

The visibility in the region under consideration is on the whole quite good if compared with that of more temperate climates. The atmosphere of southern India is less hazy than that of northern India and this is largely due to the absence of the dust which is so often in the atmosphere in northern India. A very clear atmosphere over the land, however, is exceptional. The visibility may be less than half a nautical mile at any time of the year but such visibilities are most likely to be experienced during the SW. monsoon. Thick fog is infrequent and when it occurs it is restricted to the damper regions during the early morning in the cool season; it is only likely to occur over the rivers.

Tables of the percentage frequencies of different degrees of visibility in the different months of the year in the morning at Ratnágiri, Mormugão, Mangalore, Cochin, Amini and Minicoy, and in the morning and afternoon at Bombay and Trivandrum are given on pages 111–2. The number of days with poor visibility (i.e., visibility less than 2 nautical miles) based on the same data is included in the general climatological tables.

Arabian sea and Indian ocean.—There are no reports of any fog ever having been experienced away from the vicinity of the coasts in the portion of the Arabian sea and Indian ocean under consideration here; it has, however, been reported occasionally at the island of Minicoy.

The usual type of visibility met with at any time of the year is from moderate to excellent (5 miles to over 30 miles). A visibility of about 30 miles is quite usual except from June to September, which is the period of the SW. monsoon when the visibility is mainly about 10 miles, but even during these months a visibility of 30 miles is often experienced.

Poor visibility, that is visibility of 2 miles or less, is rare and occurs only when there is heavy rain; it lasts for the time taken for the rain or shower to pass over, and the degree of visibility will depend on the intensity of the rain.

H.M.S. *Gloucester* visited Male atoll in the Maldive islands on 9th November, 1939 and reported that the visibility on that day was 15 miles, but variable during rain when at times it was reduced to about 100 yards. In the areas covered by rain squalls where there was almost continuous solid rain the visibility was reported to be nil.

West coast of India south of Bombay.—In the months from March to May, when north-westerly winds prevail, the atmosphere is generally hazy along the Konkan and Kanara coasts and this haziness is usually more marked during March and April. It is possible that owing to this haze the land and trees along the coast may appear to be much nearer than they really are.

From April to October including the period of the SW. monsoon the mountains of the western Ghats are usually enveloped in a dense mist or haze which hides them from view. These mists, however, occasionally disperse for short intervals after heavy falls of rain.

At places on the coast during the months of the SW. monsoon, especially in July, the visibility may at times be less than half a nautical mile. At Mangalore in 1937 there were five days in July with this bad visibility at 0800 local time, the average number being two or three.

In October and November early morning fogs may obscure from view low-lying land and projecting headlands until about the time of sunrise or a little later.

V—CLOUD

Step diagrams showing the monthly variation of mean cloud amount at coastal and island stations are reproduced in Fig. 25; the corresponding data are given in the general climatological tables on pages 78–85. The figures quoted in the following text refer to observations taken at 0800 local time.

Table VI shows the monthly frequencies of cloud of different amounts in the morning and afternoon at Bombay and Trivandrum and in the morning only at Ratnágiri, Mormugão, Mangalore, Cochin, Amini and Minicoy.

Observations of the amount of low cloud, i.e. of cloud with base below 8,000 feet, are available over only a short period of years, but in view of their importance in air navigation a supplementary table of the results is given below. The table shows the average amount of low cloud in each month of the year and, for comparison, the total amount of cloud taken over the same period of years, and the difference between the two.

MONTHLY AVERAGES OF THE AMOUNT OF CLOUD OF ALL TYPES COMPARED WITH THAT OF LOW CLOUD
Period: 1933–7

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	<i>tenths</i>												
BOMBAY													
0800. Total	2.2	1.6	1.2	2.4	4.1	7.4	8.9	8.8	7.1	3.5	3.0	2.0	4.4
Low	0.4	0.9	0.6	1.8	2.9	5.3	6.3	6.6	4.8	1.5	0.9	0.5	2.7
Diff.	1.8	0.7	0.6	0.6	1.2	2.1	2.6	2.2	2.3	2.0	2.1	1.5	1.7
1630. Total	2.0	1.1	1.0	0.9	2.9	7.7	9.1	8.7	7.3	3.1	2.8	2.0	4.1
Low	0.3	0.1	0.3	0.4	1.7	5.2	6.5	6.0	5.0	1.4	0.8	0.3	2.3
Diff.	1.7	1.0	0.7	0.5	1.2	2.5	2.6	2.7	2.3	1.7	2.0	1.7	1.8
RATNÁGIRI													
0800. Total	0.8	0.5	0.7	1.4	2.9	6.8	7.9	6.6	5.1	2.5	1.6	1.1	3.2
Low	0.1	0.1	0.0	0.6	1.5	5.3	6.4	5.3	3.6	1.4	0.5	0.4	2.1
Diff.	0.7	0.4	0.7	0.8	1.4	1.5	1.5	1.3	1.5	1.1	1.1	0.7	1.1
MORMUGÃO													
0800. Total	2.7	3.0	2.9	4.4	5.9	7.9	8.1	7.6	6.9	5.0	3.2	2.1	5.0
Low	0.3	0.3	0.7	1.5	3.2	6.6	7.3	6.6	5.4	2.6	0.8	0.4	3.0
Diff.	2.4	2.7	2.2	2.9	2.7	1.3	0.8	1.0	1.5	2.4	2.4	1.7	2.0
MANGALORE													
0800. Total	3.7	3.5	3.5	5.6	7.3	9.0	9.4	8.9	7.7	7.1	4.9	4.1	6.2
Low	0.7	1.4	1.5	3.3	4.7	6.5	7.3	6.3	4.7	4.1	1.5	1.0	3.6
Diff.	3.0	2.1	2.0	2.3	2.6	2.5	2.1	2.6	3.0	3.0	3.4	3.1	2.6
COCHIN													
0800. Total	4.1	3.6	3.6	6.0	7.4	8.7	8.7	8.2	6.6	7.2	5.8	4.0	6.2
Low	1.3	1.2	1.4	2.4	3.5	4.9	5.1	4.1	3.2	3.1	2.1	1.1	2.8
Diff.	2.8	2.4	2.2	3.6	3.9	3.8	3.6	4.1	3.4	4.1	3.7	2.9	3.4
TRIVANDRUM													
0800. Total	3.9	2.5	3.0	5.4	7.1	8.1	8.6	7.2	6.1	6.8	5.6	4.0	5.7
Low	0.9	1.0	1.0	2.1	4.6	5.8	6.2	4.6	4.5	4.0	2.6	0.6	3.1
Diff.	3.0	1.5	2.0	3.3	2.5	2.3	2.4	2.6	1.6	2.8	3.0	3.4	2.6
1630. Total	5.4	4.1	6.2	7.9	8.1	8.6	8.8	7.9	6.9	8.4	7.3	5.6	7.1
Low	2.8	2.0	4.5	5.9	6.0	6.3	6.6	5.0	4.1	5.9	5.2	3.3	4.8
Diff.	2.6	2.1	1.7	2.0	2.1	2.3	2.2	2.9	2.8	2.5	2.1	2.3	2.3
AMINI													
0800. Total	4.2	3.4	3.4	4.3	6.2	8.4	8.4	7.2	6.9	6.8	5.2	3.7	5.7
Low	1.9	2.1	2.2	2.2	3.0	4.2	3.7	3.6	3.9	3.5	2.4	1.6	2.9
Diff.	2.3	1.3	1.2	2.1	3.2	4.2	4.7	3.6	3.0	3.3	2.8	2.1	2.8
MINICOY													
0800. Total	5.5	4.5	5.3	5.7	6.7	7.9	7.8	7.0	6.4	6.4	5.6	4.6	6.1
Low	2.2	2.1	2.2	2.3	4.0	4.8	4.3	3.9	3.7	3.2	2.9	1.9	3.1
Diff.	3.3	2.4	3.1	3.4	2.7	3.1	3.5	3.1	2.7	3.2	2.7	2.7	3.0

Authorities.—Bibliography Nos. 55, 58.

Note.—The morning hour of observation, 0800, is local mean time, the afternoon hour, 1630, is zone -5 and approximates very closely to local time.

General.—The amount of cloud in this region depends very much on the time of year. From June to September during the wet weather of the SW. monsoon the cloud amount is fairly large with averages of 7 to 9-tenths of the sky covered in most coastal areas; during the other months of the year the cloud amount is less and varies from about 1 to 4-tenths, except in May and October when it is about 4 to 6-tenths.

Seasonal variation

Cool season (December to March).—The total cloud amount during this period is small. On the average it is 1 to 2-tenths in most places on the west coast of India, except at Trivandrum in the south where the average is just over 3-tenths decreasing from over 4-tenths in December to between 2 and 3-tenths in February and March. At Amini and Minicoy islands it is also higher being from 3 to 4-tenths.

There is very little information about cloud over the sea but such observations as are available indicate that in this season the cloud amount over the open sea is somewhat greater than over the land. The cloudiest skies are in the equatorial regions where about 4-tenths of the sky are normally covered; the amount decreases slowly northwards and north of Lat. 15° N. it is less than 2-tenths on the average.

The cloud amount on the west coast of India from Bombay southwards shows a slight increase in the early morning with a decrease in the evening.

Cloud below 10,000 feet is infrequent in most places in these months and low cloud will only be found over those parts of the Arabian sea where squalls and showers occur and possibly on the southern part of the west coast of India in March during the passage of an occasional shower or squall. Mangalore may also occasionally have clouds below 8,000 feet in February and March.

Hot season (April and May).—There is a slight increase in the average cloud amount in these months over the whole region. The cloud amount is greater in the south than in the north. Along the coast from Mormugão to Trivandrum the average cloud amount in April is between 4 and 5-tenths whilst to the north, from Mormugão to Bombay, it is about 3-tenths. May has slightly more cloud than April. Minicoy island has an average of 4-tenths in April and 5-tenths in May and in most places the increase in cloud amount between April and May is 1 to 2-tenths.

The cloud amount on the west coast of India from Bombay southwards is at its maximum in the morning and decreases to a minimum in the afternoon, increasing again slightly in the evening.

Low cloud in these months is still infrequent and at Trivandrum in April on 70 per cent of occasions the clouds are over 10,000 feet and only on about 13 per cent of occasions is the cloud below 6,500 feet.

The frequency of low cloud, however, is much greater in May than in April especially in the south. The frequency in April may be found to vary very much from year to year; in 1937 cloud at 0700 at Trivandrum was below 8,000 feet on 3 days out of 5.

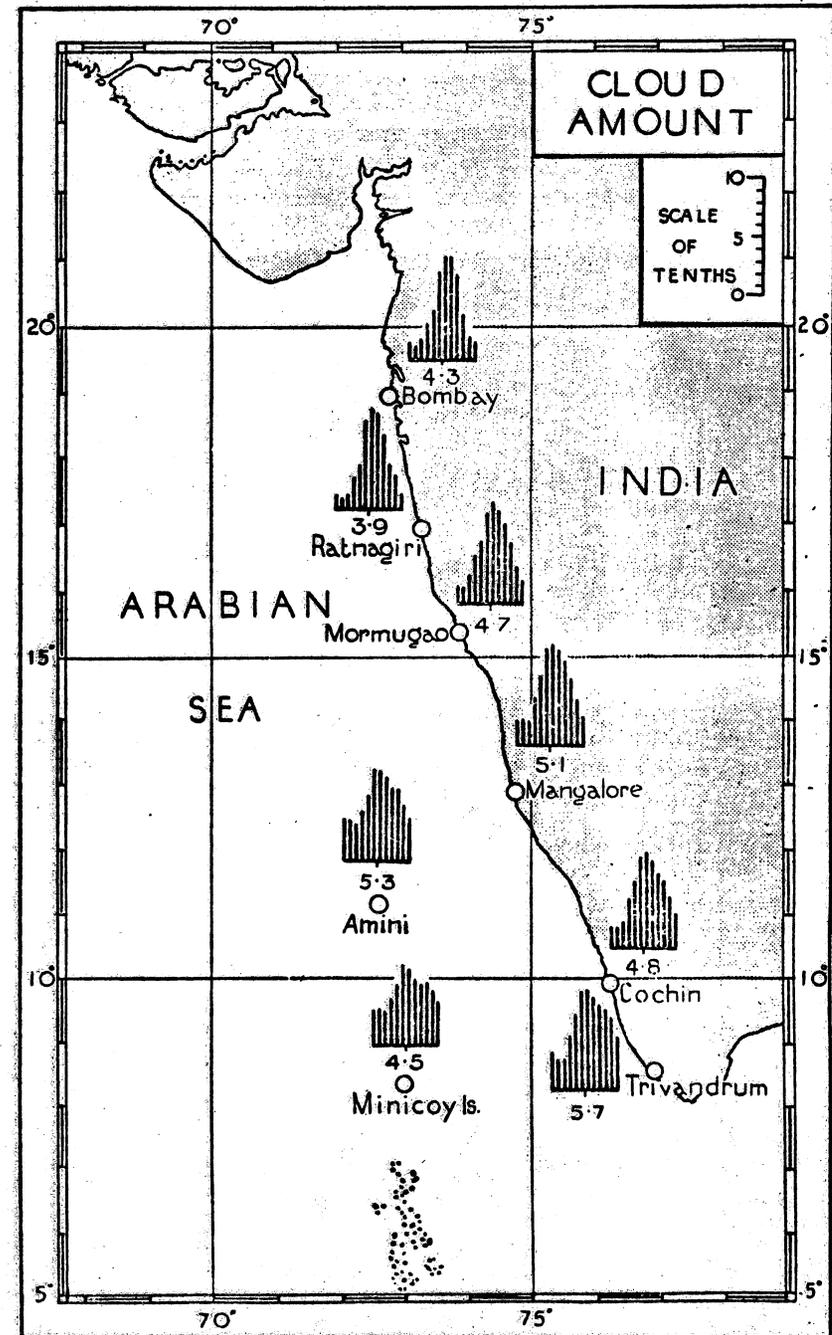


FIG. 25—MONTHLY VARIATION IN MEAN CLOUD AMOUNT
The figures below the step diagrams indicate the mean annual amount of cloud. The diagrams are for 0800 local time.

SW. monsoon (June to September).—During the SW. monsoon the amount of cloud is much greater over the coast than over the sea, in striking contrast with conditions during the cool season. The amount of cloud increases along the path of the south-westerly winds. In the equatorial regions the average amount is between 5 and 6-tenths but north of Lat. 10° N. and west of Long. 60° E. the amount is less than 4-tenths, increasing to about 6-tenths in Long. 70° E. and to more than 8-tenths on the coast.

Minicoy island has the least amount of cloud in the area; June and July are the most cloudy months with an average amount between 6 and 7-tenths, which in August and September has decreased to about 5-tenths. On the west coast of India from Bombay to Trivandrum in June, July and August the average cloud amount is 8-tenths and in September there is a slight decrease to between 6 and 7-tenths. There is not much difference between different parts of the coast. The frequency of overcast skies, cloud amount greater than 8-tenths, at 0700 is very great on the coast in July.

There is very little diurnal variation in cloud amount at Bombay or on the west coast of India during this season.

At Trivandrum in July on about 67 per cent of occasions the clouds are below 10,000 feet and on about 40 per cent of occasions they are below 6,500 feet and may often be below 3,000 feet; they are, however, rarely below 1,000 feet. In July, 1937, at Trivandrum cloud amount greater than 8-tenths occurred with cloud below 3,000 feet on 10 days and at Mangalore on 22 days.

In mountainous regions such as the western Ghats near Bombay, the cloud ceilings in the rains are often dangerously near or below the mountain tops and blind flying has to be resorted to if the hills have to be crossed.

At Poona, which is 1,830 feet above sea level and about 70 miles south-east of Bombay, the average height of the clouds during the period June to October is about 4,500 feet above sea level and observations over a period of 5 years gave no record of cloud below 3,000 feet above sea level. These results, however, refer only to times when there is no rain; there are practically no observations during actual rain.

Post SW. monsoon period (October and November).—The cloud amount in these months, on the withdrawal of the SW. monsoon, shows a decrease on the west coast of India but at Minicoy island it remains at about 5-tenths and does not show much decrease until December.

The increase in cloudiness on the west coast of India from north to south again becomes noticeable in these months. At Bombay in October the average cloud amount is about 4-tenths, increasing to about 7-tenths at Trivandrum; elsewhere it is about 5-tenths.

In November there is a further decrease in cloud amount to 2-tenths at Bombay and 3 to 4-tenths at other places to the south of Bombay. At Trivandrum, however, it still remains slightly higher than elsewhere at about 6-tenths.

In October there is slightly more cloud in the morning than in the evening but this small diurnal variation is hardly noticeable in November.

At Trivandrum on about 50 per cent of occasions in November the clouds are over 10,000 feet, and on only about 20 per cent of occasions are the clouds below 6,500 feet in this month and they are rarely below 1,500 feet. In October those parts of the Arabian sea where squalls and showers occur will have low clouds during their passage.

When H.M.S. *Gloucester* visited Male atoll in the Maldive islands on 9th November, 1939, the sky was 7 to 10-tenths covered by cumulus with some altocumulus and cirrus clouds. The average height of the clouds was between about 1,500 and 2,000 feet except during showers when the clouds lowered to about 600 feet.

VI—RAIN AND HAIL

1—RAIN

Step diagrams showing the monthly averages of rainfall and rain-days are reproduced in Figs. 26 and 27 and the corresponding data are given in the general climatological tables on pages 78-85.

The definition of a rain-day used by the India Meteorological Department is a day on which 2.54 mm. (0.1 in.) or more of rain falls.

General.—The rainfall on the west coast of India from Lat. 20° N. to Cape Comorin is the largest of the whole Indian peninsula and is comparable with that on the west coast of Burma. This large amount of rain falls almost entirely during the months of the SW. monsoon; in the other months of the year the rainfall is quite small.

In October, the rainfall is mostly associated with thunderstorms; generally in November and December, and occasionally also in October, it is associated with cyclonic storms or depressions which cross the Indian peninsula from the Bay of Bengal.

The variation in the number of rain-days is similar to that of the amount of rain. At all places the greatest number of rain-days occurs during the months of the SW. monsoon, and in July, August and September on the coast from Ratnágiri to Cochin the average number of rain-days may be as many as 24 a month, from which it can be concluded that the rain in some places may be almost continuous during those months.

At Minicoy and Trivandrum in June, which is the wettest month there, the normal number of rain-days is 17, and at Bombay in the north of the region the greatest number of rain-days occurs in July when the average is 21.

Annual rainfall.—The annual rainfall on that part of the west coast of India under consideration here is highest in the central portion of the coast from Cochin to Ratnágiri and lowest at Trivandrum in the south and at Bombay in the north. From Cochin to Ratnágiri the average annual fall exceeds 2,500 mm. (100 in.) rising to nearly 3,200 mm. (126 in.) at Mangalore; at Trivandrum it is about 1,640 mm. (65 in.) and at Bombay 1,800 mm. (71 in.).

Over the Arabian sea and Indian ocean the rainfall is not so great as on the coast in the same latitudes and this also applies to the Maldive and Laccadive islands. At Minicoy island the average annual amount of rain is about 1,625 mm. (64 in.) and at Amini it is only 1,420 mm. (56 in.).

Very little information is available with regard to the rainfall over the open sea but according to the most recent estimates the rainfall is greatest in the neighbourhood of the equator where the average lies between 1,500 and 2,000 mm. (60 to 80 in.); it decreases from south-east to north-west, and in the extreme north-west of the region in the neighbourhood of Lat. 20° N. and Long. 60° E. the annual total is probably only 250 mm. (10 in.). A chart showing the annual rainfall over the whole area is reproduced in Volume I.

Seasonal variation

Cool season (December to March).—This is the dry season and very little rain falls except in the extreme south.

In general January and February are the driest months in the south whereas in the north all four months are practically rainless.

It is also a dry season in the Maldive and Laccadive islands except that in December 89 mm. (3.5 in.) of rain falls on the average at Minicoy island. In that month the rainfall over these islands appears to be somewhat greater than over the coast in the same latitudes. February and March are normally the driest months at the islands.

Hot season (April and May).—In the month of April on that part of the west coast of India between Bombay and Mangalore the rainfall is still quite small; south of Mangalore, however, at Cochin and Trivandrum it has increased and is about 115 mm. (4.5 in.); this rain is mostly due to thunderstorms, which are frequent on this part of the coast in this month. At Minicoy island the average rainfall is 67 mm. (2.6 in.) in April and the smaller amount of rain here compared with that received on the west coast of India in about the same latitude is perhaps due to the part orography plays in the rainfall on the Indian coast.

In May the rainfall begins to show an increase everywhere but it is still small in amount from Bombay to as far south as Ratnágiri; from there the rainfall steadily increases southwards as far as Cochin where the maximum amount in this month for the west

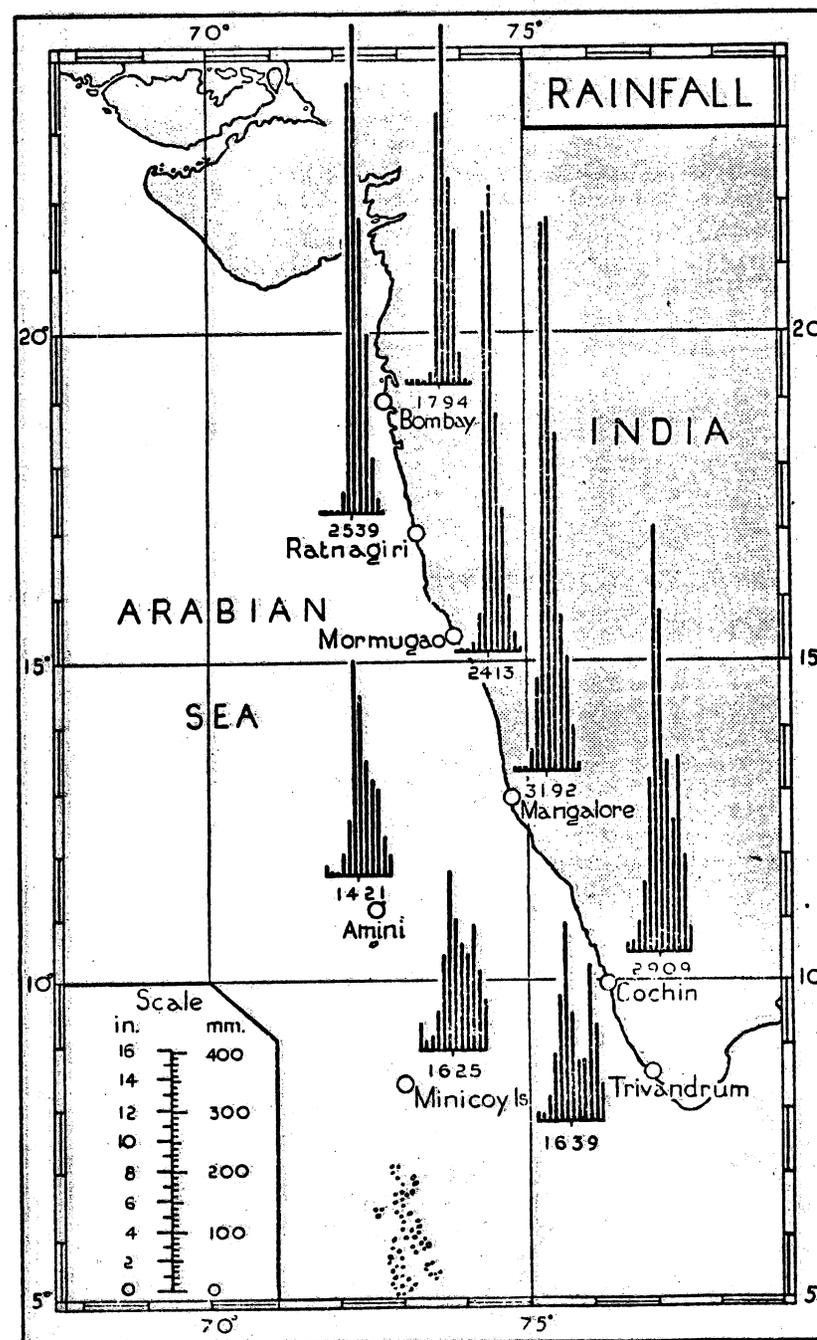


FIG. 26—MONTHLY VARIATION OF RAINFALL
The figures below the step diagrams indicate the total annual amount of rain in millimetres.

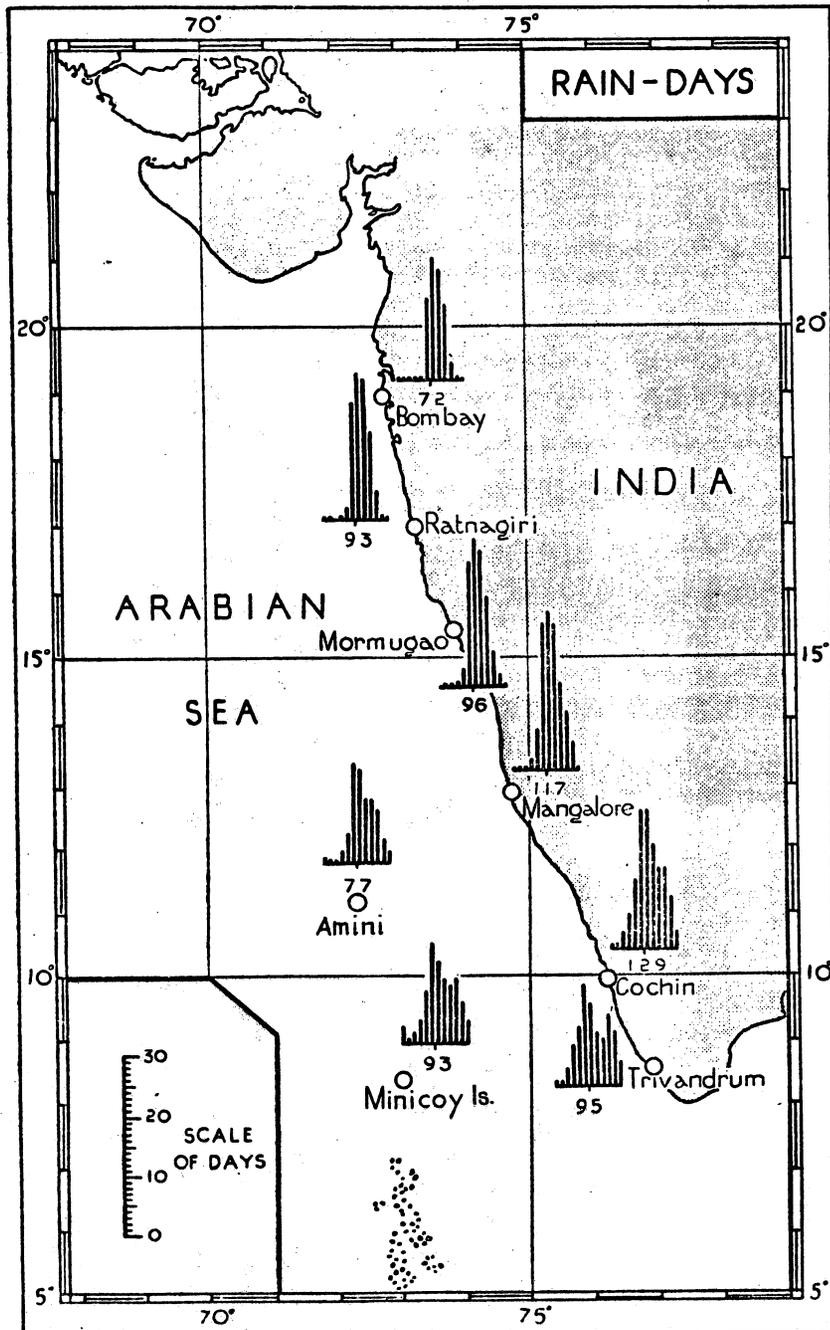


FIG. 27—MONTHLY VARIATION IN THE FREQUENCY OF RAIN-DAYS
The figures below the step diagrams indicate the total number of rain-days in the year. A rain-day is taken as one on which 2.54 mm. (0.1 in.) or more

coast of India, nearly 300 mm. (12 in.), is reached; further south, however, at Trivandrum it decreases again slightly, and in the Maldive and Laccadive islands it is less than on the coast of India in the same latitude.

SW. monsoon (June to September).—These are the months with the greatest amount of rain in all parts of the region under consideration. This large rainfall is due to the arrival on the west coast of India of the moist maritime air of the SW. monsoon. This air current usually advances across the Arabian sea and North Indian ocean in the last week of May or first week in June bringing heavy rain to the west coast of the Indian peninsula. During June, July and August the rains are frequent and heavy, averaging in some places 2,000 mm. (80 in.) or more for those months, which is about two-thirds of the total fall for the year. There are usually, however, intervals of fine weather. The rainfall is exceptionally heavy in the neighbourhood of Mangalore where the total for the three months June to August amounts normally to nearly 2,450 mm. (96 in.). In both June and July the rainfall in many places exceeds in a single month the total annual fall in south-east England.

On the Malabar coast and in the Maldive and Laccadive islands June is the month with the highest rainfall whilst from Mangalore to Bombay July is the wettest month, the rainfall at all places gradually decreasing in August and September.

The intensity of the rainfall during the SW. monsoon may be judged from the fact that at the height of the monsoon the average intensity of rain on a rain-day on many parts of the coast exceeds 35 mm. (1.5 in.) and on the western Ghats it rises in places to as much as 90 mm. (3.5 in.), whereas in winter the intensity on the coast is only about 15 mm. (0.6 in.) of rain on a rain-day.

Post SW. monsoon period (October and November).—During October, on the coast of Malabar from Cochin to Trivandrum, on the change over from SW. to NE. monsoon conditions, the rainfall, after showing a decrease from July to September, increases again. There is also a slight increase in rainfall at Minicoy island in this month though further north at Amini this is not apparent. At Trivandrum the increase is 165 mm. (6.5 in.) above that for September and at Cochin the increase is 107 mm. (4.2 in.); at Minicoy, however, it is only 50 mm. (2 in.).

Further north on the west coast of India from Mangalore to Bombay, October shows a decrease in the amount of rainfall, this decrease being larger in the north than in the south. At Mangalore it is only 74 mm. (3 in.) below that for September but at Bombay it is as much as 212 mm. (8.3 in.), and only 55 mm. (2.2 in.) of rain fall there in October.

In November there is a decrease in the amount of rainfall over the whole area and this again is more marked in the north than in the south. At Bombay the average rainfall in November is

only 10 mm. (0.4 in.) and it gradually increases along the coast to the south until at Cochin and Trivandrum the average amount for the month is 165 mm. (6.5 in.). At Minicoy and Amini the decrease in rainfall from that of October is about 80 mm. (3 in.).

Extremes of annual and monthly rainfall.—The following table gives the greatest and least amounts of rainfall that have occurred in each month of the year at three stations on the west coast of India and at one in the Laccadive islands.

MAXIMUM AND MINIMUM MONTHLY AND ANNUAL RAINFALL

The period over which the observations extend is given in brackets under each place.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	<i>millimetres</i>												
(a) Bombay (84 yrs.)	76 0(64)	43 0(62)	37 0(66)	40 0(64)	279 0(38)	1,104 119	1,500 108	925 85	1,114 41	507 0(12)	140 0(40)	29 0(73)	2,918 849
(a) Mangalore (67 yrs.)	106 0(55)	45 0(56)	45 0(49)	296 0(12)	801 6	1,775 333	1,789 277	1,156 224	749 51	445 23	249 0(4)	151 0(33)	4,630 2,270
(a) Cochin (68 yrs.)	211 0(26)	169 0(15)	189 0(4)	373 2	664 16	1,258 355	1,258 124	746 77	571 54	688 73	418 5	186 0(6)	4,215 2,047
(b) Amini (30 yrs.)	140 0(10)	23 0(20)	55 0(22)	124 0(11)	696 5	836 164	662 35	498 25	567 27	344 22	256 1	393 0(2)	2,550 910

Authorities.—Bibliography Nos. (a) 9, (b) 55.

Note.—The figures in brackets indicate the number of times during the period that the particular month was rainless. The normal rainfall during the month is given in the general climatological tables.

From this table it can be seen that the rainfall may vary considerably from year to year and that the months of the SW. monsoon, June to September, have never failed to bring some rain in all years. At Bombay which has experienced at times less rain than at any other place on the west coast of India further south, none of the months, June, July and August has ever produced less than 85 mm. (3.3 in.) which is more rain than is usually experienced in even the wettest month at Richmond (Kew Observatory) in the British Isles.

Maximum rainfall in 24 hours.—Details of the maximum rainfall in 24 hours are given in the general climatological tables on pages 78–85.

Extremely heavy rain falls at times, and along the west coast of India falls of 150 mm. (6 in.) in 24 hours are not infrequent and much larger amounts have been recorded during the months of the SW. monsoon. At Bombay 409 mm. (16.1 in.) once fell in 24 hours in June. At Minicoy 187 mm. (7.4 in.) of rain once fell in December in 24 hours and during the other months of the year, except February and March, as much as 100 mm. (4 in.) to 145 mm. (5.7 in.) have been known to fall in 24 hours.

2—HAIL

Hail is very rarely experienced on the west coast of India, south of Lat. 20° N. During a period of 38 years the total number of occurrences was 3 at Trivandrum, 1 at Cochin, 18 at Mangalore, 3 at Ratnágiri and 0 at Bombay. Even at Mangalore, therefore, where it is most frequent, it has been experienced only about once every other year.

VII—TEMPERATURE

1—AIR TEMPERATURE

The data of the mean and extremes of temperature are given in the general climatological tables on pages 78–85, and a table of the temperature of the air over the sea in 5 degree areas is given below.

MEAN TEMPERATURE OF THE AIR OVER THE SEA IN THE DIFFERENT 5° AREAS

Areas	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	<i>degrees Fahrenheit</i>											
15–20° N.												
60–65° E. . .	76	75	78	81	84	84	80	78	79	81	80	77
65–70° E. . .	77	76	79	81	84	84	82	80	80	82	81	78
70–75° E. . .	78	78	80	82	84	84	82	81	81	82	82	79
10–15° N.												
60–65° E. . .	78	78	80	82	84	83	81	79	79	80	80	79
65–70° E. . .	80	80	81	83	84	82	81	81	80	81	81	80
70–75° E. . .	81	81	82	83	84	82	80	80	80	82	82	81
75–80° E. . .	(80)	81	83	84	84	81	(78)	79	80	81	82	81
5–10° N.												
60–65° E. . .	79	79	81	83	84	83	81	81	81	81	81	80
65–70° E. . .	80	80	81	83	84	83	82	81	81	81	81	81
70–75° E. . .	81	81	82	84	84	82	82	81	81	81	81	81
75–80° E. . .	80	81	83	84	83	81	81	80	80	81	81	81
0–5° N.												
60–65° E. . .	81	81	82	83	83	82	81	81	82	81	80	81
65–70° E. . .	81	81	82	83	83	82	82	81	82	81	81	81
70–75° E. . .	81	82	(83)	84	82	83	82	82	82	81	81	81
75–80° E. . .	80	81	83	83	83	83	81	81	81	81	81	80

Authority.—Bibliography No. 61.

Note.—The figures in brackets depend on less than 50 observations.

The climate of the region under consideration is tropical, and although the west coast of India from Cape Comorin to Lat. 20° N. extends through 12 degrees of latitude the annual mean temperature of the air is almost the same throughout and is between 79° and 80°F. At both Minicoy, in the south of the Laccadive islands, and at Amini further north, in the same group of islands, the annual mean temperature is 82° F. There is an extremely small annual variation of temperature at these islands on account of their situation in the Arabian sea about 250 miles from the west coast of India.

Over the open sea the average annual temperature slightly exceeds 80° F.

Seasonal variation

Cool season (December to March).—The temperature of the air over the sea in the area under consideration decreases from SE. to NW. January and February are the coolest months, when the temperature in the extreme north-west, in the area 15°–20° N., 60°–65° E., is about 75° F., while in the south-east, in the area 0°–5° N., 70°–75° E., it is about 81° F.

On the northern section of the coast, from Lat. 20° N. to approximately Mormugão in Goa, December, January and February are the coolest months; on the coast further to the south, however, there is very little change in the mean temperature from one month to another. During these months in the north the mean temperature is about 75° or 76° F. whilst in the south it is about 79° or 80° F. The day temperatures are high, reaching to 85° F. or over in many places, but at night the temperature falls to a little over 70° F. in the south, while in the north, on the Konkan coast, it falls below 70° F.

In March the temperature starts to rise everywhere and the mean temperature during that month is about 2° or 3° F. higher than in February. Some of the highest temperatures for the year have been experienced at the end of this season, and temperatures as high as 100° F. and 102° F. have been recorded at Trivandrum and Ratnágiri in February and March.

Hot season (April and May).—The average temperature of the air over the sea in April and May is everywhere between 81° and 84° F. In the equatorial regions and off the south-west coast of India the temperature in April is about 83° or 84° F. and it falls to 81° F. in the north-western area. In May the temperature in the south is slightly lower than in April whereas between 10° N. and 20° N. it has risen to 84° F.

Along the whole west coast of India from Lat. 20° N. to Cape Comorin these are the hottest months of the year. Although the mean temperatures everywhere are higher during this season than during the cool season, the temperatures are on the whole more uniform, as the highest temperature recorded at any station on the coast during April and May does not exceed 100° F. The extreme values were recorded in the north, in April at Bombay and in May at Ratnágiri, and not in the south. The mean temperatures in May are higher in the north than in the south; this is probably due to the effects of the SW. monsoon being felt at the end of May in the south. The average monthly temperatures reach their maximum in April at Trivandrum, in April and May at Mangalore and in May at Bombay.

SW. monsoon (June to September).—Over the open sea the temperature in June lies between 81° and 84° F.; the highest temperatures are recorded in the north between latitudes 15° and 20° N. In July the temperature in the north falls 2° or 3° F. after

the arrival of the SW. monsoon. The average temperature over the whole sea in that month lies between 80° and 82° F.; from July onwards there is a slow fall in the north and little change in the south until September when the temperature in the equatorial regions is about 82° F. and in the north-western area 79° F.

On the west coast of India after the break of the SW. monsoon the heat moderates and day temperatures are lower. On the Malabar, Kanara and Konkan coasts the mean temperature in June is from 78° to 83° F., being less in the south than in the north; at Trivandrum it is 78° F. and it gradually increases northward until at Bombay it is 83° F. This gradual increase of temperature northward is due to the fact that the SW. monsoon arrives on the coast of Malabar earlier in the month than on the Konkan coast.

By July the SW. monsoon has established itself along the whole west coast of India and the temperatures from July to September vary very little anywhere. In most places the mean temperature for these months is 78° F. On the Malabar and Kanara coasts the temperature has never exceeded 91° F., but further north at Bombay it has risen as high as 99° F. The minimum temperature at most places on the coast rarely falls below 68° F.

Post SW. monsoon period (October and November).—The temperature of the air over the open sea is very uniform in October and lies between 80° and 82° F. being slightly higher in the north than in August and September. In November there is a slight fall but for the most part this is less than 1° F.

The SW. monsoon generally withdraws from India by the end of September, and there is a slight rise in the mean temperature in October and November to between 78° and 80° F. at most places. Whereas the day temperatures show a slight rise, the night temperatures begin to show a fall, and thus there is a larger diurnal variation of temperature in November; it is greatest at Ratnágiri where it amounts to 20° F. and least at Trivandrum, where it is only 9° F.

The extreme temperatures are higher during this period than at the height of the SW. monsoon, especially in the north. The extreme maximum for the whole region is 99° F. at Ratnágiri in both October and November, contrasted with an extreme of only 88° F. in August. The minimum temperatures are lower than during the SW. monsoon and a temperature as low as 60° F. has been recorded at that place in November.

2—UPPER AIR TEMPERATURE

No information with regard to upper air temperature at places on the coast is available but the following table, compiled from sounding balloon ascents at Poona and Hyderabad during the period October, 1928 to December, 1931, will give an idea of the approximate temperatures to be expected.

The ascents during December to May were made at Poona, but in the months from June to October the majority were made at Hyderabad, and in November partly at one and partly at the other. The reason for the change in the place of ascent is that during the months of the SW. monsoon easterly winds are prevalent above 20,000 feet and in consequence balloons released at Poona would be carried westward and fall into the sea in that season. The ascents were made between the hours of 1700 and 1900 (Z-5½).

		AVERAGE TEMPERATURE OF THE UPPER AIR											
Height above M.S.L.		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
feet		degrees Fahrenheit											
30,000		-28	-24	-27	-27	-22	-19	-18	-20	-19	-21	-22	-27
25,000		-8	-5	-6	-7	-1	2	2	1	1	-1	-1	-5
20,000		11	12	14	12	18	19	18	18	19	17	16	14
15,000		30	29	30	30	34	36	34	34	35	34	33	32
10,000		45	47	46	50	53	54	50	48	50	48	49	45
8,000		49	55	56	61	61	61	56	54	56	55	53	49
6,000		58	65	68	71	71	67	63	63	62	61	60	58
4,000		69	75	76	81	80	78	70	69	71	70	69	66
2,000		80	85	87	90	90	86	78	80	79	78	79	75
Surface (1,735 ft.)		81	86	89	91	91	87	80	82	80	79	81	76
No. of obs.		12	15	7	5	8	5	13	10	23	20	12	13

Authority.—Bibliography No. 42.

3—SEA TEMPERATURE

The position of the 80° F. isotherm, for the sea surface temperature, in the different months of the year, is shown on the monthly surface wind charts of Figs. 2-7 on pages 12-17. No isotherm is shown on the charts for April, May and June as the sea surface temperature during those months is above 80° F. over the whole region but does not exceed 85° F. anywhere in the area.

Seasonal variation

Cool season (December to March).—During this season the temperature of the sea is below 80° F. north of a line drawn approximately from Bombay in a south-westerly direction to about latitude 10° N. and longitude 60° E. The temperature of the sea north of this line varies between 74° and 79° F. and the lowest temperature is in the north-western area, where in January and February it is about 74° F. South of this line, as far south as the equator and along the west coast of India, the sea temperature during these months varies from 80° F. in the north to 83° or 84° F. in the south, the highest temperatures being in March.

Hot season (April and May).—The sea temperature during these months is above 80° F. over the whole area. In the south the temperature of the surface of the sea is at its highest in April and varies between 83° and 85° F. It is 85° F. off the west coast of India from Ratnágiri southwards and 84° F. off the Maldivé and

Laccadive islands. Off Bombay it is about 81° F. and this is also the temperature of the sea further west, approximately between latitudes 16° and 20° N., to longitude 60° E.

In May, in the south near the equator, the sea temperature falls slightly and varies between 83° and 84° F., but near the west coast of India and off the Maldivé and Laccadive islands it still remains at about 84° or 85° F. The sea temperature has increased in the north in this month and is about 84° F. off Bombay, and in the northern area of the Arabian sea south of Lat. 20° N. it is between 83° and 84° F., this being the month with the highest sea temperature in that area.

SW. monsoon (June to September).—There is a drop in sea temperature over the whole area during these months, principally due to the cloudy conditions that prevail during the SW. monsoon. The lower sea temperatures gradually spread in from the south-west in June. Over the whole area the sea temperature varies between 81° and 83° F., except off Bombay where it is still 84° F., but by August the sea temperature there has dropped to 81° F. and in the north-western area of the Arabian sea south of Lat. 20° N. it is between 76° and 79° F. Close off the Malabar coast it has dropped to 79° F. in this month, but further off the coast it is between 80° and 81° F. and near the equator it is between 82° and 83° F. The sea temperatures in September are very much the same as those in August.

Post SW. monsoon period (October and November).—The SW. monsoon withdraws in October and the sea temperatures become very uniform over the whole region. There is only one small area situated approximately in 12° to 16° N., 60° to 62° E. where the sea temperature is below 80° F., and here it is 79° F.; elsewhere south of Lat. 10° N. the sea temperature is between 81° and 82° F., whilst to the north of that latitude it is between 80° and 82° F.; along the whole west coast of India it is about 82° F. In November the area in the Arabian sea which is below 80° F. has increased and the temperature is now 79° F. in the area 12° to 20° N., 60° to 63° E. Off Bombay in this month the sea temperature is 80° F., and it increases southwards along the west coast of India to 83° F. in the extreme south. Off the Maldivé and Laccadive islands it is about 82° F. and near the equator it is between 81° and 82° F.

4—RELATIVE VALUES OF SEA AND AIR TEMPERATURE

The difference between the temperature of the surface water of the sea and that of the air is comparatively small at all times of the year and on the average is not more than 1° or 2° F. at any time.

In the six months from about November to April the air over the entire region is on the whole slightly colder than the sea and during the other six months of the year from about May to October the air is a little warmer than the sea except possibly in the equatorial regions where the sea may be very slightly warmer than the air.

VIII—HUMIDITY

The mean monthly relative humidity for 8 stations in the region under consideration is given in the general climatological tables on pages 78–85. The figures are corrected to the mean of 24 hours except at Amini where they are for 0800 local time. The mean wet bulb temperatures for 0800 local time at 6 stations and for 0800 and 1630 local time at Bombay and Trivandrum are also given there.

A table showing the diurnal variation of relative humidity at Bombay and Trivandrum is given on page 63.

On the west coast of India from Lat. 20° N. to Cape Comorin the mean relative humidity for the year is about 80 per cent, and it is particularly high during the months of the SW. monsoon; the monthly means from July to September are about 87 per cent, but as the temperatures are not high owing to continual cloudy weather, the heat is not oppressive, though the dull weather is enervating.

Over the Arabian sea and Indian ocean the relative humidity is remarkably uniform and shows very little variation throughout the year. The maximum mean relative humidity of 87 per cent occurs in August and the minimum of 78 per cent in April, the difference between the means for the two months being only 9 per cent. There is no very sudden increase in the mean relative humidity when the SW. monsoon first sets in. The mean for June is only about 2 per cent more than that for May.

At Minicoy and Amini in the Laccadive islands the mean daily relative humidity shows very little change throughout the year and the diurnal variation is also quite small. At Minicoy the highest mean relative humidity is from June to October when it is between 81 and 82 per cent, and the lowest of 70 per cent is in February. At Amini at 0800 the highest mean relative humidity of 83 per cent is in July and the lowest of 71 per cent is in April, the changes being very similar to those in the Arabian sea.

Seasonal variation

Cool season (December to March).—During this season the relative humidity is at its lowest for the year over the whole area. In all four months the line of 70 per cent mean relative humidity runs from north to south almost parallel to the coast. In general in the north the lowest values occur in December and in the south not until February. There is a fairly well marked increase in humidity in March at all places. The monthly averages of the mean daily relative humidity range from 61 per cent at Ratnágiri in December to 78 per cent at Cochin in March. The places with the lowest relative humidity in this season are Ratnágiri and Mangalore.

Hot season (April and May).—The mean daily relative humidity in April is between 70 and 80 per cent over the whole region. The line of 70 per cent mean relative humidity runs from north to south

almost parallel to the coast but at distances from the coast varying up to 50 miles inland. In May on the coast of Malabar there is an appreciable rise in the relative humidity, the humidity exceeding 80 per cent, whereas in the north there is not much difference between April and May.

The probable cause of the mean relative humidity in May on this coast being higher than further north is that the SW. monsoon begins to be felt here earlier.

SW. monsoon (June to September).—These are the months with the highest relative humidity, as the damp warm winds of the SW. monsoon are blowing over the whole region. The difference between the mean relative humidity at night and in the early afternoon is much smaller during this season.

The mean relative humidity in June shows an appreciable rise over that for May. At all stations in the region the mean relative humidity for the day is over 80 per cent and the highest mean relative humidity is experienced at Cochin, Mangalore and Mormugão. In July and August the mean relative humidity at those places has risen to about 90 per cent and at Bombay to about 87 per cent. The mean relative humidity shows a slight fall in September from that in July and August and the only station where it is as high as 90 per cent is Mormugão while at other places it ranges between 81 and 88 per cent.

During the months of the SW. monsoon the decrease of humidity inland is less well marked than in the hot season though there is evidence of a decrease on the leeward side of the mountains.

Post SW. monsoon period (October and November).—On the withdrawal of the SW. monsoon there is a fall in the relative humidity everywhere, it is greatest in the north where the monthly mean shows a decrease of about 15 per cent in November from that in September. The fall decreases southwards; in fact at Trivandrum the mean relative humidity remains almost constant at 85 per cent from September to November. In both October and November, and especially in the latter month, the mean relative humidity in the north is appreciably lower than in the south; it varies from about 80 per cent in October to about 70 per cent in November with slight local irregularities. In November when the dry winds of the NE. monsoon begin to set in from off the land, there is a further fall in the mean relative humidity, and it is only in the south at Trivandrum and Cochin that it is over 80 per cent.

Diurnal variation.—Over the Arabian sea and Indian ocean and also in the Maldivic and Laccadive islands where the diurnal variation in temperature is small that of the relative humidity is also small. On the coast, however, the diurnal variation in relative humidity is much more appreciable and in inland districts it may be considerable.

The following table based on hourly values gives the average humidity at the hours when it is highest and lowest at Bombay and Trivandrum, together with the difference between the two and the hours when they occur. It shows that the relative humidity is usually highest shortly before sunrise and lowest in the afternoon between 1400 and 1500. The diurnal range is least during the SW. monsoon when skies are cloudy and greatest during the NE. monsoon when skies are clear.

DIURNAL VARIATION OF MEAN RELATIVE HUMIDITY

Month	BOMBAY					TRIVANDRUM				
	Period: 48 years.					Period: 12 years.				
	Maximum		Minimum		Range	Maximum		Minimum		Range
Time	%	Time	%	Time		%	Time	%		
Jan. ..	0100-0300	74	1200-1300	54	20	1000-0400	87	1200-1400	57	30
Feb. ..	0100-0600	74	1200	57	17	0400	87	1200-1300	55	32
Mar. ..	0300-0500	80	1200-1500	64	16	0500	91	1100-1300	59	32
Apr. ..	0400-0600	81	1400-1500	66	15	0400-0500	91	1100-1400	65	26
May ..	0400-0600	79	1300-1500	66	13	0400-0500	93	1300	68	25
June ..	0300-0600	84	1300-1500	76	8	0300-0500	95	1300-1500	75	20
July ..	2300-0800	86	1300-1500	82	4	0200-0500	95	1400	75	20
Aug. ..	0000-0800	86	1200-1600	81	5	0200-0500	95	1200-1400	73	22
Sept. ..	0600	88	1400-1600	78	10	0400-0500	95	1100-1400	71	24
Oct. ..	0600	84	1200-1400	68	16	0300-0500	95	1100-1300	72	23
Nov. ..	0100-0600	77†	1200-1300	56	21	0300-0500	95	1200-1300	70	25
Dec. ..	2000-0500	74†	1300	52	22	0000-0400	89	1100-1400	63	26

Authority.—Bibliography No. 58.

Note.—† The results at Bombay in November give 77 % from 0100-0400, falling to 76 at 0500 rising to 77 again at 0600; in December 74 % at 2000 falling to 72 at 2200 and rising again to 74 from 0000-0500

Humidity in the upper air.—The following table gives the relative humidity in the upper air obtained by sounding balloon ascents at Poona and Hyderabad. The table is compiled from the same ascents as the table of upper air temperatures on page 59. The humidity was obtained by records of a hair hygrometer and the values at high levels cannot therefore be relied upon in detail.

RELATIVE HUMIDITY IN THE UPPER AIR

Period: Oct. 1928-Dec. 1931

Height above M.S.L.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<i>feet</i>												
30,000	13	29	18	45	42	62	78	60	67	26	29	21
25,000	12	27	18	52	47	69	75	74	69	32	27	21
20,000	11	29	17	59	52	67	73	88	66	40	37	24
15,000	13	34	31	66	67	72	79	88	78	56	40	30
10,000	25	48	32	73	66	78	78	93	81	72	45	46
8,000	35	46	29	57	64	77	78	92	76	73	65	59
6,000	37	39	24	47	61	74	85	88	80	74	71	63
4,000	36	35	22	41	56	65	80	85	78	71	64	59
2,000	39	39	29	37	45	57	76	75	78	70	53	56
Surface (1,735 ft.)	40	40	31	37	43	56	75	73	79	69	51	57
No. of obs.	12	15	7	5	8	5	13	10	23	20	12	13

Authority.—Bibliography No. 42.

The highest values in the year occur in August at all levels from 4,000 feet up to 20,000 feet and the lowest in January above 10,000 feet and in March below that level. In all months except January the humidity rises from the surface to a maximum at some level between 5,000 feet and 13,000 feet and then falls off more or less rapidly. The level of maximum is higher in April and May than during either the SW. monsoon or the cool season. In September when the monsoon is weak and there are breaks in the rains there are maxima at 6,500 and 13,000 feet with an intervening minimum.

In the cool season the fall of humidity above the maximum is rapid and the values above are quite low, whereas during the SW. monsoon the fall is gradual and relative humidities are high up to 25,000 feet. In about half the ascents in the cool season the humidity is less than 15 per cent above 10,000 or 13,000 feet.

IX—MISCELLANEOUS

1—THUNDERSTORMS

The average number of days per month on which thunder was heard at 8 stations in the region under consideration is given in the general climatological tables on pages 78-85.

Thunderstorms are most frequent in the southern part of the region particularly on the coast of Malabar, and they decrease in frequency northward. At Cochin the annual average number of days with thunder in the period 1914-23 was 101 whilst at Bombay it was 17.

The number of days with thunder varies very much from one year to another. At Bombay for example there were only 6 days with thunder in 1923 whereas there were as many as 43 in 1916; similarly at Trivandrum there were only 66 in 1922 but 111 in 1916.

There are two periods of maximum thunderstorm activity on the west coast of India, one is before the arrival and the other is after the withdrawal of the SW. monsoon. On the coast of Malabar they are in April and May and in October and November but further north these months approach nearer to one another and at Bombay the maximum frequencies occur in May and June and in September and October.

Seasonal variation

Cool season (December to March).—Although thunderstorms do occur during these months they are rare, owing principally to the fact that the surface winds are chiefly of land origin, as it is the season of the dry NE. monsoon winds. Occasionally, however, there may be a wind of maritime origin which contains sufficient moisture to cause a thunderstorm. Thunderstorms may also occur over the central portion of the Arabian sea in March.

Hot season (April and May).—On the west coast of India this is a period of maximum thunderstorm frequency. In April and May on the southern part of the Indian peninsula, especially on the coast of Malabar, the inflow of the moist air of the afternoon sea breeze is very vigorous during this season, and on reaching the high barrier of the western Ghats the air is forced to ascend and gives rise to thunderstorms in the afternoon.

Over the central part of the Arabian sea there may be occasional thunderstorms in April.

SW. monsoon (June to September).—The onset of the monsoon on the coast in June is often accompanied by severe thunderstorms; but in July and August thunderstorms are of rare occurrence. This is due to the fact that in these months the SW. monsoon air extends as a homogeneous current to heights of over 10,000 feet in most places. Those storms that do occur generally take place when there is a lull in the SW. monsoon.

Over the Arabian sea in June when the SW. monsoon first begins its advance over the sea it is often preceded by severe and prolonged thunderstorms.

Post SW. monsoon period (October and November).—This is the second period of maximum thunderstorm frequency on the west coast of India, especially in the south.

An examination of the monthly frequencies of thunderstorms on the Malabar coast shows that April and May are the months of maximum occurrence during the year and that October–November is a period of secondary maximum, but further north on the Kanara and Konkan coasts thunderstorms occur just about as frequently in the post SW. monsoon months as they do in April and May.

Thunderstorms in these months are also most frequent in the afternoon and the conditions that give rise to these thunderstorms at this time are similar to those that obtain in April and May. The sequence of changes in the various meteorological elements during the passage of a thunderstorm at Bombay on October 6th, 1930, is shown in Figure 28.

Diurnal variation.—There is a night as well as a day maximum in the diurnal distribution of thunderstorms on the coast. During the day the period of greatest activity of thunderstorms is in the afternoon between 1400 and 1700. In the hot season of April and May, at Trivandrum, the day maximum is at about 1600 and during the other three seasons it is at about 1500, the mean for the whole year is at about 1500. Thunderstorms are least frequent in the morning from 0700 to 1000 and if they occur at these hours it is usually in the months of the hot season.

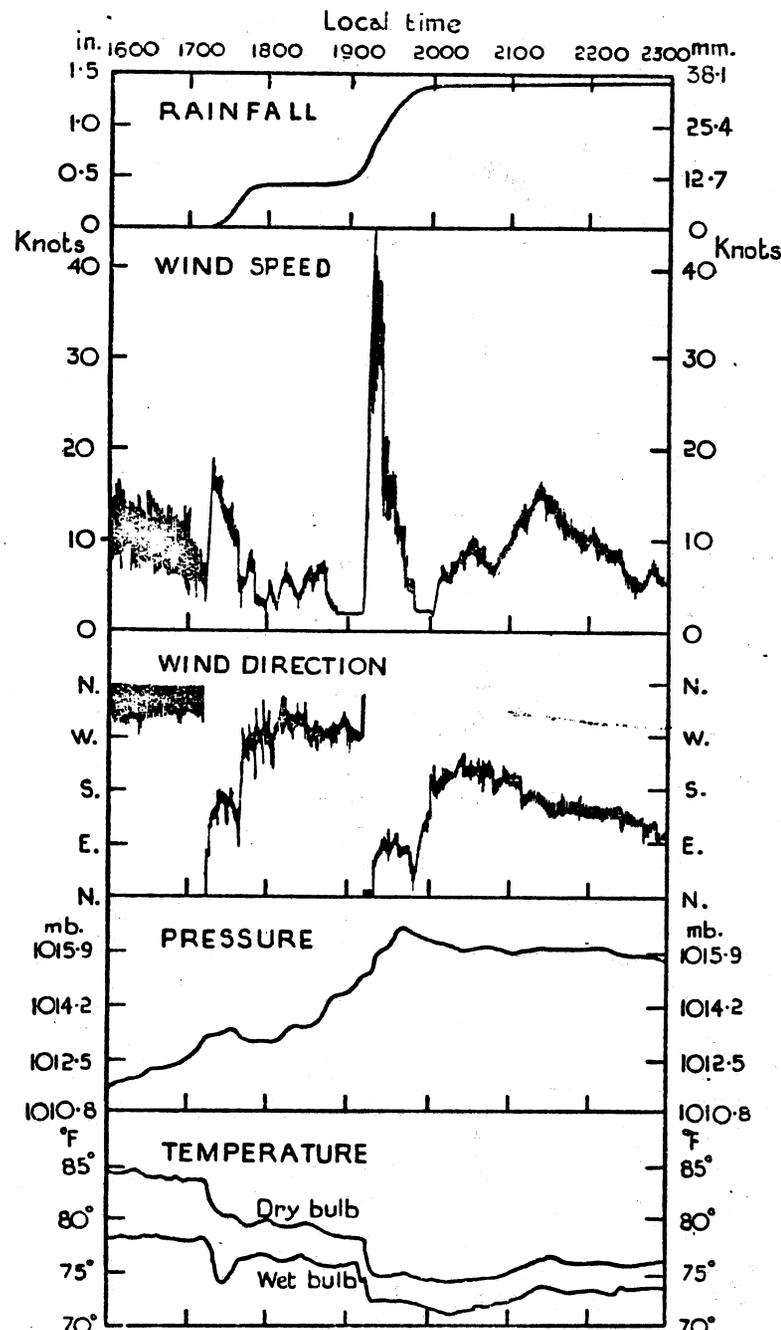


FIG. 28.—AUTOGRAPHIC RECORDS DURING A THUNDERSTORM AT BOMBAY—6TH OCT., 1930

At night there is a feeble secondary period of maximum occurrence of thunderstorms between midnight and 0500, this period is very feebly marked compared with the maximum which occurs during the day. The corresponding secondary period of minimum occurrence is at 2300.

It has been observed at Trivandrum that thunderstorms with the longest duration occur in the months when they are most frequent, namely in April.

2—SEA AND SWELL

A table showing the frequency of different states of the sea in each month of the year for two observations a day, one in the morning and the other in the afternoon, for Bombay and Trivandrum, and for 0800 local time for Ratnágiri, Mormugão, Mangalore, Cochin, Minicoy and Amini is given on pages 115-6.

H.M.S. *Gloucester* visited Male atoll in the Maldive islands in November, 1939, and reported that there was a moderate swell from west in the open sea outside and a slight swell at the anchorage. The sea was also moderate outside and slight at the anchorage but it became moderate inside during squalls.

The following are a few local notes on sea and swell taken from the West Coast of India Pilot, 1937 :—

Konkan coast.—From March to May the north-westerly sea breezes are sometimes sufficiently strong to produce a short choppy sea, and during the SW. monsoon from about the first week in June to about the middle of August there is usually a heavy south-westerly swell.

Kanara coast (Goa).—From about the middle of February to the end of March there are occasional strong winds from the north-eastward, and these winds cause a heavy swell in Enseada da Aguada and in Baía de Mormugão.

Malabar coast.—On the coast southward of the Palghat gap the SW. monsoon, which sets in towards the end of May, causes a heavy long swell to roll in upon the shore, and in June there may be a high sea running. In September the weather moderates but a swell often rolls in from WSW. particularly during unsettled squally weather.

3—WATERSPOUTS

Waterspouts have been observed fairly frequently in the portion of the Arabian sea and Indian ocean under consideration here.

During the period 1920-31, 58 waterspouts were reported by ships in the area 0°-20° N., 60°-80° E.; this is not of course the total number that have occurred, as there must have been many that formed without having been observed. The area in which they are most likely to be experienced is south of Lat. 10° N. and

especially in the neighbourhood of the Maldive and Laccadive islands and to the south and south-west of the southern point of the Indian peninsula. The most probable months for their maximum frequency are March and April and for their minimum August, but waterspouts can be expected in any month of the year.

The following is a description of a waterspout that was observed from H.M.S. *Ormonde* on the 19th October, 1927 :—

“ The ship was at Ihavandiffulu atoll, Maldive islands (7° 00' N., 72° 55' E.). At 0915 (0421 G.M.T.) a waterspout was observed bearing S. 28° E., elevation 2° 0'. Estimated track of spout NNW. This waterspout appeared very dark in colour, almost black, and during its passage altered its shape several times from a vertical column to a gentle curve bending north. The estimated distance of the waterspout from the ship was 2½ miles. The waterspout broke up at 0935 bearing S. 37° E., elevation 1° 40'. On breaking up, the spout appeared to bend very considerably to the north, tapering to a fine line about one-third of its height. The majority of the water seemed to be gathered up into the cloud. During the whole passage the swirl of water at the base of the column was very conspicuous. Barometer, 1015 mb.; wet bulb, 80.5° F.; dry bulb, 88° F.; sea, 83° F. Weather:—sultry; sky, cloudy; wind, light airs; sea, calm.” (*Marine Observer*, vol. 5, 1928).

APPENDIX

BOMBAY

I—GENERAL

As Bombay is one of the principal climatological stations on the west coast of India a good deal of the information obtained from there has of necessity been included in Part 5. The following remarks therefore on weather conditions at Bombay should be considered to be supplementary to those contained in that Part which deals with the west coast of India south of Lat. 20° N. in general.

A general climatological table for Bombay is given on page 78.

**Summary of typical weather conditions at Bombay
on a day in January, April and June**

The following is a description of the type of weather likely to be experienced at Bombay during the NE. monsoon or cool season, the hot season and the SW. monsoon. A day about the middle of January has been chosen for the cool season, one about the end of April for the hot season and one about the end of June for the SW. monsoon:—

Weather during the NE. monsoon on a day about the middle of January.—In the early morning a light land breeze blows from NE. and it is usually misty over the sea to the west or north-west, but over the city the atmosphere is clear. The sky is cloudless except for a few isolated cirrus clouds towards the eastern horizon. Before sunrise it is slightly chilly but after the sun is up, at about 0715, it soon becomes pleasantly warm.

The following are some typical morning observations taken at 0835:—air temperature, 70° F.; relative humidity, 65 per cent; minimum temperature at 0630, 67° F.; surface wind, ENE. of Beaufort force 2; visibility, 7, i.e. good, with objects visible at 5 miles; cloud amount—trace of cirrus.

During the forenoon the breeze slackens and veers to N. and drops to calm by about 1130. The sky continues clear but the mist over the sea persists, though by now it appears to have lifted from off the surface of the sea. This mist is really smoke-haze, the smoke from the mills to the north of the city having been carried seawards by the land breeze at night.

At about 1230 a light sea breeze sets in blowing from NNW. The haze from the industrial area in the north of the city has been carried towards the coastal hills to the east and south-east. The afternoon is moderately warm but breezy. Typical observations

taken at 1700 are:—air temperature, 76·5° F.; relative humidity, 70 per cent; maximum temperature at 1400, 82° F.; surface wind, NNW. of Beaufort force 3; visibility, 7, i.e. good; cloud amount—cirrus 1-tenth, cirrostratus 2-tenths, nimbus 3-tenths.

After sunset, which occurs about 1820, the temperature falls sharply, and the wind slackens, dropping to calm by about 2000. The clouds disappear and during the night the sky continues cloudless with no wind until the early morning when the land breeze again sets in from NE.

Weather during the hot season on a day about the end of April.—The sky overhead is usually free from cloud in the early morning, but there are isolated patches of cumulus cloud over some parts of the horizon. The air is calm. Over the hills to the east of the city there is a slight haze but this dissipates rapidly after sunrise. Within half an hour of sunrise it becomes warm, the humidity of the air being sufficient to cause perspiration on exertion.

The following are some typical morning observations taken at 0835:—air temperature, 82° F.; relative humidity, 80 per cent; minimum temperature at 0600, 79° F.; surface wind, calm; visibility, 7, i.e., good; cloud amount—trace of altocumulus.

At about 1000 a light wind from NW. starts to blow which reduces slightly the unpleasant heat in those streets of the city exposed to the breeze. The sky continues cloudless. Typical observations taken at 1230 are:—air temperature, 86° F.; relative humidity, 66 per cent; surface wind, NW. of Beaufort force 2; visibility, 8, i.e. very good, with objects visible at 10 miles; cloud amount—nil.

The wind increases in strength in the afternoon but, owing to the high humidity, it is uncomfortable indoors without fans. Typical observations taken at 1700 are:—air temperature, 87° F.; relative humidity, 65 per cent; maximum temperature at 1400, 89° F.; surface wind, NNW. of Beaufort force 2; visibility, 7, i.e. good; cloud amount—trace of stratocumulus.

The wind begins to slacken about 1830 and drops to calm by 2200. It continues calm throughout the night, the temperature of the air remaining at about 80° F., and as the humidity rises to about 80 per cent this makes conditions during the night rather uncomfortable.

Weather during the SW. monsoon on a day about the end of June.—In the morning it is gloomy and overcast, the sky being covered with a uniform layer of nimbostratus cloud. Light intermittent rain usually falls from about 0400 and the atmosphere is misty. A moderate gusty wind blows from WSW. with frequent sudden squalls followed by rain, these coming from any point between W. and N.

Typical morning observations taken at 0835 are:—air temperature, 79° F.; relative humidity, 85 per cent; minimum temperature, 78° F.; surface wind, WSW. of Beaufort force 4; visibility, 5, i.e. poor, less than 2 miles; cloud amount—altostratus 2-tenths, nimbostratus 6-tenths, stratus 2-tenths; rainfall, 3·8 mm. (0·15 in.).

As the day advances there is little change in the weather but towards noon the clouds lift a little and the rain ceases, with improvement in the visibility. Typical observations taken at 1230 are:—air temperature, 82° F.; relative humidity, 80 per cent; surface wind, W. of Beaufort force 4; visibility, 6, i.e. moderate, with objects visible at 2 miles; cloud amount—altostratus 2-tenths, nimbostratus 8-tenths; rainfall, 2·5 mm. (0·1 in.).

In the afternoon the wind slackens and the clouds again thicken. Moderate continuous rain usually sets in about 1600 and continues until 1730. Typical observations taken at that time are:—air temperature, 76° F.; relative humidity, 81 per cent; maximum temperature, 84° F.; surface wind, SW. of Beaufort force 3; visibility, 4, i.e. very poor, less than 1 mile; cloud amount—nimbostratus 10-tenths; rainfall, 5·1 mm. (0·2 in.).

At 1800 rain in intermittent showers accompanied by squalls is again experienced lasting until about 2100. There is generally no rain after this until the early morning but during the night a gusty wind continues to blow.

II—WIND

1—SURFACE WINDS

A discussion on the prevailing surface winds at Bombay during the different seasons is given on pages 11, 18–21, and charts showing the direction of the surface winds by wind-roses at Bombay at 0800 local time in the different months of the year are given in Figs. 2–7 on pages 12–17; the corresponding data together with similar data at 1630 are given in the general climatological table on page 78. The following table gives the maximum hourly speed of the wind in knots and the maximum speed in a gust in each month:—

Bombay.—HIGHEST HOURLY WIND SPEED AND HIGHEST SPEED IN A GUST

Period: 1925–36

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Highest hourly speed	24	24	24	23	29	35	32	26	23	38	26	24
Highest gust	35	33	33	31	54	53	48	42	38	52	41	37

Authority.—Bibliography No. 56.

A table giving the frequency of winds of different forces at Bombay at 0800 and 1630 local time is given on page 94. Wind-roses showing the frequencies of winds from different directions at 0800 and 1630 local time in January, April, July and October are reproduced in Fig. 8 on page 22.

Land and sea breezes.—At Bombay during the months from May to September the mean direction of the wind is W. to SW. throughout the 24 hours of the day. The surface winds in these months, which are of sea origin, are generally so strong and persistent that Bombay rarely experiences winds of pure land origin. In the other months of the year, October to April, as well as on some days in the first half of May and the latter half of September, land and sea breezes blow on most days.

The general direction of the sea breeze is WNW. to NW. (NNW. to NW. in the cool season) and that of the land breeze is NNE. to NE. (ENE. in the cool season).

The following table compiled from observations over a period of 3 years gives the average hour of the setting in of the land and sea breezes at Bombay, their average time of duration and the average maximum speed in each month:—

Bombay.—AVERAGE TIME OF SETTING IN, DURATION AND SPEED OF LAND AND SEA BREEZES

	Period: 1934–6						
	Jan.	Feb.	Mar.	Apr.	Oct.	Nov.	Dec.
	<i>Land breezes</i>						
Time of setting in ..	Midt.	0100	0300	0500	2300	2200	2200
Daily duration (hours) ..	12	9	6	3	12	14	14
Max. speed (knots) ..	6	5	5	4	5	6	6
Time of max. speed ..	0600–0700	0600–0700	0600–0700	0500–0600	0800–0900	0700–0800	0600–0700
	<i>Sea breezes</i>						
Time of setting in ..	1200	1100	1000	0900	1200	1300	1300
Daily duration (hours) ..	7	9	14	18	8	6	6
Max. speed (knots) ..	10	10	11	11	8	8	8
Time of max. speed ..	1600–1700	1600–1700	1500–1600	1500–1600	1600–1700	1700–1800	1700–1800

Authority.—Bibliography No. 58.

Note.—The anemometer with which the wind measurements were made had its head at 85 ft. above the ground and 127 ft. above mean sea level.

In the absence of disturbed weather the speed of the land breezes in the forenoon is seldom much more than the average, but with the sea breezes wind speeds considerably in excess of the average, with hourly speeds of as much as 21 knots and individual gusts of 26 knots, may occasionally occur in the afternoon on clear days in the hot season.

From observations of the upper winds it would appear that the thickness of the land breeze is from about 300 to 1,000 feet in the hot season and from about 1,000 to 2,300 feet in the cool season, whilst the thickness of the sea breeze generally varies between about 1,000 and 3,300 feet extending up to about 5,000 feet on rare occasions.

H.M.S. *Endeavour* when at Bombay in April, 1937, reported that the land and sea breezes were very regular there at that time of year. The times given for the onset of the breezes differ somewhat from those given in the above table; according to the report in the ship's meteorological log the sea breeze commenced to blow about 1430 from WNW. and reached its maximum force of 5 on the Beaufort scale between 1630 and 1830 after which it died away again until 2100. The land breeze became apparent by a calming of the normal northerly wind at 0300 and then a veer to NE. by N. or more at 0600 with a wind force between 2 and 3; this died away again and the wind veered to NNW. by 0800.

The following table gives the mean monthly wind direction and speed in knots at Bombay at four hourly intervals during the day throughout the year. The data are based on anemograms taken from a Robinson-Beckley anemometer with cups 58 feet above the ground and 100 feet above mean sea level.

Bombay (Colaba).—MEAN MONTHLY WIND DIRECTION AND SPEED IN KNOTS
Period: 1867-1920

Local time	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Midt. Dir.	NNE.	N.	NW.	NW.	W.	SW.	WSW.	WSW.	W.	NNE.	NE.	NE.
Speed	4	4	5	5	5	9	11	9	6	4	4	4
0400 Dir.	NE.	NNE.	N.	NNW.	W.	SW.	WSW.	WSW.	W.	ENE.	ENE.	NE.
Speed	5	5	5	4	4	8	11	9	6	5	6	6
0800 Dir.	ENE.	NE.	NE.	N.	W.	SW.	WSW.	WSW.	WSW.	ENE.	ENE.	ENE.
Speed	6	5	5	4	5	8	11	9	6	5	6	7
1200 Dir.	NW.	NW.	WNW.	WNW.	W.	WSW.	WSW.	W.	W.	WNW.	NNW.	NNW.
Speed	6	7	8	9	8	9	11	10	7	6	5	5
1600 Dir.	NW.	NW.	NW.	WNW.	W.	WSW.	WSW.	W.	WNW.	NW.	NW.	NW.
Speed	9	10	10	10	9	10	11	10	8	8	8	8
2000 Dir.	NNW.	NNW.	NW.	NW.	W.	SW.	WSW.	W.	W.	NNW.	NNW.	NNW.
Speed	7	7	6	6	6	9	10	9	6	5	6	7

Authority.—Bibliography No. 58.

Gales.—In Bombay gales are generally associated either with the thunderstorms that occur before or during the early days of the SW. monsoon, with a vigorous monsoon, or with the storms that occur after the withdrawal of the monsoon in the latter half of October or early in November.

The gales associated with the thunderstorms are of a squally nature and last only a few minutes; they generally occur in the afternoon, although, at the onset of the monsoon, they may occur at any time of the day. The wind generally changes from WNW. or NW. to some easterly direction, the maximum speed may go up to 45-50 knots. The weather that accompanies these storms is more

fully described in the paragraphs on "Elephantas" below. The gales during a vigorous monsoon period are generally caused by the presence of a depression over the central parts of India or Gujarat. During these gales wind speeds of 25-35 knots may last for periods of over 12 hours and they generally blow from a westerly or south-westerly direction. The post-monsoon storms are rare but occasionally a concentrated storm from the Arabian sea passes inland north of Bombay and causes strong winds to blow from SW. for a few hours.

Elephantas.—At Bombay the commencement and conclusion of the SW. monsoon is generally marked by storms, sometimes of considerable violence, called "Elephantas", a name which they appear to derive from the fact that they reach the city of Bombay from the direction of the island of Elephanta; these storms are accompanied by thunder and lightning. For several days preceding these storms, during the afternoon, the eastern and south-eastern skies become lurid with thunder clouds, and, as night approaches, they keep up fitful discharges of lightning which increase in intensity and nearness until the storm breaks in earnest over Bombay, bringing with it heavy showers of rain; these storms are not infrequently repeated on successive days; the fall of rain, though often continuous for several hours, is not by any means uniform, but, like the wind, which is subject to fluctuations from occasional severe squalls from the south-eastward, is heaviest during these squalls.

The SW. monsoon almost invariably starts at Bombay in this manner, but it is rarely fully developed in its main characteristics of a strong WSW. wind and almost continuous rain until the latter part of June; the intervening period is made up of days with fine but cloudy weather; on some of the days there may be a little light rain and on others much rain, and sometimes in the early part of June there may be a repetition of the "Elephantas".

When the SW. monsoon comes to an end towards the end of September or the beginning of October, there may be further storms of this description.

2—UPPER WINDS

A discussion on the upper winds at Bombay in the different seasons is given on pages 25, 42-44.

Wind-roses showing the direction of the upper winds in the different months of the year up to 10,000 feet at Bombay are given in Figs. 9-12 on pages 26-9, and the corresponding data are set out in Table IV on pages 95-8. Observations of the motion of low, middle and high cloud are also included in the table in order to give information of the wind direction on days when cloud was prevalent and when pilot balloon observations at high levels are in consequence lacking.

III—VISIBILITY

A table of the average percentage frequency of different degrees of visibility at Bombay at 0800 and 1730 is given on page 111.

Bad visibility may occur at Bombay during the months of the NE. monsoon in the interval between the land and sea breezes. During the forenoon a heavy smoke-haze frequently hangs over the land obscuring everything from view, and this also occurs occasionally during the calm hours of the evening. According to the West Coast of India Pilot, 1937, care should be exercised when approaching the land in this vicinity after daylight during these months owing to this smoke-haze.

During the period 1930-7 at the Colaba Observatory only two cases of bad visibility, i.e. visibility less than half a nautical mile, were recorded. These bad visibilities both occurred at 0830 local time in the month of February, one being due to fog and the other to dust-haze.

H.M.S. *Endeavour* when at Bombay in April, 1937, reported that the visibility in the early morning from 0600 to about 0900 tended to be very poor. This was thought probably to be due to the cooling over the land, during the night, of the moisture laden air from the sea breeze of the previous afternoon.

On the whole, however, the visibility at Bombay is at its worst during the months of the SW. monsoon, especially in July; in 1937 it did not exceed 5 nautical miles throughout the month.

IV—CLOUD

A step diagram showing the monthly variation of mean cloud amount at Bombay is reproduced in Fig. 25 on page 48, and the corresponding data are given in the general climatological table on page 78. Monthly averages of the amount of low cloud in comparison with the total amount of cloud at 0800 and 1630 local time during the 5-year period 1933-7 are included in the table on page 46.

A table showing the monthly frequencies of different cloud amounts in the morning and afternoon is also given on page 113.

The seasonal and diurnal variation in cloud amount together with the height of clouds for Bombay and the region as a whole is discussed on pages 47-50.

At Bombay there is little diurnal variation in cloud amount during November to January or during June to September but during February to May and in October there is a tendency for cloud amounts to decrease until noon and to remain more or less constant thereafter.

The following table gives the percentage frequency of cloud with base between different limits of height during the daylight hours in the months of the SW. monsoon :—

Bombay.—HEIGHT OF BASE OF LOW CLOUD DURING THE SW. MONSOON
Percentage frequency of occasions of cloud with base between given limits of height at different hours of the day.

Period : 1932-4

Height of cloud base feet	0600-0900-1200-1400- 0900 1200 1400 sunset				0600-0900-1200-1400- 0900 1200 1400 sunset			
	per cent JUNE				per cent JULY			
6,500-8,000 ..	0	0	0	0	0	0	0	0
5,000-6,500 ..	7	0	0	0	0	0	0	4
3,250-5,000 ..	21	14	24	3	15	4	20	
2,000-3,250 ..	31	50	28	43	54	63	41	
1,000-2,000 ..	38	36	45	44	31	29	30	
650-1,000 ..	0	0	0	3	0	0	4	
325- 650 ..	0	0	0	0	0	4	1	
0- 325 ..	0	0	0	0	0	0	0	
Ht. not determined ..	3	0	3	7	0	0	0	
No. of obs. ..	29	14	29	30	39	24	79	
	AUGUST				SEPTEMBER			
6,500-8,000 ..	0	2	0	0	0	0	0	0
5,000-6,500 ..	0	4	9	2	4	3	7	13
3,250-5,000 ..	9	30	29	21	40	23	7	30
2,000-3,250 ..	40	28	29	44	24	37	29	30
1,000-2,000 ..	42	28	19	19	24	21	43	15
650-1,000 ..	2	2	0	2	0	0	0	5
325- 650 ..	0	0	0	0	0	0	0	0
0- 325 ..	0	0	0	0	0	0	0	0
Ht. not determined ..	7	6	14	12	8	15	14	7
No. of obs. ..	43	50	21	57	25	38	14	40

Authority.—Bibliography No. 36.

Note.—There were no occasions with no low cloud. Owing to the scarcity of observations at some hours too much reliance should not be placed on the details of the table.

V—RAIN

Step diagrams showing the monthly averages of rainfall and rain-days are reproduced in Figs. 26 and 27 on pages 52-3, and the corresponding data are given in the general climatological table on page 78. The discussion on rain at Bombay and in the region as a whole is given on pages 50-5.

VI—AIR TEMPERATURE

The data of the means and extremes of temperature are given in the general climatological table on page 78. The seasonal temperature in the vicinity of Bombay is discussed on pages 57-8.

At Bombay the minimum temperatures usually occur at about 0600 and the maximum at 1400, and between 0600 and 1800 the variation is very regular. From 1800 to 0600 the temperature falls at an almost uniform rate except during the earlier hours when the rate is more rapid. The rise from the minimum seems to begin

immediately after sunrise; in the dry season the temperature rises rapidly at first but during the SW. monsoon this initial rise is much slower. From November to February the rapid rise begins at 0700 and during the rest of the year it occurs at 0600; in the months of May, June and July there is even a slight rise in temperature between 0500 and 0600. In these months also the fall of temperature after sunset occurs somewhat later but this delay in the fall is not so strongly marked as the advance in the rise at about sunrise.

From November to February the diurnal range of temperature is about 14° F. but during the months of the SW. monsoon, from June to September, it is only about 8° F. In contrast with this at Poona, an inland station about 70 miles from Bombay and at a height of nearly 2,000 feet above sea level, the daily range of temperature in the dry season may be as much as 35° to 38° F., whereas at the height of the SW. monsoon it is only 11° F.

VII—HUMIDITY

The mean monthly relative humidity corrected to show the mean of 24 hours is given in the general climatological table on page 78, and the mean wet bulb temperature for 0800 and 1630 local time is also given there. The relative humidity for the region is discussed on pages 61-4, and a table showing the diurnal variation of mean relative humidity at Bombay for a period of 48 years is given on page 63.

VIII—MISCELLANEOUS

1—THUNDERSTORMS

The average number of days per month on which thunder was heard are given in the general climatological table on page 78, and thunderstorms in the region are discussed on pages 64-7.

A description of the "Elephanta" storms which are accompanied by thunder and lightning is given under "Surface winds" in this Appendix on page 74, and a diagram, Fig. 28, is reproduced on page 66 showing the sequence of changes in the various meteorological elements during the passage of a heat thunderstorm at Bombay on 6th October, 1930.

2—SEA AND SWELL

A table showing the frequency of different states of the sea for two observations a day, one in the morning and the other in the afternoon for a five-year period is given in Table VII on page 115.

TABLE I—GENERAL CLIMATOLOGICAL TABLES

Bombay, 18° 54' N., 72° 49' E. 37 ft.

Times of obs. : 0800, 1630 local time.

Month	Pressure at M.S.L.		Air Temperature						Rain			Thunder heard	Wind										Poor visibility†	Relative humidity %	Cloud amount	Wet bulb temperature °F.			
	Average††	Daily range‡	Average*	Mean of		Mean of		Extreme	Average fall	No. of days‡	Max. fall in 24 hours		Speed in knots	Percentage of observations from															
				Daily max	Daily min.	Highest	Lowest							Highest	Lowest	N.	NE.	E.	SE.	S.	SW.	W.					NW.	Calm	
January ..	1013	4.1	75	83	68	88	63	92	56	3	0.1	0.2	41	1.6	0	6	12	52	28	7	0	0	0	<1	0	0.8	73	1.5	63
February ..	1013	4.1	75	83	69	88	63	95	56	2	<.1	0.2	42	1.6	0	6	11	35	38	12	3	0	0	<1	0	2	71	1.3	67
March ..	1011	4.1	78	86	73	91	68	97	62	2	<.1	0.1	34	1.3	0.2	7	21	33	19	18	8	<1	0	0	0.6	75	1.8	70	
April ..	1009	4.1	82	89	77	92	74	100	68	1	<.1	0.1	27	1.1	0.7	6	23	10	10	16	12	11	6	9	3	0.2	77	3.1	75
May ..	1007	3.4	85	91	81	93	76	96	73	21	0.8	0.8	89	3.5	2	6	16	4	6	8	8	17	15	23	3	0	77	4.3	78
June ..	1004	2.7	83	88	80	93	75	99	73	465	18.3	14	409	16.1	5	9	3	2	2	11	15	27	27	13	0	2	82	7.5	78
July ..	1004	2.4	80	85	78	88	75	99	73	616	24.3	21	255	10.0	2	11	1	<1	<1	<1	1	25	51	20	0	2	87	8.8	77
August ..	1006	2.4	80	84	77	87	75	88	72	351	13.8	19	287	11.3	0.2	9	4	1	1	2	2	23	47	20	0	2	87	8.8	77
September ..	1008	3.1	80	85	77	88	75	91	71	267	10.5	13	199	7.8	5	6	6	11	7	12	8	18	21	16	<1	0.8	86	7.2	77
October ..	1009	3.7	81	88	77	92	73	95	70	55	2.2	3	149	5.8	3	5	12	36	26	9	1	2	1	13	0	0	81	3.9	76
November ..	1011	3.7	80	87	74	91	70	96	64	10	0.4	0.7	62	2.5	0.3	6	3	43	39	11	3	0	0	0	1	0.2	73	2.0	72
December ..	1013	4.1	77	85	70	89	65	91	56	1	<.1	0.1	24	1.0	0	6	5	43	44	8	0	0	0	0	0	0.6	72	1.6	67
Year ..	1009	3.5	80	86	75	95	61	100	56	1794	70.6	72	409	16.1	18	7	10	23	18	10	5	10	14	10	<1	11	78	4.3	73

Authorities.—Bibliography Nos. 24, 48, 55, 58.

Periods.—Pressure (average), relative humidity, and cloud amount, 32 years.

Pressure (daily range), 20 years.

Temp. and rain, 43 years.

No. of days with thunder, 1914-23.

Wind (speed), 1867-1920; (direction), 1933-7.

Poor visibility and wet bulb temp., 1933-7.

Notes.—†† Mean of 24 hours.

‡ Difference between means at 1000 and 1600 local time.

* Corrected to mean of 24 hours.

† Day with 2.54 mm. (0.1 in.) or more of rain.

‡ No. of days with visibility less than 2 nautical miles.

Month	Observations at 1630														Poor visibility†	Relative humidity %	Cloud amount	Wet bulb temperature °F.
Month	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	††	*	0800						
January ..	46	0	0	0	0	<1	3	50	0	0	0	0	68					
February ..	33	0	0	0	0	0	9	58	0	0	0	70						
March ..	34	0	0	0	0	0	14	52	0	0.2	0	73						
April ..	16	0	0	0	2	19	63	0	0	0	0	76						
May ..	6	0	0	0	9	30	55	0	0	0	0	79						
June ..	1	<1	0	1	5	28	43	21	0	2	0	79						
July ..	1	0	0	0	1	21	56	21	0	0.8	0	78						
August ..	3	0	<1	0	<1	13	54	29	0	1	0	77						
September ..	13	0	0	0	<1	11	35	39	<1	0.8	0	77						
October ..	22	5	7	6	<1	3	4	53	0	0	0	77						
November ..	29	1	<1	<1	2	2	6	58	0	0	0	75						
December ..	33	1	0	0	0	<1	4	61	0	0	0	71						
Year ..	20	<1	<1	<1	<1	7	23	47	<1	5	0	75						

West coast of India

TABLE I—continued

Ratnágiri. 16° 59' N., 73° 18' E. 207 ft.

Time of obs. : 0800 local time.

Month	Pressure at M.S.L.		Air Temperature							Rain			Thunder heard	Wind											Poor visibility †	Relative humidity %	Cloud amount	Wet bulb temperature °F.	
	Average ††	Daily range ††	Average*	Mean of		Mean of		Extreme		Average fall	No. of days ‡	Max. fall in 24 hours		Percentage of observations from															
				Daily max.	Daily min.	Highest	Lowest	Highest	Lowest					N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm							
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	mm.	in.	days	Observations at 0800											*	0800				
January ..	1013	3.7	76	87	67	94	61	98	58	3	0.1	0.2	23	0.9	0	5	8	17	40	20	2	0	0	0	13	0	64	1.1	64
February ..	1012	3.7	76	86	67	93	61	101	55	1	<.1	0.1	32	1.3	0	6	17	21	29	14	2	0	0	2	15	0	65	0.9	66
March ..	1011	3.7	78	87	72	93	66	102	61	1	<.1	0	32	1.2	0	6	29	20	16	14	4	1	0	4	12	0	71	1.2	71
April ..	1009	3.7	82	89	77	93	72	97	61	2	<.1	0.3	13	0.5	0	6	32	12	6	11	7	3	1	14	14	0	72	2.6	76
May ..	1008	3.1	84	91	80	93	76	100	71	34	1.4	2	212	8.3	0	6	22	7	2	5	4	8	12	28	12	0	73	3.7	78
June ..	1005	2.4	81	87	77	92	73	95	70	732	28.8	20	224	8.8	0.6	7	7	4	5	14	8	22	20	12	8	0	82	7.5	77
July ..	1005	2.0	78	84	76	87	72	91	69	838	33.0	25	304	12.0	0	8	2	2	2	7	4	38	36	5	4	0.2	86	8.5	77
August ..	1007	2.4	78	84	75	86	73	88	71	501	19.7	24	204	8.0	0	6	3	2	2	4	1	30	39	10	9	0	86	8.2	76
September ..	1008	3.1	78	84	75	87	72	94	69	307	12.1	15	234	9.2	0.8	5	12	11	10	12	5	7	13	8	22	0	84	6.4	76
October ..	1010	3.4	80	88	74	96	69	99	64	94	3.7	5	135	5.3	1.2	4	13	12	24	19	6	2	1	4	19	0	77	3.8	75
November ..	1011	3.7	80	91	71	95	64	99	60	24	0.9	1	244	9.6	1.4	5	3	11	46	24	2	0	1	0	13	0	65	2.8	69
December ..	1013	3.7	77	89	67	94	62	97	59	2	<.1	0.2	19	0.8	0	5	4	15	48	20	2	0	0	0	11	0	61	1.3	65
Year ..	1009	3.2	79	87	73	97	60	102	55	2539	100.0	93	304	12.0	4	6	13	11	19	14	4	9	10	7	13	0.2	74	3.9	72

Table I—General climatological tables

Authorities.—Bibliography Nos. 24, 55, 58.

Periods.—Pressure (average), relative humidity and cloud amount, 32 years.

Notes.—†† Mean of 24 hours.

‡ Difference between means at 1000 and 1600 local time.

* Corrected to mean of 24 hours.

† Day with 2.54 mm. (0.1 in.) or more of rain.

‡ No. of days with visibility less than 2 nautical miles.

Pressure (daily range), 20 years.

Temp. and rain, 43 years.

No. of days with thunder and poor visibility, 1933-7.

Wind (speed), 1883-1920; (direction), 20 years.

Wet bulb temp. 1928-37.

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TABLE I—continued

Mormugão. 15° 25' N., 73° 47' E. 60 ft.

Time of obs. : 0800 local time.

Month	Pressure at M.S.L.		Air Temperature						Rain			Thunder heard	Wind										Poor visibility†	Relative humidity %	Cloud amount	Wet bulb temperature °F.
	Average††	Daily range	Average*	Mean of		Mean of		Extreme	Average fall	No. of days‡	Max. fall in 24 hours		Percentage of observations from													
				Daily max.	Daily min.	Highest	Lowest						Highest	Lowest	Speed in knots	N.	NE.	E.	SE.	S.	SW.	W.				
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	mm.	in.	days	††	Observations at 0800										*	0800		
January	1013		76	85	70	89	66	92	60	1	<.1	0	5	9	19	50	11	3	0	0	2	6	0.2	76	1.6	67
February	1012		77	85	71	90	66	93	62	2	<.1	0.1	6	22	18	29	13	5	1	0	4	8	0.6	74	1.5	70
March	1011		79	87	75	91	69	95	62	1	<.1	0.1	6	21	16	18	10	9	3	2	12	9	0.2	75	2.5	73
April	1009		83	89	79	93	74	96	68	19	0.7	0.9	6	26	12	9	5	8	6	4	17	13	0	73	4.1	76
May	1008		84	90	81	93	76	95	72	67	2.6	3	7	20	8	4	3	4	3	16	34	8	0.2	75	5.3	78
June	1006		81	87	77	92	73	95	71	752	29.6	21	7	7	4	3	6	11	15	31	16	7	0.4	88	7.8	77
July	1007	Data not available.	78	84	76	87	73	89	71	793	31.2	25	8	7	1	2	3	4	11	51	16	5	0.4	91	8.5	77
August	1008		78	83	76	86	73	88	71	403	15.9	23	7	4	4	1	1	3	12	44	17	14	0	91	8.0	76
September	1009		78	83	75	86	73	88	71	240	9.5	15	4	9	6	9	5	6	5	13	14	33	0.6	90	6.9	76
October	1010		79	85	75	89	72	94	69	96	3.8	6	4	5	13	20	11	9	4	3	7	28	0.6	86	5.1	76
November	1011		79	86	73	89	68	93	64	33	1.3	2	4	4	26	41	11	5	2	1	1	9	0	76	3.0	71
December	1013		77	85	70	88	66	92	61	6	0.2	0.4	5	5	26	49	9	5	1	0	1	4	0.2	72	1.9	67
Year ..	1010		79	86	75	94	64	96	60	2413	94.9	96	6	11	13	20	7	6	5	14	12	12	3	81	4.7	74

West coast of India

Authorities.—Bibliography Nos. 24, 48, 55, 58.

Periods.—Pressure, temp., rain, relative humidity and cloud amount, 29–30 years.

Notes.—†† Mean of 24 hours.

* Corrected to mean of 24 hours.

‡ Day with 2.54 min. (0.1 in.) or more of rain.

¶ No. of days with visibility less than 2 nautical miles.

No. of days with thunder, 1914–23.

Wind (speed), unknown; (direction), 20 years.

Poor visibility, 1933–7.

Wet bulb temp., 1931–7.

TABLE I—continued

Trivandrum. 8° 29' N., 76° 59' E. 197 ft.

Times of obs. : 0800 and 1630 local time.

Month	Pressure at M.S.L.		Air Temperature						Rain			Thunder heard	Wind										Poor visibility [¶]	Relative humidity %	Cloud amount	Wet bulb temperature °F.				
	Average ^{††}	Daily range	Average*	Mean of		Mean of		Extreme	Average fall	No. of days [†]	Max. fall in 24 hours		Speed in knots	Percentage of observations from								Calm								
				Daily max.	Daily min.	Highest	Lowest							Highest	Lowest	N.	NE.	E.	SE.	S.	SW.						W.	NW.		
January ..	mb. 1011	3.7	77	84	72	86	68	90	63	19	0.7	1	52	2.0	3	2	5	14	6	3	0	0	0	1	1	71	13	74	3.2	73
February ..	1011	4.1	79	86	74	87	70	100	66	16	0.6	1	72	2.8	3	3	14	10	5	2	1	0	0	1	1	63	14	71	2.6	74
March ..	1010	4.1	81	88	77	90	73	93	71	41	1.6	3	54	2.1	12	3	30	5	6	1	1	0	0	0	3	55	10	75	2.6	76
April ..	1009	3.7	82	85	78	91	75	93	70	114	4.5	7	123	4.8	19	4	56	4	1	1	0	1	1	1	9	29	4	79	4.6	78
May ..	1008	3.4	81	87	78	90	74	92	71	215	8.4	10	158	6.2	14	4	60	2	1	1	1	1	1	3	19	12	6	83	6.4	79
June ..	1008	2.7	78	83	76	88	72	90	67	340	13.4	17	151	5.9	4	4	49	0	1	1	0	1	0	13	13	24	11	86	8.4	76
July ..	1009	2.7	77	82	75	85	72	88	61	188	7.4	14	152	6.0	2	5	52	1	0	0	0	0	4	37	6	11	86	8.5	75	
August ..	1009	3.1	78	83	75	85	73	89	70	103	4.1	9	92	3.6	2	6	62	1	0	0	0	0	5	27	5	9	86	7.9	76	
September ..	1010	3.4	78	83	75	86	73	89	71	105	4.1	8	125	4.9	5	5	57	0	1	1	0	1	4	30	7	7	84	7.1	76	
October ..	1010	3.4	78	83	75	86	72	88	69	269	10.6	12	216	8.5	12	3	29	1	1	2	1	1	9	13	44	9	86	6.9	76	
November ..	1011	3.4	78	83	74	86	71	93	64	167	6.6	9	112	4.4	11	2	7	2	6	2	1	0	0	1	81	4	85	6.1	75	
December ..	1011	3.7	77	83	73	85	69	88	66	62	2.4	4	149	5.9	3	2	5	4	3	0	0	0	1	0	87	5	78	4.5	74	
Year ..	1010	3.5	79	84	75	91	67	100	61	1639	64.5	95	216	8.5	90	4	35	4	3	<1	<1	<1	3	13	40	103	81	5.7	76	
													Observations at 1630																	
January ..	Data not available												0	2	1	0	17	27	29	4	20	6			76					
February ..	Data not available												2	0	1	1	17	35	39	1	4	3			76					
March ..	Data not available												5	2	1	1	8	29	40	8	8	6			77					
April ..	Data not available												5	1	2	2	6	3	59	16	6	9			79					
May ..	Data not available												5	1	2	2	1	4	56	26	3	10			79					
June ..	Data not available												13	0	0	0	0	3	50	33	1	12			77					
July ..	Data not available												8	0	0	0	0	0	28	63	1	13			77					
August ..	Data not available												7	1	0	0	1	0	27	64	1	8			77					
September ..	Data not available												3	1	0	1	0	1	37	54	4	6			77					
October ..	Data not available												10	2	1	0	2	10	40	21	14	12			77					
November ..	Data not available												5	1	1	1	11	9	22	9	41	8			77					
December ..	Data not available												2	2	3	0	4	21	28	4	36	4			76					
Year ..	Data not available												5	1	<1	<1	6	12	38	25	12	97			77					

Authorities.—Bibliography Nos. 24, 48, 55, 58.
Periods.—Pressure (average), 29 years; (daily range), 20 years.
 Temp., 29-31 yrs.
 Rain (average fall and no. of days), 69 years; (max. fall in 24 hours), 32 years.
 No. of days with thunder, 1914-23.
 Wind (speed), 1889-1920.
 Wind (direction), poor visibility and wet bulb temp., 1933-7.
 Cloud amount and relative humidity, 31 years.
Notes.—†† Mean of 24 hours.
 || Difference between means at 1000 and 1600 local time.
 * Corrected to mean of 24 hours.
 † Day with 2.54 mm. (0.1 in.) or more of rain.
 ‡ No. of days with visibility less than 2 nautical miles.

Table I—General climatological tables 5 83

TABLE I—continued

Minicoy island. 8° 18' N., 73° 00' E. 9 ft.

Time of obs. : 0800 local time.

Month	Pressure at M.S.L.		Air Temperature							Rain			Thunder heard	Wind										Poor visibility [¶]	Relative humidity %	Cloud amount	Wet bulb temperature °F.		
	Average ^{††}	Daily range	Average	Mean of		Mean of		Extreme		Average fall	No. of days [‡]	Max. fall in 24 hours		Percentage of observations from															
				Daily max.	Daily min.	Highest	Lowest	Highest	Lowest					N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm							
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	mm.	in.	days	Observations at 0800										*	0800					
January ..	1012		81	86	75	88	71	90	69	48	1.9	3	35	39	12	4	1	1	0	2	6	6	74	3.0	75				
February ..	1012		81	86	76	89	71	90	63	17	0.6	1	46	32	7	2	1	0	1	5	6	1	70	3.0	75				
March ..	1011		83	88	77	91	73	92	71	26	1.0	2	49	20	4	3	1	1	2	15	5	3	72	2.8	77				
April ..	1009		84	89	79	93	74	98	72	67	2.6	4	34	9	5	2	1	4	7	31	7	3	74	3.9	78				
May ..	1009		84	89	79	93	74	94	71	162	6.4	9	15	5.7	5	5	12	2	1	1	1	9	24	48	2	9	79	5.0	79
June ..	1009		82	86	78	90	73	93	72	303	11.9	17	113	4.4	1	9	2	0	0	1	27	53	16	1	13	81	6.8	78	
July ..	1009		81	85	77	88	73	90	71	223	8.8	14	114	4.5	0.2	9	1	0	0	0	0	13	65	20	1	13	81	6.3	77
August ..	1010		81	86	77	88	72	90	70	182	7.2	11	134	5.3	0.2	7	5	0	0	0	7	47	41	0	9	81	5.5	77	
September ..	1011		81	86	77	88	74	89	72	163	6.4	10	108	4.2	0.2	6	10	1	1	1	0	5	34	47	1	6	81	5.0	77
October ..	1010		81	86	77	89	73	92	70	211	8.3	11	128	5.0	0.6	5	11	6	2	3	4	10	32	30	2	9	82	5.2	77
November ..	1011		81	86	76	89	72	91	69	134	5.3	7	140	5.5	3	3	17	15	8	6	5	8	19	16	6	4	79	4.5	77
December ..	1011		81	86	76	88	71	90	69	89	3.5	4	187	7.4	1	3	27	33	10	7	4	1	2	5	11	1	75	3.5	76
Year ..	1010		82	87	77	94	69	98	63	1625	64.0	93	187	7.4	14	5	21	13	4	2	2	7	24	23	4	77	77	4.5	77

Authorities.—Bibliography Nos. 24, 55, 58.

Notes.—†† Mean of 24 hours.
 ‡ (max. + min.).
 † Day with 2.54 mm. (0.1 in.) or more of rain.
 ¶ No. of days with visibility less than 2 nautical miles.
 * Corrected to mean of 24 hours.

Periods.—Pressure, rain (average fall and no. of days) and cloud amount, 28 years.

Temp. (average), 10–15 years; (mean daily max., extreme highest), 14–15 years; (mean daily min., mean highest and lowest, extreme lowest), 1927–36.
 Rain (max. fall in 24 hours), 30 years.
 No. of days with thunder and poor visibility, 1933–7.
 Wind (speed), 1891–1920; (direction), 20 years.
 Relative humidity, 15 years.
 Wet bulb temp., 1928–36.

Table I—General climatological tables

TABLE II—MONTHLY FREQUENCY OF WIND DIRECTION AND FORCE AT SEA

Number of occasions per 100 on which particular winds may be expected

I = Beaufort force 1-3. II = force 4-7. III = force 8-12

15°-20° N., 60°-65° E.

Month	N.			NE.			E.			SE.			S.			SW.			W.			NW.			Calm	Totals of			No. of obs.
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III		I	II	III	
January	15	6	0	31	21	0	12	3	0	.5	.2	0	.2	0	0	.4	0	0	2	0	0	4	.6	0	4	65	31	0	587
February	17	4	0	27	9	0	10	2	0	3	.3	0	1	0	0	.9	0	0	3	.1	0	11	.5	0	12	71	17	0	431
March ..	23	1	0	29	3	0	10	.4	0	2	0	0	2	1	0	3	.2	0	3	.2	0	9	.5	0	12	82	6	0	574
April ..	15	1	0	11	2	0	2	0	0	.9	0	0	4	.1	0	9	1	0	20	3	0	17	.8	0	14	79	7	0	600
May ..	3	0	0	2	0	0	2	.1	0	1	.2	0	5	2	0	17	21	0	20	14	0	6	1	0	6	56	38	0	392
June ..	.3	0	0	.3	0	0	0	0	0	0	0	0	1	3	.1	6	54	3	7	22	1	1	0	0	.3	15	80	5	329
July ..	0	0	0	0	0	0	0	0	0	0	0	0	.7	1	.5	.3	67	11	0	17	3	0	0	0	0	1	85	14	289
August ..	0	0	0	0	0	0	0	0	0	0	0	0	.9	2	0	7	66	2	.6	22	0	0	0	0	0	8	90	2	171
September	1	0	0	2	0	0	1	0	0	.5	0	0	5	5	0	28	23	0	13	9	0	4	0	0	8	55	37	0	202
October	19	3	0	30	7	0	9	2	0	1	0	0	.4	.2	0	1	.8	0	5	2	0	8	3	0	6	76	18	0	476
November	12	5	0	32	15	0	15	3	0	1	2	0	1	1	0	.5	0	0	1	.5	0	7	.8	0	2	70	28	0	481
December	11	9	0	39	25	0	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	.6	0	2	60	38	0	456

West coast of India

15°-20° N., 65°-70° E.

January	27	10	0	26	15	0	3	1	0	0	.1	0	0	0	0	.3	0	0	3	0	0	10	1	0	3	69	28	0	638
February	31	13	0	17	10	0	4	.9	0	.4	0	0	0	0	0	0	.2	0	3	.8	0	14	3	0	3	69	28	0	485
March ..	30	13	0	16	5	0	2	.4	0	.6	0	0	.7	0	0	.9	0	0	5	.1	0	19	5	0	4	73	23	0	540
April ..	19	8	0	6	1	0	1	0	0	.1	0	0	.1	0	0	2	1	0	17	3	0	29	8	0	4	74	22	0	617
May ..	6	2	0	2	1	0	.9	.8	0	1	.5	0	1	1	0	6	5	0	27	17	0	16	9	0	3	60	37	0	447
June ..	.9	0	0	0	0	0	.6	.3	0	.4	0	0	.2	0	0	7	35	.5	6	39	1	2	4	.2	3	17	78	2	351
July ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.8	52	.8	1	42	2	.2	.3	0	0	2	95	3	356
August ..	.2	.5	0	0	0	0	0	0	0	0	0	0	0	0	0	4	42	.4	5	44	0	2	2	0	1	10	88	.4	239
September	5	1	0	1	0	0	0	0	0	.1	0	0	.7	.3	0	9	9	0	28	17	0	14	9	0	6	58	36	0	301
October	23	7	.1	25	6	0	7	4	0	.7	.5	0	1	.7	0	.4	.8	0	2	3	0	12	3	.1	3	72	25	.2	515
November	17	6	0	32	13	0	9	3	0	2	.7	0	1	.5	0	.5	0	0	2	.1	0	9	2	0	2	72	26	0	511
December	20	10	0	33	20	0	5	2	0	.3	0	0	0	0	0	.2	0	0	.7	0	0	4	2	0	2	64	34	0	484

Authorities.—Bibliography Nos. 2, 61.

TABLE II—continued

Number of occasions on which particular winds may be expected

I = Beaufort force 1-3. II = force 4-7. III = force 8-12

15°-20° N., 70°-75° E.

Month	N.			NE.			E.			SE.			S.			SW.			W.			NW.			Calm	Totals of			No. of obs.
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III					
January	27	18	0	11	7	0	3	2	0	1	0	0	.5	.1	0	.5	.5	0	3	.6	0	17	6	0	4	62	34	0	729
February	28	16	0	8	4	0	3	.7	0	.8	0	0	.9	.2	0	2	.1	0	5	1	0	17	9	0	4	65	31	0	703
March ..	25	12	0	4	.6	0	1	.4	0	1	0	0	2	.1	0	2	.4	0	7	2	0	24	13	0	6	66	28	0	702
April ..	17	7	0	2	.7	0	.7	0	0	.6	.1	0	3	.1	0	8	.8	0	16	2	0	26	12	0	4	74	22	0	702
May ..	8	3	0	.7	.1	0	1	.3	0	1	.2	.1	3	.7	.1	9	2	0	25	.8	0	25	9	0	3	73	24	.2	724
June ..	2	.1	0	1	.2	0	1	.2	0	2	1	0	3	4	0	14	19	.3	14	23	.5	7	5	0	2	43	54	.8	486
July ..	.4	.2	0	0	0	0	0	0	0	.5	.8	0	3	37	.2	5	47	.8	1	3	0	1	3	0	0	11	88	1	429
August ..	2	.2	0	0	0	0	0	0	0	1	.1	0	7	20	0	19	38	0	9	3	0	9	3	0	2	38	60	0	377
September	5	2	0	1	.1	0	.4	.6	0	.2	1	0	3	.4	0	8	5	0	25	10	0	26	6	0	5	68	27	0	523
October ..	26	6	0	13	3	0	5	1	0	3	.1	0	3	.6	0	4	1	0	6	.9	0	19	5	0	4	78	18	0	624
November	23	8	0	24	4	0	8	2	0	3	.6	0	.7	.2	0	2	0	0	4	.2	0	13	2	0	5	77	18	0	627
December	26	8	0	23	7	0	7	1	0	1	.3	0	1	.2	0	1	.2	0	4	.1	0	12	3	0	4	76	20	0	631

Authorities.—Bibliography Nos. 2, 61.

Table I—Wind direction and force at sea

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TABLE II—continued

Number of occasions per 100 on which particular winds may be expected

I = Beaufort force 1-3. II = force 4-7. III = force 8-12

10°-15° N., 60°-65° E.

Month	N.			NE.			E.			SE.			S.			SW.			W.			NW.			Calm	Totals of			No. of obs.
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III		I	II	III	
January	6	12	0	23	43	·4	9	5	·1	0	0	0	0	0	0	0	·3	0	0	0	·8	0	0	·1	39	61	·5	653	
February	13	8	0	32	29	0	9	4	0	·2	0	0	·2	0	0	0	0	0	0	1	·1	0	2	56	42	0	447		
March ..	20	6	0	35	11	0	16	2	0	·2	0	0	·3	0	0	·1	0	0	·9	0	0	5	·1	0	3	79	18	0	611
April ..	29	1	0	27	3	0	10	·4	0	·7	·2	0	·8	0	0	2	·2	0	5	·1	0	11	·8	0	9	86	5	0	534
May ..	14	·2	0	12	0	0	5	0	0	3	0	0	6	·7	0	9	8	0	13	7	0	11	1	0	10	72	18	0	579
June ..	0	·4	0	0	0	0	·3	0	0	·2	0	0	1	3	0	4	62	3	2	21	·4	·9	1	0	7	9	87	3	435
July ..	0	0	0	0	0	0	0	0	0	0	0	0	0	6	·4	1	73	7	·4	12	1	0	0	0	0	2	90	8	540
August ..	0	0	0	0	0	0	0	0	0	0	0	0	2	5	·2	7	65	4	2	15	·3	0	0	0	0	10	86	4	452
September	·5	·1	0	·5	0	0	·6	0	0	·5	0	0	8	2	0	25	32	0	14	10	0	5	2	0	1	53	46	0	497
October ..	17	4	0	20	6	0	6	2	0	·7	·3	0	·8	·8	0	4	·9	0	8	3	0	14	5	0	8	70	22	0	489
November	20	8	0	23	22	·1	5	3	·1	·6	·7	0	1	·2	0	1	·6	0	3	·9	0	5	1	0	3	60	37	·2	482
December	9	11	0	18	50	0	5	3	0	1	·4	0	·3	0	0	·1	0	0	·1	·2	0	·9	·5	0	·4	34	65	0	506

10°-15° N., 65°-70° E.

January	17	12	0	30	28	0	8	1	·4	·1	·3	·1	0	0	0	0	·7	0	·1	0	0	2	·2	0	0	57	43	·5	431
February	23	16	0	25	23	0	3	·2	0	0	0	0	0	0	0	0	0	0	·4	0	0	5	0	0	5	56	39	0	243
March ..	32	10	0	26	7	0	3	0	0	0	0	0	·1	0	0	·2	0	0	1	1	0	10	4	0	6	72	22	0	349
April ..	31	5	0	15	1	0	5	0	0	0	0	0	1	0	0	1	0	0	8	1	0	20	6	0	6	80	14	0	256
May ..	19	·8	0	7	1	0	1	1	0	1	·3	0	3	·3	0	6	5	·3	11	5	0	26	7	0	4	75	21	·3	333
June ..	0	0	0	0	0	0	0	0	0	·8	0	0	2	·8	0	7	45	2	3	31	3	·6	3	1	·5	14	80	6	185
July ..	0	0	0	0	0	0	0	0	0	0	0	0	·5	4	0	5	55	·4	3	33	·2	0	0	0	0	8	91	·6	303
August ..	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	14	30	0	9	33	0	·9	8	0	·6	27	72	0	173
September	3	·8	0	·7	0	0	0	0	0	·2	·2	0	·2	·2	0	7	11	0	21	22	0	18	12	0	5	50	45	0	242
October ..	24	4	0	17	2	0	5	3	0	1	1	0	2	·9	0	3	2	0	8	2	0	15	6	0	3	76	21	0	289
November	21	6	0	37	15	0	7	3	0	·9	·2	0	1	·1	0	2	·8	0	2	·7	0	·9	·9	0	2	71	27	0	345
December	19	8	0	29	31	0	4	3	0	1	·5	0	0	0	0	·3	0	0	0	0	0	1	·7	0	1	55	44	0	324

Authorities.—Bibliography Nos. 2, 61.

TABLE II—continued

Number of occasions per 100 on which particular winds may be expected.

I = Beaufort force 1-3. II = force 4-7. III = force 8-12

10°-15° N., 70°-75° E.

Month	N.			NE.			E.			SE.			S.			SW.			W.			NW.			Calm	Totals of			No. of obs.
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III		I	II	III	
January	26	13	0	19	2	0	5	.7	0	2	.4	0	.4	.1	0	1	.3	0	6	.4	0	17	4	0	3	76	21	0	539
February	25	12	0	11	3	0	2	.5	0	3	.1	0	1	.1	0	2	.3	0	6	1	0	16	9	0	7	67	26	0	450
March ..	25	7	0	3	.3	0	2	0	0	1	0	0	1	0	0	3	.3	0	7	1	0	29	10	0	11	71	18	0	430
April ..	15	3	0	2	.5	0	.8	0	0	1	.1	0	3	.2	0	4	.5	0	17	1	0	33	11	0	7	76	17	0	516
May ..	14	3	0	.8	.2	0	.7	0	.2	2	.2	0	3	.2	0	9	3	0	17	4	0	29	10	0	5	75	20	.2	511
June ..	1	.3	0	.5	.5	0	.3	0	0	.4	0	0	3	2	0	12	16	.8	17	26	.6	11	6	0	4	45	50	1	372
July ..	3	2	0	2	0	0	.5	0	0	.4	0	0	0	.4	0	4	23	0	5	47	.4	4	9	0	.5	17	82	.4	222
August ..	3	1	0	.8	.4	0	.4	0	0	.6	0	0	2	0	0	5	13	0	18	27	0	12	11	0	3	42	55	0	255
September	9	2	0	.8	0	0	.6	0	0	1	.3	0	3	.2	0	9	3	0	15	15	0	25	9	0	8	63	29	0	320
October..	21	2	0	8	.7	0	5	1	0	6	1	0	3	.6	0	5	.6	0	9	2	0	23	4	0	8	80	12	0	464
November	20	3	0	14	3	0	9	3	0	5	3	0	3	.9	0	4	.6	0	7	.4	0	16	1	0	6	79	15	0	399
December	18	7	0	19	7	0	10	4	.3	6	1	0	4	.2	0	3	.2	0	4	.3	0	9	1	0	6	74	20	.3	443

10°-15° N., 75°-80° E.

January	16	1	0	15	5	0	9	4	0	3	.3	0	1	.3	0	3	.7	0	9	2	0	19	4	0	7	75	18	0	151
February	14	3	0	10	.4	0	11	2	0	2	0	0	.8	0	0	3	.8	0	10	2	0	22	8	0	11	72	17	0	125
March ..	15	2	0	4	0	0	6	0	0	6	0	0	2	0	0	5	.7	0	16	4	0	24	5	0	11	78	11	0	148
April ..	10	2	0	3	0	0	.9	.4	0	2	2	0	.8	1	0	3	0	0	22	4	0	37	10	0	3	77	20	0	115
May ..	4	1	0	2	0	0	3	0	0	9	.8	0	7	2	0	11	2	0	16	5	0	25	6	0	7	76	17	0	129
June ..	5	.5	0	1	.5	0	.5	.5	0	1	1	0	9	3	.5	14	10	1	19	14	3	8	7	0	0	58	37	5	99
July ..	25	5	0	5	0	0	0	0	0	5	0	0	0	0	0	3	23	0	7	13	0	5	0	0	10	50	40	0	20
August ..	8	.6	0	1	0	0	0	0	0	1	0	0	5	0	0	10	1	0	21	4	0	33	5	0	9	80	11	0	78
September	10	0	0	1	0	0	1	0	0	5	0	0	6	0	0	9	2	0	12	10	0	27	3	0	13	72	15	0	72
October..	8	3	0	3	0	0	4	1	0	13	3	0	11	3	0	2	3	0	7	3	0	24	3	0	10	70	20	0	84
November	10	1	0	7	1	0	6	5	0	10	1	0	6	1	0	5	.7	0	8	3	0	11	7	0	16	65	19	0	141
December	12	2	0	13	6	0	9	7	0	7	2	0	6	0	0	3	0	0	9	0	0	13	1	0	11	71	18	0	124

Authorities.—Bibliography Nos. 2, 61.

Table II—Wind direction and force at sea

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TABLE II—continued

Number of occasions per 100 on which particular winds may be expected
 I = Beaufort force 1-3. II = force 4-7. III = force 8-12

5°-10° N., 60°-65° E.																													
Month	N.			NE.			E.			SE.			S.			SW.			W.			NW.			Calm	Totals of			No. of obs.
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III		I	II	III	
January	6	13	0	25	38	0	7	5	0	2	-7	0	-6	-2	0	0	0	0	0	0	3	0	0	-7	43	57	0	289	
February	10	7	0	30	36	0	12	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	46	0	313	
March	21	7	0	43	12	0	9	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	76	20	0	348	
April	22	3	0	33	5	0	9	2	0	-5	-2	0	-2	0	0	-4	0	0	2	1	0	14	1	0	6	81	13	0	372
May	8	1	0	8	-6	0	3	-2	0	-8	0	0	3	-3	0	7	5	0	17	16	-3	14	6	-1	11	60	29	-4	419
June	0	0	0	0	0	0	0	0	0	0	0	0	-4	1	0	5	54	1	2	33	0	-2	3	0	-5	7	91	1	394
July	0	0	0	0	0	0	0	0	0	0	0	0	-7	4	0	8	62	-3	2	23	-2	-2	0	0	0	11	89	-5	361
August	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	9	43	0	8	29	0	-5	2	0	-4	21	78	0	301
September	2	-2	0	-6	0	0	-5	0	0	-9	0	0	2	2	0	18	21	0	23	16	0	7	3	0	4	54	42	0	412
October	14	1	0	13	2	0	7	1	0	1	-2	0	-4	-1	0	5	4	0	16	6	0	25	1	0	4	80	16	0	379
November	20	6	0	23	16	0	6	3	0	1	0	0	-5	-4	0	1	-3	0	2	-7	0	11	2	0	5	66	29	0	292
December	7	7	0	25	40	0	7	5	-3	2	1	0	-2	0	0	0	0	0	0	0	0	2	-6	0	2	44	54	-3	322
5°-10° N., 65°-70° E.																													
January	15	10	0	30	23	0	13	5	0	-7	-3	0	0	0	0	-9	0	0	-1	0	0	1	-1	0	-7	61	38	0	675
February	23	9	0	29	19	0	9	1	0	-3	-1	0	0	0	0	0	0	0	-3	0	0	5	-3	0	2	67	31	0	596
March	26	7	0	35	7	0	5	2	0	-8	-1	0	-7	0	0	-3	0	0	2	0	0	10	1	0	3	80	17	0	704
April	22	4	0	16	1	0	6	-4	0	2	-9	0	1	0	0	2	-4	-3	7	1	0	24	5	0	6	80	14	-3	751
May	14	1	0	8	-5	0	3	0	0	2	0	0	2	-3	0	3	4	0	16	11	-3	22	5	0	7	70	23	-3	796
June	-4	-2	0	-3	-3	0	-1	0	0	-1	0	0	-2	-2	0	7	32	-2	11	39	-1	3	4	0	-8	23	76	-3	607
July	0	0	0	0	0	0	0	0	0	-2	0	0	3	2	0	16	33	0	13	29	0	2	2	0	0	35	65	0	485
August	1	-1	0	-3	0	0	-2	0	0	-4	0	0	2	-5	0	12	17	-8	18	33	0	6	7	0	2	40	57	-8	540
September	10	-6	0	4	-2	0	2	-2	0	-7	0	0	1	-1	0	7	3	0	21	17	0	18	12	0	3	65	32	0	715
October	12	2	0	10	1	0	3	-8	0	-5	-2	0	1	1	0	1	3	0	17	8	0	24	8	0	7	70	23	0	736
November	21	7	0	18	5	-1	7	3	0	2	1	0	1	-2	0	2	-9	0	6	3	-2	11	5	-2	6	69	24	-5	751
December	17	6	0	31	18	0	10	3	0	4	-3	0	1	-2	0	1	0	0	1	0	0	3	1	0	3	68	29	0	662

Authorities.—Bibliography Nos. 2, 61.

TABLE II—continued

Number of occasions per 100 on which particular winds may be expected

I = Beaufort force 1-3. II = force 4-7. III = force 8-12

5°-10° N., 70°-75° E.

Month	N.			NE.			E.			SE.			S.			SW.			W.			NW.			Calm	Totals of			No. of obs.
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III					
January	24	5	0	31	6	0	13	1	0	2	.2	0	.3	0	0	1	0	0	1	.1	0	7	.9	0	6	81	13	0	705
February	27	5	0	25	5	0	7	.5	0	1	.2	0	.6	0	0	.4	0	0	2	.1	0	12	1	0	12	76	12	0	577
March ..	27	5	0	16	2	0	5	.2	0	1	.1	0	1	.1	0	.9	.1	0	5	.4	0	19	3	0	13	76	11	0	695
April ..	15	3	0	9	1	0	3	.4	.1	.9	.6	.1	.6	.2	.2	2	.6	.6	13	4	.1	25	7	0	13	69	17	1	695
May ..	6	.9	0	3	.2	0	.9	0	0	.9	.1	0	2	.3	.1	7	7	.5	20	13	.5	19	11	0	6	61	32	1	778
June ..	2	.9	0	.4	.1	0	.1	0	0	0	0	0	1	.5	0	10	19	.2	17	35	.6	8	6	.3	.4	38	61	1	699
July ..	.6	.8	0	0	0	0	0	0	0	.3	0	0	3	1	0	14	11	0	20	27	0	9	11	0	2	47	51	0	629
August ..	3	.6	0	.8	.3	0	.1	0	0	.3	0	0	.8	.6	0	7	6	.2	21	25	0	16	19	0	.8	48	51	.2	629
September	10	3	0	1	.1	0	.6	0	0	.3	0	0	.8	0	0	4	1	0	23	14	0	24	15	0	3	63	34	0	603
October..	9	1	0	3	.2	0	2	.2	0	2	.3	0	3	1	0	7	4	0	17	14	0	22	8	0	7	64	29	0	720
November	15	3	0	13	.5	0	6	.5	.2	4	.6	0	2	.3	0	3	.6	0	11	4	0	21	3	0	13	75	12	.2	699
December	20	3	0	27	4	0	11	2	0	3	2	0	2	.4	0	1	.2	0	5	.6	0	9	2	0	8	77	15	0	656

5°-10° N., 75°-80° E.

January	12	11	0	14	21	.3	8	4	.4	3	.7	0	2	0	0	2	.2	0	4	.3	0	7	1	0	7	53	39	.7	948
February	11	7	0	15	17	.1	5	3	0	2	.7	0	2	0	0	2	.6	0	7	.7	0	13	2	0	11	58	31	.1	847
March ..	8	2	0	10	5	0	7	2	0	7	.3	0	4	1	0	4	1	0	13	1	0	18	4	0	13	71	16	0	883
April ..	4	.5	0	4	.5	0	5	.9	0	7	.5	0	5	1	0	12	4	.1	18	8	0	14	5	0	9	70	21	.1	921
May ..	2	.3	0	1	.1	0	.5	0	0	.8	.1	0	2	1	0	10	21	.2	17	25	.5	7	8	0	3	41	56	.7	938
June ..	1	.5	0	.7	.1	0	.3	0	0	.5	0	0	2	1	0	15	23	0	15	28	0	7	6	0	1	41	58	0	841
July ..	1	2	0	.7	.3	0	0	0	0	.2	0	0	1	1	0	11	11	.1	17	33	.2	8	11	0	.8	40	59	.3	745
August ..	2	2	0	.2	0	0	0	0	0	.2	0	0	2	.7	0	6	10	0	15	34	0	12	15	.1	2	38	60	.1	809
September	3	.8	0	.4	0	0	.2	0	0	.8	.1	0	3	1	0	10	11	0	15	28	.1	11	13	0	2	44	54	.1	872
October..	4	.9	0	2	.9	0	2	.2	0	3	.1	0	2	.5	0	11	9	0	22	17	.2	14	6	0	5	60	35	.2	861
November	11	3	0	10	6	0	6	1	.1	5	.5	0	3	.1	0	6	.9	0	11	6	0	14	5	0	11	66	23	.1	912
December	11	12	.1	14	19	.8	8	5	0	3	.7	0	1	.1	0	1	.2	0	6	.8	0	7	1	0	8	52	39	.9	857

Authorities.—Bibliography Nos. 2, 61.

Table II—Wind direction and force at sea

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TABLE II—continued

Number of occasions per 100 on which particular winds may be expected
I = Beaufort force 1-3. II = force 4-7. III = force 8-12

0°-5° N., 60°-65° E.

Month	N.			NE.			E.			SE.			S.			SW.			W.			NW.			Calm	Totals of			No. of obs.
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III		I	II	III	
January	15	8	0	18	9	0	11	3	0	3	0	0	3	0	0	5	0	0	5	0	0	10	1	0	9	70	21	0	82
February	30	5	0	31	9	0	8	1	0	1	2	0	1	0	0	0	0	0	0	0	0	9	0	0	3	79	18	0	148
March ..	18	2	0	21	14	0	21	2	0	5	0	0	0	0	0	3	0	0	4	0	0	6	0	0	8	74	18	0	180
April ..	12	.8	0	17	1	0	5	0	0	5	0	0	2	0	0	4	2	0	15	2	0	13	3	0	19	72	9	0	127
May ..	5	.9	0	3	.3	0	2	0	0	3	0	0	9	2	0	14	5	0	14	9	0	16	5	0	12	66	22	0	161
June ..	.2	0	0	.2	0	0	0	0	0	1	.4	0	8	12	0	19	23	0	9	21	0	3	2	0	.4	40	60	0	255
July ..	0	0	0	.7	0	0	2	0	0	3	2	0	14	11	0	24	28	0	5	7	0	.4	.6	0	3	48	49	0	272
August ..	2	0	0	.9	0	0	.6	0	0	3	2	0	12	12	0	17	15	0	13	6	0	7	3	.4	5	55	39	.4	228
September	1	.2	0	2	.8	0	9	1	0	6	.6	0	18	2	0	17	9	0	7	12	0	3	1	0	10	63	27	0	246
October...	5	.8	0	.3	0	0	0	0	0	.8	0	0	10	1	0	14	10	0	11	17	0	15	9	0	6	56	38	0	187
November	14	2	0	5	1	0	1	0	0	.7	0	0	2	1	0	5	6	0	16	15	0	15	8	0	7	59	34	0	142
December	18	2	0	23	5	0	7	.6	0	4	0	0	4	0	0	3	0	0	5	2	0	14	3	0	11	77	12	0	180

West coast of India

0°-5° N., 65°-70° E.

January	15	3	0	27	7	0	14	3	0	3	.5	0	.9	0	0	.4	0	0	.9	1	0	7	3	0	15	68	17	0	224
February	21	5	0	29	10	0	8	5	0	1	.9	0	0	0	0	0	0	0	2	0	0	11	3	0	5	71	24	0	119
March ..	26	.9	0	30	3	0	7	0	0	3	0	0	3	0	0	.7	.7	0	2	0	0	14	0	0	10	85	5	0	152
April ..	9	3	0	8	.2	0	3	0	0	5	0	0	7	0	0	12	.5	0	16	5	0	21	4	0	9	78	13	0	268
May ..	3	2	0	.8	.3	0	.6	0	0	.7	0	0	10	.5	0	16	9	0	18	12	0	17	5	0	6	66	28	0	192
June ..	1	0	0	.2	0	0	.2	0	0	.8	1	0	11	11	0	17	13	0	10	15	0	5	5	0	9	46	45	0	241
July ..	1	0	0	.2	0	0	3	0	0	8	.6	0	10	3	0	34	7	0	10	4	0	4	2	0	11	72	17	0	236
August ..	0	.3	0	.3	0	0	3	0	0	10	.6	0	17	4	0	18	8	0	15	9	0	5	5	0	5	68	27	0	172
September	4	.4	0	1	0	0	3	0	0	3	.9	0	7	4	0	9	7	0	17	10	0	19	7	0	9	62	29	0	254
October..	3	.8	0	.5	0	0	.9	0	0	2	0	0	8	.2	0	10	4	0	21	22	0	16	10	0	1	62	37	0	358
November	5	1	0	5	1	0	3	5	0	4	1	0	6	0	0	7	.4	0	11	10	0	27	8	0	8	66	26	0	224
December	15	1	0	19	3	0	11	2	0	.5	.2	0	2	0	0	5	2	0	11	5	0	11	3	0	11	73	16	0	234

Authorities.—Bibliography Nos. 2, 61.

TABLE II—continued

Number of occasions per 100 on which particular winds may be expected

I = Beaufort force 1-3. II = force 4-7. III = force 8-12

0°-5° N., 70°-75° E.

Month	N.			NE.			E.			SE.			S.			SW.			W.			NW.			Calm	Totals of			No. of obs.
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III		I	II	III	
January	16	4	0	31	18	0	8	5	0	2	3	0	3	0	0	6	0	0	4	0	0	8	0	0	3	70	27	0	168
February	18	4	0	33	12	0	11	4	0	2	0	0	5	0	0	5	0	0	2	0	0	9	1	0	1	77	22	0	106
March ..	16	0	0	18	0	0	7	0	0	4	0	0	2	0	0	9	0	0	5	0	0	21	0	0	26	74	0	0	54
April ..	5	5	0	3	0	0	0	0	0	0	0	0	3	0	0	11	4	0	25	11	0	15	3	0	19	61	20	0	118
May ..	6	6	0	1	0	0	1	0	0	0	0	0	2	2	0	11	15	0	27	21	0	9	8	0	1	52	47	0	94
June ..	1	2	0	3	0	0	6	0	0	5	3	0	9	4	0	18	11	0	20	8	3	4	8	0	8	60	32	3	316
July ..	5	2	0	0	0	0	0	0	0	7	2	0	18	5	0	35	1	0	17	1	0	2	4	0	13	79	8	0	213
August ..	9	4	0	1	0	0	9	0	0	7	0	0	7	2	0	6	9	0	25	19	9	6	6	0	9	54	36	9	117
September	3	0	0	1	0	0	4	0	0	4	4	0	5	3	0	11	10	0	14	18	0	13	7	0	12	50	38	0	225
October..	2	2	0	0	0	0	1	0	0	2	0	0	9	0	0	8	6	0	28	10	0	13	4	0	17	62	21	0	88
November	10	2	0	3	0	0	3	0	0	4	0	0	3	2	0	8	3	0	27	5	0	16	9	0	8	71	21	0	119
December	13	4	0	21	12	0	3	4	0	7	0	0	4	0	0	2	1	0	3	4	0	12	4	0	13	61	26	0	119

0°-5° N., 75°-80° E.

January	19	13	0	14	21	0	4	4	0	8	5	0	1	0	0	7	0	0	3	3	0	6	4	0	6	49	45	0	196
February	14	11	0	19	19	0	7	5	0	3	9	0	5	0	0	1	0	0	3	6	0	11	1	0	5	57	38	0	177
March ..	11	2	0	11	6	0	6	4	0	6	1	0	3	0	0	5	2	0	9	3	0	15	5	0	10	68	22	0	208
April ..	5	1	0	2	0	0	4	0	0	4	7	0	7	2	0	13	6	0	20	9	0	16	6	0	5	71	24	0	229
May ..	2	7	0	3	0	0	1	0	0	8	1	0	10	2	0	18	23	0	11	23	0	3	5	0	2	45	53	0	374
June ..	0	2	0	0	0	0	2	0	0	5	2	0	12	3	0	22	17	0	14	19	0	2	7	0	2	51	47	0	645
July ..	0	1	0	0	0	0	4	0	0	9	0	0	2	4	0	23	11	0	13	25	1	7	11	2	4	48	48	3	364
August ..	8	0	0	5	0	0	6	0	0	7	0	0	5	2	0	12	17	3	16	28	4	5	8	0	3	42	55	7	291
September	1	2	0	2	0	0	9	0	0	1	0	0	5	1	0	15	10	0	13	32	0	9	9	0	3	46	51	0	376
October..	7	4	0	0	0	0	7	0	0	0	0	0	7	3	0	14	20	0	9	31	0	7	11	0	4	33	63	0	145
November	5	6	0	7	4	0	5	3	0	5	4	0	2	1	0	5	7	0	8	15	0	12	14	0	5	50	45	0	262
December	14	3	0	21	8	0	8	8	0	5	2	0	8	3	0	7	0	0	4	1	0	8	4	0	7	75	18	0	182

Authorities.—Bibliography Nos. 2, 61.

Table II—Wind direction and force at sea

5 93

TABLE IV—MONTHLY FREQUENCY OF WIND DIRECTION AND SPEED IN THE UPPER AIR AND OF CLOUD MOTION

Number of occasions per 100 on which particular winds may be expected
 I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Bombay. 18° 54' N., 72° 49' E. 128 ft.

Time of observation : morning.

Period* : May, 1933-December, 1937.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV						
JANUARY																																						
Surface ..	4	0	0	0	65	0	0	0	10	.9	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	14	114
1,800 ..	21	16	9	0	32	4	0	0	9	3	0	0	6	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	4	0	0	0	4	0	0	0	0	114
3,300 ..	18	4	0	0	13	.9	0	0	7	2	0	0	9	.9	0	0	5	0	0	0	4	0	0	0	12	0	0	0	18	.9	0	0	6	114				
6,500 ..	4	2	0	0	4	0	0	0	3	.9	0	0	6	0	0	0	21	14	0	0	11	6	2	0	7	4	.9	0	7	3	0	0	4	114				
10,000 ..	3	2	0	0	0	.9	0	0	.9	2	0	0	2	.9	0	0	3	6	.9	0	8	7	4	0	10	24	2	0	15	8	0	0	0	107				
Low cloud ..		2				6				6				4				17				45				14				5			0	55				
Medium cloud		0				0				2				9				13				48				23				1			4	55				
High cloud ..		0				0				1				6				7				42				37				6			0	219				
FEBRUARY																																						
Surface ..	3	0	0	0	47	1	0	0	14	0	0	0	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	26	99				
1,800 ..	31	13	0	0	17	5	0	0	10	4	0	0	1	0	0	0	1	0	0	0	2	1	0	0	4	0	0	0	12	0	0	0	0	101				
3,300 ..	19	5	0	0	16	0	0	0	11	1	0	0	3	2	0	0	3	0	0	0	4	1	0	0	9	0	0	0	21	5	0	0	0	100				
6,500 ..	10	0	0	0	3	0	0	0	4	0	0	0	4	1	0	0	15	12	0	0	13	8	1	0	9	6	0	0	6	3	0	0	4	99				
10,000 ..	6	4	0	0	2	3	0	0	1	0	0	0	4	2	0	0	6	7	0	0	13	14	1	0	12	13	2	0	4	1	0	0	4	95				
Low cloud ..		5				4				8				9				20				19				22				13			0	66				
Medium cloud		4				5				0				0				30				44				16				0			0	28				
High cloud ..		3				0				2				8				5				33				32				17			0	90				
MARCH																																						
Surface ..	11	0	0	0	30	0	0	0	4	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	42	114				
1,800 ..	28	26	0	0	12	8	0	0	9	8	0	0	.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	.9	0	0	0	116				
3,300 ..	20	20	.9	0	16	15	.9	0	4	4	.9	0	2	.9	0	0	0	0	0	0	.9	0	0	0	3	0	0	0	9	3	0	0	0	116				
6,500 ..	8	0	0	0	8	2	0	0	12	.9	0	0	8	2	0	0	4	5	0	0	10	5	.9	0	14	6	0	0	7	4	0	0	2	113				
10,000 ..	5	0	0	0	3	1	0	0	1	0	0	0	7	1	0	0	7	14	0	0	27	14	0	0	9	9	2	0	10	6	1	0	3	98				
Low cloud ..		20				1				6				13				18				12				12				17			0	101				
Medium cloud		0				0				5				8				30				32				15				9			0	44				
High cloud ..		0				0				4				8				8				28				35				17			0	66				

Note.—The approximate height of the clouds is as follows:—Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft.
 No information of the rate of motion of clouds is available.

* Period for cloud motion : 1926-35.

Table IV—Wind direction and speed in the upper air

5
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TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected
 I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Bombay—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV						
APRIL																																		
Surface ..	4	0	0	0	18	0	0	0	3	0	0	0	13	0	0	0	4	0	0	0	10	0	0	0	0	0	0	0	6	0	0	0	44	110
1,800 ..	28	14	0	0	6	3	0	0	3	0	0	0	2	0	0	0	15	0	0	0	6	0	0	0	5	0	0	0	10	9	0	0	6	110
3,300 ..	31	27	9	0	7	2	0	0	3	0	0	0	9	0	0	0	0	0	0	0	9	0	0	0	8	0	0	0	17	3	0	0	0	111
6,500 ..	6	14	0	0	12	6	0	0	2	0	0	0	0	0	0	0	3	0	0	0	4	4	0	0	13	7	0	0	17	12	0	0	0	108
10,000 ..	3	1	0	0	6	2	0	0	8	0	0	0	10	0	0	0	10	9	0	0	15	8	0	0	12	7	1	0	2	4	0	0	0	98
Low cloud ..	13				4				4				6				11				23				20				19				0	272
Medium cloud ..	1				4				3				10				8				36				31				9				0	58
High cloud ..	3				4				2				4				7				38				33				9				0	75
MAY																																		
Surface ..	2	0	0	0	7	0	0	0	0	0	0	0	9	9	0	0	2	0	0	0	17	0	0	0	3	0	0	0	20	0	0	0	39	114
1,800 ..	17	4	0	0	3	0	0	0	2	9	0	0	9	9	0	0	6	9	0	0	18	9	0	0	17	0	0	0	27	9	0	0	9	115
3,300 ..	9	18	0	0	3	0	0	0	2	0	0	0	9	0	9	0	0	0	0	0	8	3	0	0	17	2	0	0	26	13	0	0	0	114
6,500 ..	15	12	0	0	3	1	0	0	6	1	0	0	0	0	0	0	1	0	0	0	5	2	0	0	9	9	0	0	20	18	0	0	0	102
10,000 ..	5	0	0	0	5	0	0	0	5	3	0	0	16	0	0	0	1	4	0	0	16	7	0	0	15	10	0	0	8	0	0	0	3	73
Low cloud ..	11				2				5				1				6				13				30				29				0	465
Medium cloud ..	15				3				10				11				31				23				3				3				0	38
High cloud ..	5				6				7				27				9				7				20				18				0	78
JUNE																																		
Surface ..	8	0	0	0	2	0	0	0	8	0	0	0	13	0	0	0	6	3	0	0	40	3	0	0	13	0	0	0	10	8	0	0	8	119
1,800 ..	2	0	0	0	2	0	0	0	8	0	0	0	2	0	0	0	7	5	2	0	19	19	8	0	18	12	2	0	6	8	0	0	2	121
3,300 ..	0	0	0	0	3	0	0	0	2	0	0	0	1	0	0	0	2	1	0	0	23	11	1	0	21	16	3	0	12	3	0	0	1	100
6,500 ..	1	0	0	0	1	0	0	0	6	4	0	0	1	1	0	0	7	3	0	0	8	10	1	0	21	11	0	0	19	4	0	0	0	72
10,000 ..	2	0	0	0	2	2	0	0	7	7	5	0	5	7	0	0	2	2	2	0	11	0	0	0	11	14	0	0	7	7	0	0	7	44
Low cloud ..	1				1				1				3				11				41				33				8				0	624
Medium cloud ..	11				15				18				15				8				14				10				7				1	90
High cloud ..	5				11				23				32				3				13				8				3				0	72

Note.—The approximate height of the clouds is as follows :—Low cloud, 6,500 ft. ; Medium cloud, 16,000 ft. ; High cloud, 33,000 ft.
 No information of the rate of motion of clouds is available.

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected

I = 3-13 knots
(4-15 m.p.h.)

II = 14-27 knots
(16-31 m.p.h.)

III = 28-40 knots
(32-47 m.p.h.)

IV = over 40 knots
(over 47 m.p.h.)

C = less than 3 knots
(less than 4 m.p.h.)

Bombay—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
JULY																																		
Surface ..	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	·7	0	0	0	34	15	0	0	15	8	0	0	15	4	0	0	4	142
1,800 ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	·8	0	0	0	5	22	6	·8	6	46	10	0	2	·8	0	0	0	129
3,300 ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	14	3	0	8	57	13	1	3	0	0	0	0	77
6,500 ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	11	0	0	11	64	4	0	0	0	0	0	0	28
10,000 ..	Insufficient observations																																	
Low cloud ..	0				0				0				0				2				41				55				0				0	787
Medium cloud ..	1				9				16				6				6				32				23				7				0	67
High cloud ..	13				33				30				4				1				0				16				2				0	30
AUGUST																																		
Surface ..	0	0	0	0	2	0	0	0	·7	0	0	0	1	0	0	0	·7	0	0	0	40	4	0	0	21	4	0	0	18	4	0	0	3	136
1,800 ..	0	·8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	·8	0	0	0	7	18	2	0	18	46	3	0	3	·8	0	0	0	130
3,300 ..	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	9	3	0	21	53	7	0	2	0	0	0	0	102
6,500 ..	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	17	7	0	0	19	50	0	0	2	0	0	0	0	42
10,000 ..	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	8	0	0	25	8	0	0	17	12
Low cloud ..	2				1				2				1				1				24				62				9				0	682
Medium cloud ..	5				8				9				3				0				34				34				7				0	73
High cloud ..	7				19				44				13				0				0				8				9				0	102
SEPTEMBER																																		
Surface ..	1	0	0	0	9	0	0	0	2	0	0	0	12	·7	0	0	11	0	0	0	20	2	0	0	9	·7	0	0	17	0	0	0	14	139
1,800 ..	15	·7	0	0	5	0	0	0	·7	0	0	0	·7	·7	0	0	4	1	0	0	9	10	0	0	23	16	0	0	10	2	0	0	1	136
3,300 ..	4	0	0	0	10	·9	0	0	9	·9	0	0	3	0	0	0	·9	·9	0	0	9	6	0	0	23	22	3	0	7	·9	0	0	0	115
6,500 ..	0	0	0	0	3	0	2	0	14	12	0	0	12	2	0	0	3	0	0	0	11	0	0	0	20	11	2	0	3	0	0	0	2	65
10,000 ..	0	0	0	0	13	3	0	0	19	8	0	0	8	3	0	0	0	5	0	0	8	8	0	0	16	3	0	0	5	0	0	0	0	37
Low cloud ..	7				4				3				2				4				21				41				18				0	664
Medium cloud ..	10				12				15				12				3				20				14				13				2	94
High cloud ..	8				21				30				14				9				8				8				2				0	59

Note.—The approximate height of the clouds is as follows:—Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft. No information of the rate of motion of clouds is available.

Table IV—Wind direction and speed in the upper air

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected
 I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Bombay—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV						
OCTOBER																																		
Surface ..	6	0	0	0	38	0	0	0	10	0	0	0	12	0	0	0	3	0	0	0	-7	0	0	0	0	0	0	0	1	0	0	0	29	140
1,800 ..	17	4	0	0	14	2	0	0	19	20	-7	0	4	-7	0	0	3	-7	0	0	1	0	0	0	1	0	0	0	9	0	0	0	2	139
3,300 ..	12	1	0	0	25	9	0	0	16	26	0	0	1	1	0	0	-7	0	0	0	-7	0	0	0	1	0	0	0	3	-7	0	0	0	140
6,500 ..	5	2	-8	0	23	10	0	0	23	14	0	0	10	2	0	0	4	0	0	0	2	0	0	0	2	-8	0	0	2	0	0	0	0	131
10,000 ..	5	0	-9	0	12	9	-9	0	16	7	0	0	9	-9	0	0	12	3	0	0	5	-9	0	0	7	0	0	0	5	-9	0	0	5	114
Low cloud ..		15				8				15				13				7				10				12				19			0	460
Medium cloud ..		5				16				15				21				12				12				8				9			2	131
High cloud ..		6				12				17				24				11				16				11				2			1	176
NOVEMBER																																		
Surface ..	-7	0	0	0	50	0	0	0	13	0	0	0	15	-7	0	0	-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	143
1,800 ..	9	1	0	0	19	-7	0	0	33	25	-7	0	6	1	-7	0	-7	-7	0	0	-7	0	0	0	0	0	0	0	-7	0	0	0	1	138
3,300 ..	7	0	0	0	21	1	0	0	37	13	0	0	10	5	0	0	-7	2	-7	0	-7	0	0	0	0	0	0	0	0	0	0	0	-7	138
6,500 ..	8	2	0	0	18	2	0	0	25	-8	0	0	19	2	-8	0	11	2	0	0	2	0	0	0	2	0	0	0	-8	0	0	0	5	130
10,000 ..	14	2	0	0	22	3	-8	0	13	2	0	0	6	2	0	0	7	2	0	0	9	-8	0	0	7	-8	0	0	4	0	0	0	6	124
Low cloud ..		6				23				16				7				22				17				4				6			0	174
Medium cloud ..		2				2				4				22				22				29				19				0			2	69
High cloud ..		2				1				3				16				14				45				11				3			5	215
DECEMBER																																		
Surface ..	2	0	0	0	57	0	0	0	17	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-7	0	0	0	21	149
1,800 ..	21	2	0	0	24	1	0	0	17	16	1	0	7	5	0	0	0	-7	0	0	0	0	0	0	0	0	0	0	2	0	0	0	-7	149
3,300 ..	9	0	0	0	16	-7	0	0	26	3	0	0	15	4	0	0	5	-7	0	0	3	0	0	0	7	0	0	0	5	0	0	0	5	149
6,500 ..	6	0	0	0	5	2	-7	0	10	0	0	0	18	1	0	0	18	7	0	0	14	3	0	0	6	-7	0	0	3	0	0	0	4	148
10,000 ..	13	1	0	0	11	3	-7	0	4	1	-7	0	5	0	0	0	7	6	-7	0	13	4	0	0	10	4	0	0	12	-7	0	0	2	138
Low cloud ..		4				9				15				17				18				15				13				9			0	107
Medium cloud ..		0				0				4				16				25				40				14				2			0	57
High cloud ..		1				0				3				9				15				44				21				5			3	159

West coast of India

Authorities.—Bibliography Nos. 33, 57, 58.

Note.—The approximate height of the clouds is as follows:—Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft. No information of the rate of motion of clouds is available.

TABLE IV--continued

Number of occasions per 100 on which particular winds may be expected

I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Poona. 18° 31' N., 73° 55' E., 1,837 ft.†

Time of obsn. : not known.

Period* : May-Oct. 1915 ; 1925-9 ; Jan. 1937-May, 1938.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV						
JANUARY																																						
Surface ..	0	0	0	0	.5	0	0	0	.5	0	0	0	0	0	0	0	10	0	0	0	13	0	0	0	.5	0	0	0	0	0	0	0	0	0	0	0	76	200
3,500 ..	5	0	0	0	12	2	0	0	25	3	0	0	13	7	0	0	6	.5	0	0	5	.5	0	0	11	2	0	0	6	.5	0	0	2	2	0	0	2	199
6,500 ..	2	0	0	0	7	.5	0	0	8	2	0	0	15	2	0	0	28	7	0	0	10	7	0	0	1	2	.5	0	3	2	0	0	3	196				
10,000 ..	10	3	0	0	5	.5	0	0	2	1	.5	0	4	0	0	0	4	3	.5	0	8	9	0	0	11	11	.5	0	17	8	2	0	2	195				
Low cloud ..		0				2				3				16				13				36				21				6				0				106
Medium cloud		4				1				1				1				2				44				38				8				0				52
High cloud ..		0				0				0				0				0				46				50				2				0				196
FEBRUARY																																						
Surface ..	0	0	0	0	1	0	0	0	1	0	0	0	.5	0	0	0	14	0	0	0	15	0	0	0	2	0	0	0	1	0	0	0	66	186				
3,500 ..	9	.5	0	0	15	1	0	0	24	5	0	0	12	1	0	0	3	0	0	0	3	.5	0	0	11	7	0	0	6	1	0	0	2	186				
6,500 ..	4	.5	0	0	6	.5	0	0	9	1	0	0	11	3	0	0	15	8	0	0	13	12	.5	0	5	6	0	0	2	.5	0	0	2	185				
10,000 ..	7	4	0	0	4	2	0	0	.6	0	0	0	3	.6	0	0	11	9	.6	0	13	11	2	.6	8	10	.6	0	9	3	0	0	1	181				
Low cloud ..		1				1				2				6				28				36				20				5				0				75
Medium cloud		0				0				0				4				7				39				36				15				0				38
High cloud ..		1				0				0				0				7				22				50				26				0				67
MARCH																																						
Surface ..	0	0	0	0	0	0	0	0	.5	0	0	0	.5	0	0	0	7	0	0	0	21	0	0	0	2	0	0	0	2	0	0	0	68	207				
3,500 ..	23	0	0	0	28	3	0	0	8	1	0	0	5	.5	0	0	4	.5	0	0	.5	0	0	0	4	2	0	0	15	5	0	0	1	208				
6,500 ..	8	1	0	0	14	4	0	0	10	1	0	0	9	2	0	0	5	1	.5	0	11	5	0	0	11	6	0	0	7	1	0	0	2	208				
10,000 ..	2	.5	0	0	7	1	0	0	13	.5	0	0	10	1	0	0	15	8	.5	0	15	10	.5	0	5	3	.5	0	4	0	0	0	3	202				
Low cloud ..		3				11				8				11				25				25				15				4				0				93
Medium cloud		0				1				7				2				12				49				20				9				0				58
High cloud ..		0				0				0				0				0				47				41				12				0				69

Note.—The approximate height of the clouds is as follows :—Low cloud, 6,500 ft. ; Medium cloud, 16,000 ft. ; High cloud, 33,000 ft. No information of the rate of motion of clouds is available.

† From Jan. 1937, 18° 32' N., 73° 51' E., 1,932 ft. * Period for cloud motion : 1926-35. Period for surface winds : 1925-9 ; Jan. 1937-May, 1938.

Table IV—Wind direction and speed in the upper air

5
99

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected
 I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Poona—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
APRIL																																	62	205
Surface ..	.5	0	0	0	0	0	0	0	.5	0	0	0	0	0	0	0	3	0	0	0	24	0	0	0	4	0	0	0	5	0	0	0	62	205
3,500 ..	23	6	0	0	12	1	0	0	4	.5	0	0	4	0	0	0	2	0	0	0	.5	.5	0	0	6	4	0	0	17	18	0	0	1	203
6,500 ..	12	3	0	0	11	11	0	0	7	2	0	0	6	.5	0	0	4	1	0	0	3	4	.5	0	9	8	2	0	12	2	0	0	.5	204
10,000 ..	9	.5	.5	0	12	3	0	.5	14	5	0	0	8	3	.5	0	8	9	2	0	6	9	.5	0	3	.5	0	0	2	2	0	0	.5	203
Low cloud ..		3				14				12				10				15				18				19				9			1	154
Medium cloud		3				4				11				16				16				35				12				4			0	101
High cloud ..		0				1				0				2				7				26				50				14			0	56
MAY																																	36	211
Surface ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	36	0	0	0	21	0	0	0	5	0	0	0	36	211
3,500 ..	9	3	0	0	2	0	0	0	1	0	0	0	.5	0	0	0	0	0	0	0	1	1	0	0	12	26	.5	0	14	29	0	0	1	213
6,500 ..	13	9	0	0	8	5	0	0	2	0	0	0	3	0	0	0	5	2	0	0	4	1	0	0	13	7	.5	0	12	14	.5	0	.5	211
10,000 ..	5	.5	0	0	4	2	1	0	9	3	0	0	10	3	0	0	9	6	0	0	18	5	1	0	7	5	0	0	6	1	0	0	3	204
Low cloud ..		6				11				6				10				10				10				29				18			0	148
Medium cloud		4				6				16				27				15				18				8				1			7	64
High cloud ..		0				3				16				18				18				28				12				4			1	90
JUNE																																	25	157
Surface ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	2	0	0	25	3	0	0	4	0	0	0	25	157
3,500 ..	1	0	0	0	.6	0	0	0	.6	0	0	0	0	0	0	0	1	0	0	0	6	10	3	0	17	42	5	0	11	3	0	0	.6	177
6,500 ..	11	0	0	0	6	2	0	0	5	2	0	0	8	.8	0	0	2	.8	0	0	3	2	.8	0	10	14	7	.8	18	4	0	0	4	132
10,000 ..	5	2	0	0	7	3	0	0	12	6	0	0	12	5	0	0	12	0	0	0	12	0	0	0	6	1	2	0	10	0	1	0	5	104
Low cloud ..		1				2				4				3				3				23				55				10			0	527
Medium cloud		4				14				25				20				7				8				13				6			3	149
High cloud ..		3				18				43				25				1				4				1				2			1	120

West coast of India

Notes.—The approximate height of the clouds is as follows:—Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft.
 No information of the rate of motion of clouds is available.

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected

I = 3-13 knots
(4-15 m.p.h.)

II = 14-27 knots
(16-31 m.p.h.)

III = 28-40 knots
(32-47 m.p.h.)

IV = over 40 knots
(over 47 m.p.h.)

C = less than 3 knots
(less than 4 m.p.h.)

Poona—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
JULY																																		
Surface ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.6	0	0	0	35	4	0	0	34	5	0	0	5	0	0	0	16	168
3,500 ..	.6	0	0	0	0	0	0	0	.6	0	0	0	0	0	0	0	0	0	0	0	4	11	1	0	5	58	20	0	0	0	0	0	0	173
6,500 ..	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	4	4	0	0	7	35	37	7	0	0	0	0	0	46
10,000 ..	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	12	0	0	0	25	6	0	0	19	25	0	0	0	0	0	0	0	16
Low cloud ..		0				0				0				0				0				15				82				2			0	776
Medium cloud ..		8				19				21				7				4				11				9				18			2	130
High cloud ..		2				16				68				12				1				0				0				0			1	60
AUGUST																																		
Surface ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	.6	0	0	26	.6	0	0	8	0	0	0	17	160
3,500 ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.6	5	.6	0	11	71	11	0	.6	.6	0	0	0	177
6,500 ..	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	0	5	54	23	3	7	0	0	0	0	61
10,000 ..	6	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6	0	0	0	11	6	0	0	28	0	0	0	11	17	0	0	11	18
Low cloud ..		0				1				1				1				1				9				84				3			0	663
Medium cloud ..		7				29				17				5				1				4				15				20			0	128
High cloud ..		1				13				67				11				1				1				6				0			0	91
SEPTEMBER																																		
Surface ..	0	0	0	0	.7	0	0	0	0	0	0	0	0	0	0	0	.7	0	0	0	32	.7	0	0	10	0	0	0	6	0	0	0	50	145
3,500 ..	6	0	0	0	11	1	0	0	7	0	0	0	2	1	0	0	2	0	0	0	2	4	0	0	19	26	.6	0	13	2	0	0	3	164
6,500 ..	6	0	0	0	9	3	0	0	13	8	.8	0	5	3	0	0	9	0	0	0	5	.8	0	0	8	15	2	0	4	3	0	0	5	133
10,000 ..	6	1	0	0	10	2	0	0	18	2	0	0	11	2	0	0	9	1	0	0	10	2	0	0	11	1	0	0	4	3	0	0	8	101
Low cloud ..		3				5				7				4				4				12				53				13			1	550
Medium cloud ..		8				20				24				11				7				9				8				12			3	174
High cloud ..		2				19				54				21				1				1				2				0			0	154

Note.—The approximate height of the clouds is as follows:—Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft. No information of the rate of motion of clouds is available.

Table IV—Wind direction and speed in the upper air 5 101

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected

I = 3-13 knots
(4-15 m.p.h.)

II = 14-27 knots
(16-31 m.p.h.)

III = 28-40 knots
(32-47 m.p.h.)

IV = over 40 knots
(over 47 m.p.h.)

C = less than 3 knots
(less than 4 m.p.h.)

Poona—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
OCTOBER																																	67	151
Surface ..	1	0	0	0	1	0	0	0	.7	0	0	0	.7	0	0	0	1	0	0	0	24	0	0	0	.7	0	0	0	3	0	0	0	67	151
3,500 ..	9	0	0	0	19	4	0	0	21	7	0	0	10	7	0	0	2	0	0	0	2	-6	0	0	4	2	0	0	12	0	0	0	0	169
6,500 ..	6	1	0	0	18	9	0	0	23	15	.6	0	12	2	0	0	2	0	0	0	2	0	0	0	4	-6	0	0	.6	0	0	0	4	163
10,000 ..	7	-7	0	0	18	9	1	0	11	5	.7	0	5	.7	0	0	7	-7	0	0	10	0	0	0	7	0	0	0	10	2	0	0	6	152
Low cloud ..		5				16				30				19				4				8				8				10			1	431
Medium cloud ..		6				14				19				18				11				11				3				9			8	187
High cloud ..		2				7				13				17				17				29				11				3			1	174
NOVEMBER																																	77	141
Surface ..	.7	0	0	0	6	0	0	0	1	0	0	0	.7	0	0	0	4	0	0	0	10	0	0	0	.7	0	0	0	0	0	0	0	77	141
3,500 ..	2	0	0	0	1	.7	0	0	27	11	0	0	24	28	0	0	4	0	0	0	4	0	0	0	-7	0	0	0	1	0	0	0	.7	147
6,500 ..	2	0	0	0	4	4	0	0	41	17	0	0	10	2	.7	0	8	-7	0	0	6	0	0	0	0	0	0	0	2	0	0	0	3	145
10,000 ..	10	3	0	0	21	4	.7	0	10	2	0	0	8	0	0	0	7	0	0	0	4	4	.7	0	11	1	0	0	8	1	0	0	4	143
Low cloud ..		8				11				28				18				12				15				6				2			1	166
Medium cloud ..		1				10				10				18				24				23				11				4			0	65
High cloud ..		1				0				0				3				18				51				24				3			0	173
DECEMBER																																	79	161
Surface ..	2	0	0	0	6	0	0	0	3	0	0	0	1	0	0	0	4	0	0	0	4	0	0	0	-6	0	0	0	0	0	0	0	79	161
3,500 ..	1	0	0	0	3	0	0	0	29	11	0	0	27	12	0	0	4	0	0	0	2	1	0	0	3	0	0	0	1	0	0	0	6	161
6,500 ..	1	-6	0	0	13	-6	0	0	14	4	0	0	18	1	0	0	21	4	0	0	11	3	0	0	4	0	0	0	1	0	0	0	2	159
10,000 ..	9	3	0	0	8	1	0	0	11	1	0	0	6	0	0	0	4	3	0	0	8	13	0	0	10	6	0	0	12	1	0	0	3	151
Low cloud ..		1				4				18				16				21				23				17				2			0	159
Medium cloud ..		0				0				4				3				22				45				26				1			0	37
High cloud ..		0				0				0				0				8				44				43				3			3	142

Authorities.—Bibliography Nos. 28, 33, 57.

Note.—The approximate height of the clouds is as follows :—Low cloud, 6,500 ft. ; Medium cloud, 16,000 ft. ; High cloud, 33,000 ft.
No information of the rate of motion of clouds is available.

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected

I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Mangalore. 12° 52' N.; 74° 51' E., 131 ft. Time of observation: morning Period*: June 1928—Dec. 1937

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV						
JANUARY																																						
Surface ..	.8	0	0	0	21	0	0	0	52	.4	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.4	0	0	0	23	262
1,800 ..	25	1	0	0	7	.4	0	0	16	27	2	0	7	2	0	0	.4	0	0	0	.8	0	0	0	0	0	0	0	7	0	0	0	4	0	0	0	4	262
3,300 ..	5	.8	0	0	13	.4	0	0	28	13	2	0	20	2	0	0	2	0	0	0	2	0	0	0	4	0	0	0	5	.4	0	0	3	0	0	0	3	262
6,500 ..	2	0	0	0	17	5	0	0	25	12	.4	0	15	3	0	0	8	1	0	0	4	.4	0	0	.4	0	0	0	3	0	0	0	3	0	0	0	3	262
10,000 ..	3	0	0	0	14	8	0	0	19	11	.4	0	11	3	0	0	6	.4	0	0	7	2	0	0	3	.8	0	0	5	0	0	0	6	0	0	0	6	247
Low cloud ..		2				17				29				13				0				11				15				13				0			0	45
Medium cloud ..		3				5				25				26				8				22				9				1				0			0	55
High cloud ..		0				3				7				10				9				23				37				10				0			0	118
FEBRUARY																																						
Surface ..	2	0	0	0	34	0	0	0	29	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	226
1,800 ..	34	5	0	0	4	0	0	0	13	3	0	0	4	.4	0	0	4	0	0	0	0	0	0	0	2	0	0	0	24	2	0	0	6	0	0	0	6	225
3,300 ..	18	2	0	0	6	.9	0	0	12	5	0	0	10	2	0	0	3	0	0	0	6	0	0	0	13	0	0	0	18	.4	0	0	4	0	0	0	4	225
6,500 ..	2	0	0	0	14	5	0	0	24	6	1	0	16	.9	0	0	14	4	0	0	3	.9	.5	0	2	.5	0	0	2	0	0	0	3	0	0	0	3	212
10,000 ..	5	.5	0	0	12	8	.5	0	12	9	.5	0	8	0	0	0	8	2	0	0	10	3	.5	0	10	2	0	0	5	.5	0	0	3	0	0	0	3	183
Low cloud ..		8				9				7				10				6				10				23				27				0			0	62
Medium cloud ..		2				4				4				39				31				6				9				4				0			0	32
High cloud ..		0				0				9				16				18				23				23				11			1	48				
MARCH																																						
Surface ..	2	0	0	0	17	0	0	0	26	0	0	0	.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.4	0	0	0	55	254				
1,800 ..	25	.8	0	0	6	0	0	0	9	2	0	0	6	0	0	0	7	0	0	0	2	0	0	0	2	0	0	0	18	.4	0	0	22	0	0	0	22	249
3,300 ..	21	2	0	0	7	.8	0	0	13	5	0	0	7	2	0	0	7	0	0	0	5	0	0	0	7	0	0	0	11	.4	0	0	11	0	0	0	11	253
6,500 ..	7	3	0	0	23	5	0	0	25	12	.4	0	10	3	0	0	3	.4	0	0	.8	0	0	0	2	0	0	0	1	0	0	0	4	0	0	0	4	240
10,000 ..	4	1	0	0	20	15	.5	0	29	16	.5	0	5	1	0	0	2	.5	0	0	.5	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0	2	210
Low cloud ..		15				12				10				6				9				13				10				24				0			0	137
Medium cloud ..		1				29				21				26				4				13				2				4				0			0	46
High cloud ..		11				6				10				26				22				23				3				1				0			0	57

Note.—The approximate height of the clouds is as follows: Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft.
No information of the rate of motion of clouds is available.

* Period for cloud motion: 1929-35.

Table IV—Wind direction and speed in the upper air 5 103

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected
 I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Mangalore—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV						
APRIL																																						
Surface ..	1	0	0	0	17	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	225
1,800 ..	23	-5	0	0	2	0	0	0	-9	0	0	0	3	0	0	0	5	-5	0	0	5	0	0	0	12	0	0	0	35	-9	0	0	14	222				
3,300 ..	21	5	0	0	5	0	0	0	3	0	0	0	3	0	0	0	7	0	0	0	10	0	0	0	10	-5	0	0	26	2	0	0	10	219				
6,500 ..	14	4	0	0	22	5	0	0	20	2	0	0	10	0	0	0	4	-5	0	0	4	-5	0	0	2	0	0	0	7	2	0	0	4	200				
10,000 ..	3	-6	0	0	21	16	-6	0	23	20	0	0	7	0	0	0	3	0	0	0	2	0	0	0	0	-6	0	0	1	0	-6	0	-6	159				
Low cloud ..		11				9				4				2				4				10				23				38			0	251				
Medium cloud ..		4				36				30				10				3				7				2				6			2	94				
High cloud ..		6				9				14				13				15				28				10				4			0	85				
MAY																																						
Surface ..	4	0	0	0	7	0	0	0	19	0	0	0	2	0	0	0	1	0	0	0	-5	-5	0	0	1	0	0	0	8	0	-5	0	56	211				
1,800 ..	8	2	0	0	2	0	0	0	-5	0	0	0	-5	-5	0	0	2	2	0	0	3	0	0	0	11	2	0	0	49	2	2	0	14	202				
3,300 ..	6	2	0	0	2	0	0	0	1	0	0	0	1	-5	0	0	4	0	0	0	7	-5	0	0	21	-5	0	0	39	8	1	0	6	189				
6,500 ..	16	12	0	0	19	2	0	0	12	0	0	0	6	1	0	0	1	0	0	0	5	-6	0	0	6	1	0	0	12	3	0	0	3	154				
10,000 ..	6	4	0	0	28	7	-9	0	22	19	-9	0	4	2	0	0	-9	-9	0	0	-9	0	0	0	4	0	0	0	-9	0	0	0	0	114				
Low cloud ..		6				4				3				1				4				6				24				52			0	7				
Medium cloud ..		6				28				39				12				3				6				3				4			0	95				
High cloud ..		2				16				44				11				12				11				3				1			1	6				
JUNE																																						
Surface ..	3	0	0	0	7	0	0	0	26	0	0	0	6	-5	0	0	1	0	0	0	16	-5	-5	0	9	0	0	0	1	0	0	0	31	210				
1,800 ..	3	0	0	0	0	0	0	0	-5	0	0	0	-5	0	0	0	7	2	-5	0	11	11	0	0	19	21	2	-5	13	5	0	0	4	193				
3,300 ..	-7	-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-7	-7	0	0	11	3	2	0	12	36	8	-7	9	14	-7	0	-7	146				
6,500 ..	6	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	11	4	0	0	13	37	3	0	8	6	4	0	1	71				
10,000 ..	5	0	0	0	10	0	0	0	3	3	0	0	15	7	0	0	7	0	0	0	5	3	0	0	7	20	3	0	3	10	0	0	0	40				
Low cloud ..		1				1				0				1				3				14				50				28			3	298				
Medium cloud ..		0				22				16				15				15				6				11				7			9	62				
High cloud ..		5				23				38				11				3				9				7				1			3	38				

Note.—The approximate height of the clouds is as follows : Low cloud, 6,500 ft. ; Medium cloud, 16,000 ft. ; High cloud, 33,000 ft. No information of the rate of motion of clouds is available.

TABLE IV—continued

I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Mangalore—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV					
JULY																																					
Surface ..	1	0	0	0	2	0	0	0	9	0	0	0	2	0	0	0	2	0	0	0	22	2	0	0	20	8	0	0	11	0	0	0	28				256
1,800 ..	9	4	0	0	4	0	0	0	0	0	0	0	4	0	0	0	9	0	0	0	4	5	4	0	13	57	6	0	6	4	9	0	0				225
3,300 ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0	0	3	48	26	2	6	12	2	0	0				155
6,500 ..	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	43	14	0	5	19	7	0	0				42
10,000 ..	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	13	44	13	0	6	13	0	0	0				16
Low cloud ..		0				0				0				0				0				5				70				24			0				415
Medium cloud ..		5				6				11				16				4				6				23				17			14				51
High cloud ..		0				20				69				13				0				0				0				0			0				20
AUGUST																																					
Surface ..	4	0	0	0	5	0	0	0	4	0	0	0	2	0	0	0	2	0	0	0	7	8	0	0	17	8	0	0	13	4	0	0	45				256
1,800 ..	9	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4	8	0	0	8	8	0	0	11	38	5	4	16	11	0	0	3				244
3,300 ..	6	1	0	0	0	0	0	0	5	0	0	0	1	0	0	0	0	5	0	0	0	0	0	0	6	33	12	5	15	25	0	0	0				183
6,500 ..	6	0	0	0	4	0	0	0	1	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	13	30	4	0	20	17	0	0	1				79
10,000 ..	14	0	0	0	14	0	0	0	6	8	0	0	0	0	0	0	6	0	0	0	3	0	0	0	6	8	0	0	25	6	0	0	6				36
Low cloud ..		5				1				1				0				0				0				47				43			0				324
Medium cloud ..		2				8				24				8				0				4				22				20			13				79
High cloud ..		5				8				67				15				0				0				4				0			0				63
SEPTEMBER																																					
Surface ..	3	0	0	0	7	0	0	0	15	0	0	0	6	0	0	0	4	0	0	0	9	0	0	0	3	0	0	0	2	0	0	0	50				228
1,800 ..	13	3	0	0	2	0	0	0	8	0	0	0	2	4	0	0	4	4	0	0	5	2	0	0	16	15	4	0	27	7	0	0	3				238
3,300 ..	6	1	0	0	1	0	0	0	5	0	0	0	1	0	0	0	2	0	5	0	3	9	0	0	15	19	3	0	27	19	5	0	1				217
6,500 ..	2	0	0	0	6	0	0	0	10	1	0	0	3	7	0	0	1	7	0	0	8	7	0	0	16	19	3	0	8	17	0	0	4				145
10,000 ..	3	0	0	0	9	1	0	0	20	5	0	0	4	0	0	0	7	0	0	0	7	5	0	0	5	9	3	0	12	3	0	0	8				76
Low cloud ..		4				1				3				1				4				13				29				40			3				328
Medium cloud ..		10				5				43				18				0				0				12				12			0				86
High cloud ..		0				26				61				9				0				1				2				0			1				95

Note.—The approximate height of the clouds is as follows:—Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft. No information of the rate of motion of clouds is available.

Table IV—Wind direction and speed in the upper air 5 105

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected

I = 3-13 knots
(4-15 m.p.h.)II = 14-27 knots
(16-31 m.p.h.)III = 28-40 knots
(32-47 m.p.h.)IV = over 40 knots
(over 47 m.p.h.)C = less than 3 knots
(less than 4 m.p.h.)

Mangalore—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.	
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV							
OCTOBER																																			
Surface ..	2	0	0	0	9	0	0	0	30	0	0	0	8	0	0	0	.8	0	0	0	2	0	0	0	.8	0	0	0	2	.4	0	0	46	254	
1,800 ..	23	2	0	0	9	0	0	0	8	2	0	0	6	0	1	0	8	2	1	0	6	.8	0	0	6	0	0	0	16	1	0	0	8	247	
3,300 ..	15	.4	0	0	12	.9	0	0	13	9	0	0	4	1	0	0	3	1	.4	0	5	3	0	0	6	3	0	0	13	.4	0	0	9	234	
6,500 ..	5	2	0	0	10	7	0	0	30	18	0	0	8	0	0	0	4	.5	.5	0	1	1	0	0	5	3	0	0	3	0	0	0	1	202	
10,000 ..	3	0	0	0	12	7	0	0	27	15	1	0	10	1	0	0	5	0	0	0	3	0	0	0	5	1	1	0	4	.6	0	0	4	167	
Low cloud ..		9			9				6				8				10				10				21				26				0	366	
Medium cloud ..		0			17				39				22				2				6				12				1				0	133	
High cloud ..		0			10				47				25				12				4				1				1				0	150	
NOVEMBER																																			
Surface ..	1	0	0	0	15	0	0	0	48	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	261
1,800 ..	17	.8	0	0	8	.4	0	0	27	15	.4	0	9	.8	.4	0	2	2	0	0	2	0	0	0	2	0	0	0	7	0	0	0	7	258	
3,300 ..	10	0	0	0	15	2	0	0	35	15	0	0	10	1	.4	0	3	2	0	0	.4	0	0	0	2	0	0	0	1	0	0	0	3	260	
6,500 ..	10	.4	0	0	19	2	0	0	26	14	.4	0	11	4	0	0	4	.8	0	0	2	.4	0	0	.4	0	0	0	2	.4	0	0	4	248	
10,000 ..	4	.4	0	0	18	7	0	0	28	16	.4	0	9	2	0	0	5	0	0	0	2	.9	0	0	2	0	0	0	3	.4	0	0	4	227	
Low cloud ..		10			10				30				10				7				14				8				11				0	167	
Medium cloud ..		2			13				40				25				7				3				9				0				0	99	
High cloud ..		1			3				25				35				15				11				9				2				0	176	
DECEMBER																																			
Surface ..	.4	0	0	0	20	0	0	0	54	.8	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	259	
1,800 ..	15	1	0	0	7	.4	0	0	20	30	2	0	9	.8	0	0	2	.4	0	0	.4	0	0	0	.4	0	0	0	7	0	0	0	5	259	
3,300 ..	9	.8	0	0	9	.8	0	0	33	14	2	0	13	3	0	0	2	.8	0	0	.4	0	0	0	2	0	0	0	4	0	0	0	7	258	
6,500 ..	2	.4	0	0	16	3	0	0	32	12	.4	0	14	2	0	0	5	0	0	0	3	0	0	0	2	0	0	0	.8	0	0	0	6	250	
10,000 ..	5	.4	0	0	14	5	0	0	21	16	.9	0	11	2	0	0	4	0	0	0	4	.4	0	0	8	1	0	0	4	.4	0	0	2	225	
Low cloud ..		0			13				37				16				7				18				3				8				0	115	
Medium cloud ..		0			15				27				23				17				15				2				0				0	76	
High cloud ..		1			1				12				18				28				22				13				5				0	179	

Authorities.—Bibliography Nos. 33, 57, 58.

Note.—The approximate height of the clouds is as follows :—Low cloud, 6,500 ft. ; Medium cloud, 16,000 ft. ; High cloud, 33,000 ft.
No information of the rate of motion of clouds is available.

TABLE IV—continued

I = 3-13 knots (4-15 m.p.h.)
 II = 14-27 knots (16-31 m.p.h.)
 III = 28-40 knots (32-47 m.p.h.)
 IV = over 40 knots (over 47 m.p.h.)
 C = less than 3 knots (less than 4 m.p.h.)

Trivandrum. 8° 31' N., 77° 00' E., 239 ft.

Number of occasions per 100 on which particular winds may be expected

Time of observation: morning. Period*: Dec. 1928-Dec. 1937.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
JANUARY																																		
Surface ..	9	0	0	0	21	0	0	0	5	0	0	0	2	0	0	0	.8	0	0	0	2	0	0	0	2	0	0	0	3	0	0	0	56	253
2,000 ..	12	.8	0	0	21	.4	0	0	17	.4	0	0	8	.4	0	0	7	0	0	0	6	0	0	0	4	0	0	0	4	0	0	0	18	248
3,300 ..	11	0	0	0	25	2	0	0	25	2	0	0	9	0	0	0	1	0	0	0	4	0	0	0	3	.4	0	0	5	0	0	0	13	248
6,500 ..	8	0	0	0	20	3	0	0	29	5	0	0	12	0	.4	0	5	1	0	0	1	0	0	0	4	.4	0	0	5	.4	0	0	6	236
10,000 ..	4	.5	0	0	19	3	0	0	25	8	0	0	16	5	0	0	4	.5	0	0	3	0	0	0	6	0	0	0	3	1	0	0	.5	207
Low cloud ..		4				42				22				9				3				9				4				7				145
Medium cloud ..		3				35				31				13				9				7				4				1				0
High cloud ..		1				17				28				21				15				11				2				5				0
FEBRUARY																																		
Surface ..	11	0	0	0	20	0	0	0	3	0	0	0	8	0	0	0	1	0	0	0	.4	0	0	0	1	0	0	0	3	0	0	0	51	237
2,000 ..	13	.9	0	0	13	0	0	0	8	0	0	0	13	0	0	0	9	0	0	0	5	0	0	0	3	0	0	0	10	1	0	0	24	229
3,300 ..	14	.4	0	0	18	0	0	0	17	0	0	0	12	0	0	0	6	0	0	0	3	0	0	0	4	0	0	0	10	.9	0	0	16	230
6,500 ..	5	.5	0	0	24	6	0	0	26	4	0	0	12	.9	.5	0	3	0	0	0	3	.9	0	0	3	.5	0	0	5	0	0	0	6	220
10,000 ..	7	1	0	0	17	3	.5	0	29	7	1	0	9	3	0	0	5	2	0	0	3	1	0	0	3	.5	0	0	3	.5	0	0	4	202
Low cloud ..		5				35				22				5				7				13				2				11				0
Medium cloud ..		5				13				21				26				3				6				13				10				2
High cloud ..		8				3				28				32				13				6				10				0				0
MARCH																																		
Surface ..	18	0	0	0	21	0	0	0	6	0	0	0	3	0	0	0	.7	0	0	0	2	0	0	0	1	0	0	0	14	.4	0	0	33	269
2,000 ..	22	1	0	0	16	.8	0	0	7	0	0	0	5	0	0	0	6	0	0	0	5	0	0	0	2	0	0	0	18	3	0	0	14	262
3,300 ..	18	2	0	0	17	.8	0	0	12	0	0	0	8	.4	0	0	6	0	0	0	4	0	0	0	.8	0	0	0	20	.4	0	0	11	260
6,500 ..	10	2	0	0	26	8	0	0	21	5	0	0	9	.8	0	0	5	0	0	0	3	0	0	0	2	0	0	0	5	0	0	0	2	256
10,000 ..	4	0	.4	0	21	7	.4	0	26	9	2	0	13	2	0	0	6	0	0	0	3	.9	0	0	.9	.4	0	0	3	.4	0	0	.9	228
Low cloud ..		14				19				9				7				4				10				10				29				0
Medium cloud ..		0				21				29				25				5				8				10				4				0
High cloud ..		0				10				24				43				13				3				2				6				0

Note.—The approximate height of the clouds is as follows: Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft.
 No information of the rate of motion of clouds is available.

* Period for cloud motion: 1926-35.

Table IV—Wind direction and speed in the upper air 5 107

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected

I = 3-13 knots
(4-15 m.p.h.)II = 14-27 knots
(16-31 m.p.h.)III = 28-40 knots
(32-47 m.p.h.)IV = over 40 knots
(over 47 m.p.h.)C = less than 3 knots
(less than 4 m.p.h.)

Trivandrum—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV						
APRIL																																						
Surface ..	27	-8	0	0	10	0	0	0	3	0	0	0	2	0	0	0	-4	0	0	0	2	0	0	0	2	0	0	0	2	0	0	0	27	0	0	0	26	259
2,000 ..	15	3	0	0	7	0	0	0	4	-4	0	0	2	0	0	0	2	0	0	0	2	0	0	0	2	0	0	0	5	-8	0	0	41	13	0	0	5	255
3,300 ..	14	2	0	0	9	-4	0	0	3	0	0	0	6	-4	0	0	2	0	0	0	2	0	0	0	4	1	0	0	39	12	0	0	6	254				
6,500 ..	14	3	0	0	24	4	0	0	22	2	0	0	7	-4	0	0	-9	0	0	0	-9	0	0	0	3	-4	0	0	13	4	0	0	2	227				
10,000 ..	8	2	0	0	20	15	4	0	18	11	-5	0	7	3	0	0	2	0	0	0	0	0	0	0	3	2	0	0	3	2	0	0	0	185				
Low cloud ..		9				13				7				4				1				3				18				46			0	317				
Medium cloud ..		14				11				27				9				7				7				4				20			0	76				
High cloud ..		5				11				26				29				6				7				5				12			0	77				
MAY																																						
Surface ..	29	-4	0	0	2	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	7	0	0	0	45	-4	0	0	14	231				
2,000 ..	10	5	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	-9	0	0	0	6	2	-5	0	46	25	0	0	2	222				
3,300 ..	9	2	0	0	-5	0	0	0	2	0	0	0	-5	0	0	0	1	0	0	0	-9	0	-5	0	8	4	1	0	39	29	-9	0	1	220				
6,500 ..	18	7	0	0	15	4	0	0	3	1	0	0	0	0	0	0	0	-6	0	0	-6	0	0	0	4	3	1	0	29	11	2	0	1	178				
10,000 ..	12	7	0	0	19	13	2	0	5	10	-9	0	-9	-9	2	0	2	0	0	0	-9	-9	0	0	4	2	0	0	4	11	3	0	0	113				
Low cloud ..		7				3				0				0				1				3				26				59			0	293				
Medium cloud ..		13				17				10				2				1				17				23				17			0	72				
High cloud ..		6				4				20				38				1				22				9				1			0	66				
JUNE																																						
Surface ..	21	-5	0	0	1	0	0	0	0	0	0	0	-5	0	0	0	-5	0	0	0	-5	0	0	0	8	0	0	0	49	2	0	0	17	205				
2,000 ..	5	-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	-5	0	9	21	0	0	27	33	2	0	0	183				
3,300 ..	3	2	0	0	0	0	0	0	0	0	0	0	-6	0	0	0	0	0	0	0	1	-6	-6	0	3	26	9	0	20	27	7	0	0	166				
6,500 ..	5	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	13	19	0	16	20	15	3	0	105				
10,000 ..	18	8	0	0	8	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	3	8	13	5	7	12	10	0	2	60				
Low cloud ..		2				1				0				2				0				3				38				53			2	242				
Medium cloud ..		18				9				3				0				1				6				19				44			0	85				
High cloud ..		12				13				41				19				1				3				4				7			0	44				

Note.—The approximate height of the clouds is as follows: Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft.
No information of the rate of motion of clouds is available.

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected
 I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Trivandrum—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
JULY																																		
Surface ..	22	.8	0	0	.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.8	0	0	0	9	.4	0	0	53	3	.4	0	10	262
2,000 ..	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	15	1	0	17	43	9	0	0	239
3,300 ..	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.5	0	0	7	13	9	0	7	40	19	.5	0	210
6,500 ..	2	3	.8	.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	15	15	.8	.8	23	26	5	0	123
10,000 ..	2	2	2	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	25	8	0	4	23	21	2	0	48
Low cloud ..		2				0				1				0				0				1				35				61			0	363
Medium cloud ..		9				5				1				1				7				7				25				51			0	82
High cloud ..		7				9				39				17				0				3				2				23			0	49
AUGUST																																		
Surface ..	26	0	0	0	.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.4	0	0	0	9	.4	0	0	51	2	0	0	10	246
2,000 ..	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.5	0	0	0	.5	0	0	0	8	6	.5	0	22	48	.9	.5	0	221
3,300 ..	4	4	.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	7	3	0	18	49	11	0	0	200
6,500 ..	2	6	2	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	8	3	.9	7	40	22	.9	0	115
10,000 ..	1	9	3	0	5	4	0	0	3	2	1	0	1	0	0	0	0	0	0	0	0	0	1	0	3	9	1	0	9	34	10	1	1	68
Low cloud ..		5				1				0				0				1				3				20				71			0	301
Medium cloud ..		20				13				10				8				0				1				11				38			0	96
High cloud ..		11				20				40				8				0				0				0				19			0	37
SEPTEMBER																																		
Surface ..	30	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.4	0	0	0	11	.8	0	0	44	.4	0	0	10	239
2,000 ..	8	4	.4	0	.4	0	0	0	1	0	0	0	.4	0	0	0	.4	0	0	0	0	0	0	0	10	9	.4	0	27	37	2	0	0	227
3,300 ..	6	8	0	0	1	0	0	0	1	0	0	0	.5	0	0	0	0	.5	0	0	0	0	0	0	4	9	.5	0	17	49	3	0	0	211
6,500 ..	8	8	0	0	4	2	0	0	3	.7	0	0	.7	0	0	0	.7	0	0	0	0	0	0	0	5	10	.7	0	12	39	7	0	.7	153
10,000 ..	5	13	3	0	7	6	2	0	5	4	0	0	2	2	0	0	1	0	0	0	0	0	0	0	6	9	3	0	9	16	5	0	3	101
Low cloud ..		7				3				2				0				1				3				13				68			0	246
Medium cloud ..		23				8				10				4				0				2				11				43			0	86
High cloud ..		7				17				49				9				1				3				5				8			0	104

Note.—The approximate height of the clouds is as follows:—Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft.
 No information of the rate of motion of clouds is available.

Table IV—Wind direction and speed in the upper air 5 109

TABLE IV—continued

Number of occasions per 100 on which particular winds may be expected
 I = 3-13 knots (4-15 m.p.h.) II = 14-27 knots (16-31 m.p.h.) III = 28-40 knots (32-47 m.p.h.) IV = over 40 knots (over 47 m.p.h.) C = less than 3 knots (less than 4 m.p.h.)

Trivandrum—cont.

Height above M.S.L. (feet)	N.				NE.				E.				SE.				S.				SW.				W.				NW.				C.	No. of obs.
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
OCTOBER																																		
Surface ..	16	0	0	0	4	0	0	0	.9	0	0	0	.4	0	0	0	1	0	0	0	3	0	0	0	5	0	0	0	30	.4	0	0	39	228
2,000 ..	9	2	0	0	3	0	0	0	1	0	0	0	5	0	0	0	4	0	0	0	3	.5	0	0	14	4	.5	0	38	10	0	0	5	202
3,300 ..	10	3	0	0	6	.5	0	0	8	0	0	0	2	0	0	0	3	.5	0	0	3	2	0	0	11	9	1	0	26	11	.5	0	5	196
6,500 ..	9	1	.6	0	12	5	0	0	14	2	0	0	5	0	0	0	0	0	0	0	2	2	0	0	5	10	3	0	14	12	1	0	2	155
10,000 ..	6	5	0	0	17	8	0	0	11	2	1	0	3	2	0	0	2	2	0	0	6	3	0	0	6	10	2	0	9	4	0	0	3	106
Low cloud ..		8				4				6				2				3				6				31				38			0	286
Medium cloud		19				23				13				8				1				4				10				21			0	85
High cloud ..		1				21				46				20				7				0				4				0			0	87
NOVEMBER																																		
Surface ..	4	0	0	0	8	0	0	0	3	0	0	0	5	0	0	0	2	0	0	0	2	0	0	0	2	0	0	0	12	0	0	0	62	228
2,000 ..	9	.5	0	0	7	0	0	0	7	0	0	0	11	0	0	0	10	0	0	0	8	0	0	0	11	0	0	0	23	1	0	0	13	226
3,300 ..	12	0	0	0	11	.5	0	0	14	0	0	0	11	0	0	0	6	.5	0	0	9	0	0	0	12	.9	0	0	13	2	0	0	8	218
6,500 ..	10	.5	0	0	12	2	0	0	18	3	0	0	9	1	0	0	2	0	0	0	9	.5	0	0	7	4	0	0	10	4	0	0	8	187
10,000 ..	8	1	0	0	17	3	0	0	22	2	0	0	6	1	0	0	5	0	0	0	8	.7	0	0	8	3	0	0	8	3	0	0	4	143
Low cloud ..		7				16				8				8				5				18				18				21			0	298
Medium cloud		8				28				26				16				4				12				1				4			1	101
High cloud ..		6				12				29				41				6				1				3				2			0	88
DECEMBER																																		
Surface ..	5	0	0	0	19	0	0	0	2	0	0	0	2	0	0	0	1	0	0	0	2	0	0	0	.7	0	0	0	4	0	0	0	64	267
2,000 ..	8	.4	0	0	18	1	0	0	14	0	0	0	7	0	0	0	8	0	0	0	7	0	0	0	6	0	0	0	10	0	0	0	19	260
3,300 ..	10	.4	0	0	21	2	0	0	20	2	0	0	9	0	0	0	4	0	0	0	5	0	0	0	5	0	0	0	10	0	0	0	12	259
6,500 ..	8	.4	0	0	16	2	0	0	21	5	0	0	9	2	.4	0	4	.4	0	0	7	0	0	0	9	2	0	0	7	.8	0	0	4	242
10,000 ..	8	.5	0	0	13	3	.5	0	30	7	0	0	12	2	.5	0	4	2	0	0	3	.5	0	0	5	1	0	0	5	1	0	0	3	199
Low cloud ..		6				28				20				10				2				12				10				12			0	257
Medium cloud		7				33				37				9				1				6				2				4			0	79
High cloud ..		3				6				32				30				7				8				8				5			0	152

Authorities.—Bibliography Nos. 33, 57, 58.

Note.—The approximate height of the clouds is as follows:—Low cloud, 6,500 ft.; Medium cloud, 16,000 ft.; High cloud, 33,000 ft.
 No information of the rate of motion of clouds is available.

TABLE V—VISIBILITY AT COASTAL STATIONS

Percentage frequency of different degrees of visibility

0800 local time.						Period: 1933-7														
Limits of visibility Nautical miles	over					over					over					over				
	0- $\frac{1}{2}$	$\frac{1}{2}$ -2	2-5	5-10	10	0- $\frac{1}{2}$	$\frac{1}{2}$ -2	2-5	5-10	10	0- $\frac{1}{2}$	$\frac{1}{2}$ -2	2-5	5-10	10	0- $\frac{1}{2}$	$\frac{1}{2}$ -2	2-5	5-10	10
	BOMBAY					RATNÁGIRI					MORMUGÃO					MANGALORE				
January	0	3	17	48	32	0	0	0	0	100	0	0.6	0.6	13	86	0	18	51	30	1
February	0.7	6	16	40	37	0	0	0	0	100	0.7	1	3	17	78	0	21	48	31	0
March	0	2	25	59	14	0	0	0	0	100	0	0.6	5	30	64	0.6	15	53	32	0
April	0	0.7	7	62	31	0	0	0	0	100	0	0	1	15	84	0	2	28	69	0.7
May	0	0	6	57	37	0	0	0	0.6	99	0.6	0	4	14	82	0.6	6	29	63	1
June	2	6	22	49	21	0	0	7	29	64	0	1	17	20	62	7	34	14	45	0
July	0.6	5	43	51	0.6	0	0.6	6	53	40	0	1	23	20	56	8	49	28	15	0
August	0.6	6	11	68	14	0	0	5	34	61	0	0	9	14	77	3	42	29	26	0
September	0	3	5	52	40	0	0	0.7	19	80	0.7	1	5	18	75	1	20	37	42	0
October	0	0	0	12	88	0	0	0.6	10	89	0.6	1	0	9	89	2	8	27	60	3
November	0	0.7	2	5	93	0	0	0	0	100	0	0	0	0.7	99	0.7	5	27	64	3
December	0	2	3	17	78	0	0	0	0	100	0	0.6	0	4	95	0	7	54	37	2
Year	0.3	3	13	43	40	0	<.1	2	12	86	0.2	0.6	6	15	78	2	19	35	43	0.9
1630 local time.																				
January	0	0	3	21	76	Data not available					Data not available					Data not available				
February	0	0	2	13	85															
March	0	0.6	4	45	51															
April	0	0	3	43	54															
May	0	0	1	45	54															
June	2	3	24	38	33															
July	0	3	39	56	2															
August	0	3	13	60	24															
September	0.7	2	5	42	50															
October	0	0	0	5	95															
November	0	0	0.7	0.7	99															
December	0	0	0	5	95															
Year	0.2	1	8	31	60															

Authority.—Bibliography No. 58. Note.—The latitudes and longitudes are given in the general climatological tables.

Table V—Visibility at coastal stations

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TABLE V—continued
Percentage frequency of different degrees of visibility

0800 local time. Period: 1933-7

Limits of visibility Nautical miles	over					over					over					over				
	0-½	½-2	2-5	5-10	10	0-½	½-2	2-5	5-10	10	0-½	½-2	2-5	5-10	10	0-½	½-2	2-5	5-10	10
	COCHIN					TRIVANDRUM					AMINI					MINICOY				
January	0	0	0	13	87	0.6	41	54	5	0	0	0.6	7	48	45	1	19	21	41	18
February	0	0	11	21	68	0	51	44	5	0	0	0.7	4	49	46	0	4	20	61	15
March	0	0	10	32	58	0	31	64	5	0	0	0	5	56	39	0	8	21	59	12
April	0	0.7	0.7	19	79	0	13	66	21	0	0	0	6	47	47	0	11	27	51	11
May	0	1	4	29	66	4	15	57	24	0	0	4	22	54	20	1	26	36	30	7
June	0	3	13	43	41	3	34	44	16	3	0	29	41	28	2	0.7	43	39	18	0
July	0	5	15	52	28	3	34	55	8	0	0	35	40	23	2	0	43	33	24	0
August	0	2	10	52	36	0.6	28	56	15	0	0	25	43	31	1	0	28	32	34	6
September	0	2	5	33	60	0	22	45	33	0	0	20	44	29	7	0.7	21	24	39	16
October	0	0	6	23	71	0.6	28	54	17	0	0	23	36	35	6	0	30	22	30	18
November	0	0	1	9	90	2	12	66	20	0	0	19	26	36	19	2	12	25	47	14
December	0	0	5	31	64	0	17	77	6	0	0	3	13	50	34	0	3	23	51	23
Year	0	1	7	30	62	1	27	57	15	0.3	0	13	24	41	22	0.5	21	27	40	12

1630 local time.

January		0	19	35	45	0.6		
February		0	9	43	42	6		
March		1	19	44	35	1		
April		5	24	34	32	5		
May		9	24	38	29	0.6		
June		7	33	39	21	0		
July	Data not available	2	39	45	14	0	Data not available	Data not available
August		4	23	48	25	0		
September		5	16	40	39	0		
October		6	34	34	26	0.6		
November		3	25	45	27	0		
December		1	11	46	42	0		
Year		4	23	41	31	1		

Authority.—Bibliography No. 58. Note.—The latitudes and longitudes are given in the general climatological tables.

TABLE VI—MONTHLY FREQUENCY OF DIFFERENT AMOUNTS OF CLOUD

Number of days per 100 on which particular cloud amounts may be expected.
The figures refer to tenths of sky covered by cloud. 0 = clear sky. 10 = overcast.

0800 local time.						Period: 1933-7														
Cloud amount	0	Tr.-3	4-6	7-9	10	0	Tr.-3	4-6	7-9	10	0	Tr.-3	4-6	7-9	10					
	BOMBAY					RATNAGIRI					MORMUGÃO					MANGALORE				
January	46	27	12	14	1	70	21	4	5	0	49	19	18	11	3	10	47	22	14	7
February	50	30	11	6	3	65	32	3	7	0	36	27	26	10	1	14	45	22	15	4
March	66	20	8	5	6	69	25	5	6	0	34	34	21	11	0	18	42	18	17	5
April	36	38	15	11	7	48	37	12	3	0	17	26	32	22	3	3	22	36	26	13
May	7	43	29	15	6	22	38	32	7	1	3	20	37	32	8	0	10	25	32	33
June	0	18	15	25	42	3	9	32	29	27	0	7	22	45	26	0	0	14	19	67
July	0	3	10	23	64	0	6	24	43	32	0	2	21	54	23	0	6	4	17	78
August	0	4	7	26	63	6	26	17	28	28	0	4	25	57	14	0	1	9	33	57
September	2	16	23	26	33	7	33	30	15	15	2	13	30	38	17	7	11	18	30	40
October	19	40	19	16	6	44	27	13	8	8	15	24	28	30	3	3	15	18	31	33
November	34	31	15	15	5	52	29	10	6	3	31	34	17	17	7	9	29	27	26	9
December	50	25	10	12	3	54	34	6	6	0	43	35	15	7	0	13	36	25	19	7
1630 local time.																				
January	45	34	8	10	3	Data not available					Data not available					Data not available				
February	56	28	11	5	0															
March	69	19	6	5	6															
April	61	31	7	1	0															
May	27	36	23	8	6															
June	0	11	19	24	46															
July	0	0	8	32	60															
August	0	1	14	30	55															
September	3	14	15	30	38															
October	23	43	14	16	4															
November	27	43	11	14	5															
December	42	36	9	12	1															

Authority.—Bibliography No. 58.

Note.—The latitudes and longitudes are given in the general climatological tables.

Table VI—Cloud amount at coastal stations

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TABLE VI—continued

Number of days per 100 on which particular cloud amounts may be expected.
The figures refer to tenths of sky covered by cloud. 0 = clear sky. 10 = overcast.

0800 local time.						Period : 1933-7														
Cloud amount	0	Tr.-3	4-6	7-9	10	0	Tr.-3	4-6	7-9	10	0	Tr.-3	4-6	7-9	10					
	COCHIN					TRIVANDRUM					AMINI					MINICOY				
January	13	42	15	24	6	44	4	22	17	13	19	29	25	21	6	8	20	28	41	3
February	14	45	14	26	1	55	11	14	14	6	18	42	22	18	7	11	29	32	28	0
March	6	55	16	17	6	43	14	25	12	6	25	30	28	14	3	3	20	43	31	3
April	7	23	28	37	11	14	11	37	23	15	13	30	31	24	2	4	14	37	42	3
May	6	12	19	43	25	4	6	31	23	36	4	17	30	30	19	4	11	27	39	19
June	0	3	11	32	54	7	7	13	31	48	1	7	8	31	53	1	1	18	53	27
July	0	3	10	26	61	1	5	10	24	60	0	5	14	28	53	0	4	23	48	25
August	0	6	17	35	42	6	7	20	31	36	0	11	24	37	28	2	7	26	47	18
September	7	23	17	31	28	13	12	23	27	25	7	12	31	31	25	3	16	30	36	15
October	1	17	13	42	27	6	12	23	26	33	3	17	21	27	32	3	14	25	48	10
November	4	31	16	27	22	24	9	16	27	24	13	28	18	24	17	7	16	34	36	7
December	10	46	16	21	7	41	9	18	22	10	22	30	25	19	4	14	24	33	27	2
1630 local time.																				
January	Data not available					29	8	14	23	26	Data not available					Data not available				
February	Data not available					39	7	23	15	16	Data not available					Data not available				
March	Data not available					18	8	15	32	27	Data not available					Data not available				
April	Data not available					4	3	19	33	41	Data not available					Data not available				
May	Data not available					4	5	13	26	52	Data not available					Data not available				
June	Data not available					7	3	14	21	61	Data not available					Data not available				
July	Data not available					6	3	12	15	69	Data not available					Data not available				
August	Data not available					6	3	15	28	48	Data not available					Data not available				
September	Data not available					10	7	20	27	36	Data not available					Data not available				
October	Data not available					2	4	13	18	63	Data not available					Data not available				
November	Data not available					13	4	12	25	46	Data not available					Data not available				
December	Data not available					27	5	17	21	30	Data not available					Data not available				

Authority.—Bibliography No. 58.

Note.—The latitudes and longitudes are given in the general climatological tables.

TABLE VII—MONTHLY FREQUENCY OF DIFFERENT STATES OF THE SEA

Number of occasions per 100 on which particular states of the sea may be expected.
 I = Calm, smooth or slight. II = Moderate. III = Rough. IV = Very rough or high. V = Very high or precipitous. VI = Confused.
 0800 local time.

Period: 1933-7

State of sea	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI
	BOMBAY						RATNÁGIRI						MORMUGÃO						MANGALORE					
January ..	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0
February ..	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0
March ..	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0
April ..	100	0	0	0	0	0	99	1	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0
May ..	100	0	0	0	0	0	95	6	4	0	0	0	97	3	0	0	0	0	93	2	3	2	0	0
June ..	82	17	7	0	0	0	31	3	63	3	0	0	56	29	15	0	0	0	21	28	18	31	1	7
July ..	79	20	1	0	0	0	0	35	62	3	0	0	34	45	20	6	0	0	3	17	35	36	9	0
August ..	97	3	0	0	0	0	13	26	60	1	0	0	73	22	5	0	0	0	41	22	26	11	0	0
September ..	98	1	1	0	0	0	48	35	17	0	0	0	97	3	0	0	0	0	90	7	3	0	0	0
October ..	100	0	0	0	0	0	86	14	0	0	0	0	100	0	0	0	0	0	95	4	1	0	0	0
November ..	100	0	0	0	0	0	95	3	2	0	0	0	99	7	0	0	0	0	98	1	7	0	0	0
December ..	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0

1630 local time.

January ..	100	0	0	0	0	0	Data not available	Data not available	Data not available
February ..	100	0	0	0	0	0			
March ..	100	0	0	0	0	0			
April ..	100	0	0	0	0	0			
May ..	99	0	6	0	0	0			
June ..	81	18	1	0	0	0			
July ..	78	21	1	0	0	0			
August ..	96	4	0	0	0	0			
September ..	97	2	7	0	0	0			
October ..	100	0	0	0	0	0			
November ..	100	0	0	0	0	0			
December ..	100	0	0	0	0	0			

Authority.—Bibliography No. 58.

Note.—The latitudes and longitudes are given in the general climatological tables.

Table VII—State of the sea at coastal stations

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TABLE VII—continued

Number of occasions per 100 on which particular states of the sea may be expected.

I = Calm, smooth or slight. II = Moderate. III = Rough. IV = Very rough or high. V = Very high or precipitous. VI = Confused.

0800 local time.

Period : 1933-7

State of sea	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI
	COCHIN						TRIVANDRUM						AMINI						MINICOY					
January ..	100	0	0	0	0	0	79	20	7	0	0	0	17	67	16	0	0	0	87	7	4	2	0	0
February ..	100	0	0	0	0	0	92	8	0	0	0	0	46	46	8	0	0	0	96	4	0	0	0	0
March ..	100	0	0	0	0	0	82	18	0	0	0	0	74	18	8	0	0	0	99	1	0	0	0	0
April ..	100	0	0	0	0	0	47	39	14	0	0	0	74	26	0	0	0	0	81	16	2	7	0	0
May ..	90	4	6	0	0	0	12	47	32	6	3	0	34	42	18	6	0	0	49	25	13	12	1	0
June ..	71	13	5	0	11	0	2	5	50	42	7	0	3	15	27	52	3	0	8	11	21	57	3	0
July ..	80	15	5	0	0	0	6	1	30	67	1	0	0	2	25	65	8	0	6	10	25	52	7	0
August ..	87	5	2	0	6	0	1	12	34	48	5	0	6	23	47	28	1	0	17	35	21	26	1	0
September ..	92	7	1	0	0	0	13	28	49	10	0	0	10	39	34	16	7	0	26	28	25	20	1	0
October ..	92	6	0	0	7	0	30	35	19	15	6	0	48	31	14	6	1	0	57	13	14	13	3	0
November ..	100	0	0	0	0	0	55	27	13	5	0	0	51	35	11	3	0	0	82	9	6	3	0	0
December ..	100	0	0	0	0	0	81	18	1	0	0	0	50	41	9	0	0	0	93	5	2	0	0	0

1630 local time.

January ..		98	2	0	0	0	0																	
February ..		99	1	0	0	0	0																	
March ..		93	7	0	0	0	0																	
April ..		68	31	1	0	0	0																	
May ..		11	61	18	9	1	0																	
June ..		0	7	63	30	0	0																	
July ..	Data not available	0	0	29	69	2	0	Data not available					Data not available						Data not available					
August ..		0	15	36	42	7	0																	
September ..		35	20	37	8	0	0																	
October ..		59	29	6	6	0	0																	
November ..		60	35	3	2	0	0																	
December ..		100	0	0	0	0	0																	

Authority.—Bibliography No. 58.

Note.—The latitudes and longitudes are given in the general climatological tables.

BIBLIOGRAPHY

GENERAL CLIMATOLOGY, ATLASES, ETC.

1. London, Admiralty, Hydrographic Department. West coast of India Pilot, 8th edn., 1937.
2. London, Meteorological Office. Monthly meteorological charts of the East Indian seas.
3. Calcutta, India Meteorological Department. Climatological atlas of India. Edinburgh, 1906.
4. Ditto, Meteorological atlas of the Indian seas and the North Indian ocean. Simla, 1908.
5. Poona, India Meteorological Department. Winds, weather and currents on the coasts of India and the laws of storms. Calcutta, 1931.
6. Ditto, Meteorology for airmen in India, Parts I and II. Delhi, 1936.
7. Utrecht, K. Nederlandsch Meteorologisch Instituut. Klimatologie van den Indischen Oceaan, by P. H. Gallé. *Meded. ned. met. Inst.*, No. 29. 1924-30.
8. Washington, D.C., Hydrographic Office. Pilot charts of the Indian ocean.
9. Washington, D.C., Smithsonian Institution. World weather records. *Washington, Smithson. misc. Coll.*, 79, 1927 and 90, 1934.
10. BLANFORD, H. F.; A practical guide to the climates and weather of India, Ceylon and Burmah, and the storms of Indian seas. London, 1889.
11. SCHOTT, G.; *Geographie des Indischen und Stillen Ozeans*. Hamburg, 1935.
12. WALKER, G. T.; Monthly and annual normals of pressure temperature, relative humidity, vapour tension and cloud. *Calcutta, Indian met. Mem.*, 22, Part 3, 1914.

LOCAL CLIMATOLOGY

13. Calcutta, India Meteorological Department. Magnetic, meteorological and seismographic observations made at the Government Observatories at Bombay and Alibag, 1898-9 and 1928 (Appendix).
14. CHAMBERS, C.; General remarks on the climate of Bombay, with a brief description of the peculiarities of the weather of 1871.
15. ELIOT, J.; Hourly meteorological observations taken at the Trivandrum Observatory during the years 1853-64. *Calcutta, Indian met. Mem.*, 7, No. 1, 1894-7 and 10, Nos. 1 and 3, 1898-9.

CYCLONES AND DEPRESSIONS

16. London, Meteorological Office. The Sicilia Arabian sea cyclone. *London, Mon. met. Ch. Ind. Ocean*, July, 1919 and 1922.
17. Calcutta, India Meteorological Department. Storm tracks in the Arabian sea, compiled by C. W. B. Normand. Calcutta, 1926.
18. DALLAS, W. L.; Cyclone Memoirs, Part IV. Arabian sea. An inquiry into the nature and course of storms in the Arabian sea..from 1648 to 1889. Calcutta, 1891.
19. NEWNHAM, MRS. E. V.; Hurricanes and tropical revolving storms. *London, Geophys. Mem.*, 2, No. 19, 1922.
20. NORMAND, C. W. B.; Recent investigations on structure and movement of tropical storms in Indian seas. *Leipzig, Beitr. Geophys.*, 34, 1931, p. 233. (Köppen Band 3).
21. ROY, S. C. AND ROY, A. K.; The structure and movement of cyclones in the Indian seas. *Leipzig, Beitr. Phys. frei. Atmos.*, 16, 1930, p. 224.

SURFACE WINDS

22. London, Meteorological Office. Local winds, Indian ocean. III. Coasts of India, Ceylon, Malaya and Sumatra; V. Islands of the Indian ocean. *London, Mar. Obs.*, 5, 1928, p. 169 and p. 212.
23. Ditto, The monsoons. II. The monsoons of the India ocean, China seas and the eastern Mediterranean. *Ibid.*, 6, 1929, p. 130.
24. DORAISWAMY IYER, V.; Wind data for wind mills. *Poona, Sci. Notes met. Dep. India*, 6, No. 63, 1935.
25. RAMANATHAN, K. R.; The structure of the sea-breeze at Poona. *Ibid.*, 3, No. 30, 1931.
26. SEN, S. N.; Long-range forecasting of the south-west monsoon and Everest expeditions. *Calcutta, Sci. & Cult.*, 2, 1937, p. 593.

UPPER WINDS

27. Poona, India Meteorological Department. Monthly normal isobars and wind-roses at 0.5, 1, 2 and 3 Km. above sea-level over India and neighbourhood. *Poona, Sci. Notes met. Dep. India*, 1, No. 8, 1931.
28. Ditto, Tables of monthly average frequencies of surface and upper winds up to 3 Km. in India. *Ibid.*, 2, No. 17 D, 1930.
29. Ditto, Normal monthly percentage frequencies of upper winds at 4, 6, 8 and 10 Km. above sea-level obtained from pilot balloon ascents. *Ibid.*, 6, No. 66, 1935.
30. BANERJEE, H. C. AND RAMANATHAN, K. R.; Upper air circulation over India and its neighbourhood up to the cirrus level during the winter and the monsoon. *Ibid.*, 3, No. 21, 1930.
31. HARWOOD, W. A.; The free atmosphere in India. *Calcutta, Indian met. Mem.*, 24, Parts 7 and 8, 1924.
32. RAMANATHAN, K. R. AND RAMAKRISHNAN, K. P.; The Indian SW. monsoon and the structure of depressions associated with it. *Ibid.*, 26, Part 2, 1933.
33. Ditto, The general circulation of the atmosphere over India and its neighbourhood. *Ibid.*, 26, Part 10, 1939.
34. WAGNER, A.; Zur Aerologie des indischen Monsuns. *Leipzig, Beitr. Geophys.*, 30, 1931, p. 196.

CLOUD

35. NARAYANAN, M. V. AND MANNA, M. P.; Heights of base of clouds in India as determined from pilot balloon ascents. *Poona, Sci. Notes met. Dep. India*, 3, No. 25, 1931.
36. RAMAKRISHNAN, H. P.; A note on some measurements of cloud heights at Poona, Bombay and Madras. *Ibid.*, 8, No. 85, 1939.
37. SCHOTT, G.; Die Bewölkung über dem Indischen und Stillen Ozeans. *Berlin, Ann. Hydrogr.*, 61, 1933, p. 280.

RAINFALL

38. Poona, India Meteorological Department. Data of heavy rainfall over short periods in India. *Poona, Indian met. Mem.*, 25, Part 3, 1929.
39. DORAISWAMY IYER, V. AND SOBTI, K.; Average intensity of rainfall on a rainy day in India. *Poona, Sci. Notes met. Dep. India*, 7, No. 76, 1938.
40. RAMDAS, L. A., SATAKOPAN, V. AND GOPAL RAO, S.; Agricultural meteorology: frequency of days with hailstorms in India. *New Delhi, Indian J. agric. Sci.*, 8, 1938, p. 787.
41. WALKER, G. T.; Monthly and annual rainfall normals and number of rainy days. *Calcutta, Indian met. Mem.*, 22, Parts 1 and 2, 1913; 23, Part 7, 1924.

TEMPERATURE OF THE UPPER AIR

42. RAMANATHAN, K. R. AND RAMAKRISHNAN, K. P.; Discussion of results of sounding balloon ascents at Poona and Hyderabad during the period Oct. 1928 to Dec. 1931. *Poona, Indian met. Mem.*, 26, Part 4, 1934.

TEMPERATURE OF THE SEA

43. KEETON, H.; Mean sea surface temperatures. Indian Ocean. *London, Mar. Obs.*, 5, 1928, p. 257 (with monthly charts).
44. Ditto, The sea surface temperature distribution in the Indian Ocean. *Ibid.*, 12, 1935, p. 152.
45. PATON, J.; Report on the meteorological observations of the John Murray Expedition 1933-4. *Sci. Rep. London, British Museum (Natural History)*, 2, No. 1, 1936.

HUMIDITY

46. DALLAS, W. L.; Investigation into the mean temperature, humidity and vapour tension conditions of the Arabian sea and Persian gulf. *Calcutta, Indian met. Mem.*, 6, Part 2, 1894.
47. SZÁVA-KOVÁTS, J.; Verteilung der Luftfeuchtigkeit auf der Erde. *Berlin, Ann. Hydrogr.*, 66, 1938, p. 373.

MISCELLANEOUS

Thunderstorms

48. Poona, India Meteorological Department. Frequency of thunderstorms in India. *Poona, Sci. Notes met. Dep. India*, 1, No. 5, 1929.
49. BROOKS, C. E. P.; The distribution of thunderstorms over the globe. *London, Geophys. Mem.*, 3, No. 24, 1925.
50. RAMANATHAN, K. R.; Thunderstorms in Trivandrum. *Calcutta, Proc. Indian Ass. Cult. Sci.*, 7, 1922, p. 107.
51. VENKITESHWARAN, S. P.; Thunderstorms in the Peninsula during the pre-monsoon months April and May. *Poona, Sci. Notes met. Dep. India*, 4, No. 44, 1932.
52. Ditto, Thunderstorms in south India during the post-monsoon months, October and November, 1929. *Ibid.*, 5, No. 52, 1933.

Waterspouts

53. FLETCHER, L. E.; Waterspouts. *London, Mar. Obs.*, 9, 1932, p. 153.
54. London, Meteorological Office. Waterspout observed by H.M.S. *Ormonde*, 19th October, 1927. *Ibid.*, 5, 1928, p. 203.

DAILY, MONTHLY AND ANNUAL REPORTS, ETC.

55. Poona, India Meteorological Department. India Weather Review.
56. Ditto, Magnetic, meteorological and seismographic observations, made at the Government observatories at Bombay and Alibag, 1925-36.
57. Ditto, Monthly frequency tables.
58. Ditto, MS. data.
59. Lisbon, Anais meteorologicos das Colonias.
60. Meteorological log of H.M.S. *Endeavour*, April, 1937.
61. MS. data in Meteorological Office, London.