

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.

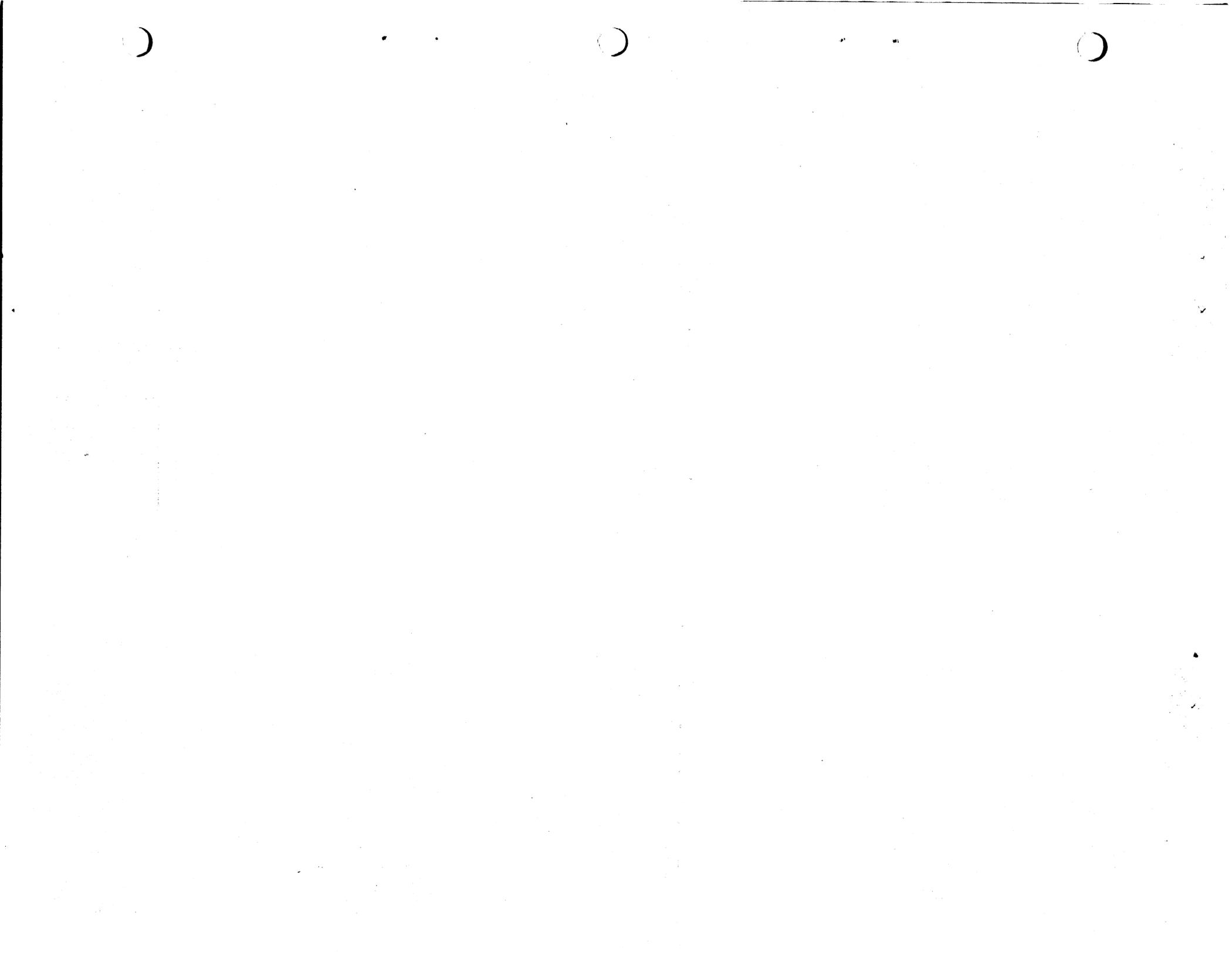
Users of the series should be alert to the fact that a number of place names used in the original writing have changed over the intervening years.

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 30⁰S and Longitude 95⁰E 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 00⁰E
3. The Persian Gulf and Gulf of Oman
4. The Makran Coast from Gwadar to Karachi and the West Coast of India to Latitude 20⁰N
5. West Coast of India from Latitude 20⁰N 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 30⁰S.
9. Coast of East Africa from the Equator to Cape Delgado



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FROM GWADAR TO KARACHI
AND
THE WEST COAST OF INDIA
TO LATITUDE 20° N.**

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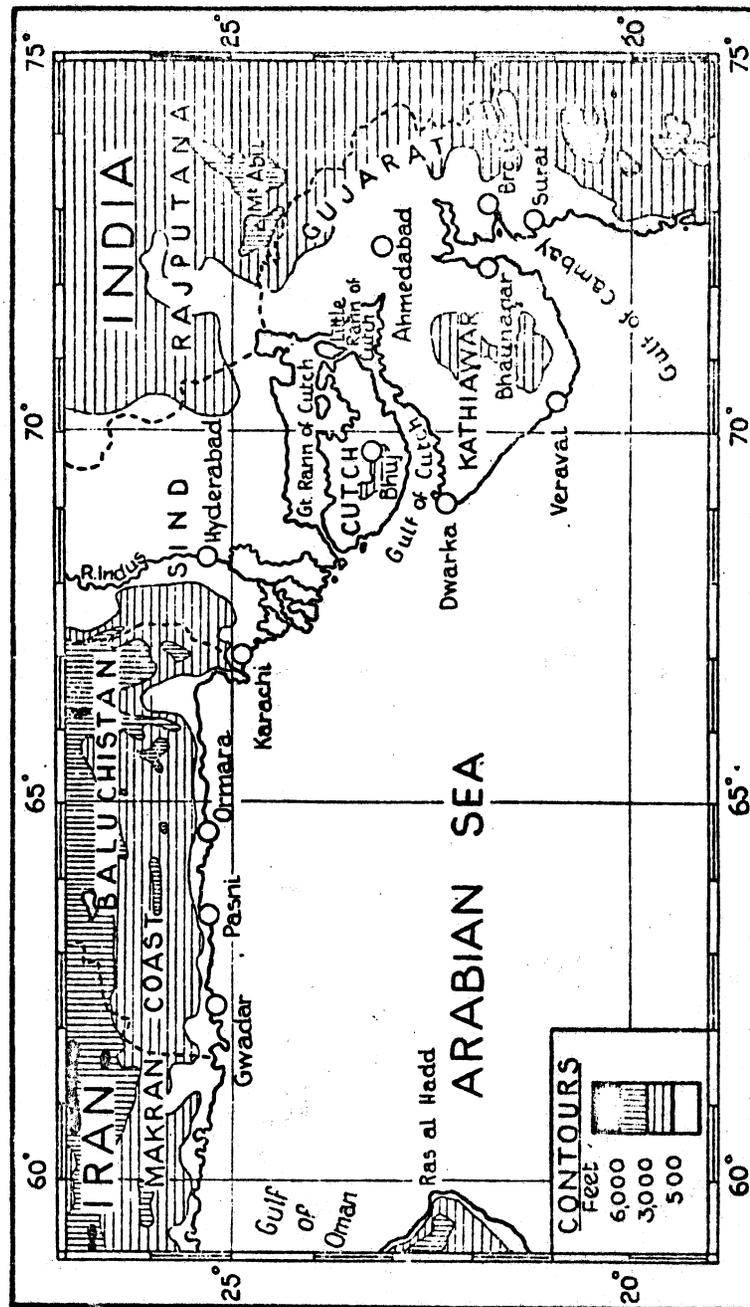


FIG. 1—THE MAKRAN COAST FROM GWADAR TO KARACHI AND THE WEST COAST OF INDIA TO LATITUDE 20° N.

**THE MAKRAN COAST
FROM GWADAR TO KARACHI
AND
THE WEST COAST OF INDIA
TO LATITUDE 20° N.**

INCLUDING

THAT PORTION OF THE ARABIAN SEA TO THE NORTH OF LATITUDE
20° N. AND TO THE EAST OF A LINE DRAWN BETWEEN
RAS AL HADD AND GWADAR

I—GENERAL

The Makran coast from Gwadar eastwards runs practically due east, and is approximately 250 nautical miles in length. It consists of a low-lying strip of land which forms a narrow border to the high tablelands of Baluchistan.

The coast of India from about 70 miles north of Karachi to latitude 20° N. runs in a south-easterly and southerly direction, and this portion of the coast is on the whole very low-lying, the lowland region in places extending some distance inland. It is part of the Bombay Presidency, and includes the coasts of Sind, Cutch and Kathiawar, which is a portion of the province of Gujarat, and the shores of the Gulf of Cambay. The lower Indus valley, which joins the coast line between Karachi and Cutch, is a very dry plain and the state of Cutch is a barren, rocky, treeless country. The province of Gujarat, although on the whole a low-lying region, has numerous hills; the Kathiawar peninsula is generally undulating with low ranges of hills running in irregular directions, the south-eastern portion having extensive mountainous districts, and the northern portion being almost universally flat.

Whereas in the Persian gulf, the gulf of Oman and the western part of the Makran coast winter is the period of most disturbed weather, on the Makran coast from Gwadar eastwards summer is the period when the weather is most disturbed. This change occurs approximately in the neighbourhood of Gwadar, and is due to the fact that the SW. monsoon, which blows over the Arabian Sea from June to September, affects the Makran coast from Gwadar eastwards but has little effect on the western part of that coast. The SW. monsoon has a great influence also on the weather of the west coast of India from Karachi southwards.

Tropical depressions and cyclones occasionally affect the area during the months from April to November. Severe storms are very infrequent.

In accordance with the practice of the India Meteorological Department the year has been divided into the following four seasons:—

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

In this region the term "hot season" is somewhat of a misnomer as May and June are the hottest months of the year.

During the cool season the weather may be disturbed at intervals by the passage of well-marked western disturbances. The NE. monsoon is the predominating influence during these months and the surface winds are mainly north-easterly in December backing to north and west as the season advances; land and sea breezes also are felt on the coasts. There is very little cloud and there are many days with clear skies. This is a dry season; any rain that falls is almost entirely associated with western depressions and rarely falls further east than Karachi. The rainfall is very variable from year to year, and even on the Makran coast it is not infrequent for any of the months to be rainless, although in some years the rainfall may be heavy.

On the coast frost is practically unknown and high temperatures have sometimes occurred, but on the whole the temperature varies very little throughout the cool season. At Karachi the climate can be pleasant and at times even cool and bracing, the relative humidity being comparatively low.

The hot season of April and May sometimes lasts to nearly the end of June in lower Sind and to the middle of that month in Gujarat. The surface winds are mainly between NW. and SW. and calms are frequent, but on the eastern part of the Makran coast May is the most windy and dusty month of the year, and the dust affects the visibility to some extent. On the coast to the south of Karachi there is an increase in cloud amount during these months, but on the Makran coast there are many days with clear skies in April, and the amount of cloud does not begin to increase until May or even June. This season is a period of dry weather and the average number of rain days in the region is less than two at all places. Any rain that occurs is usually associated with thunderstorms.

As the season advances the temperature rises rapidly in all parts, and some of the highest temperatures in India have been recorded in this north-west area in June; they vary from 115° to 126° F. in the different districts. The relative humidity shows a slight increase during the season over the whole region.

The SW. monsoon arrives about the middle of June and lasts until the end of September; it is heralded by cloudy weather with

scud flying overhead, occasional showers and strong winds which at times rise to a fresh gale. An indication of its arrival is a falling barometer and a heavy swell from a south-westerly or westerly direction; the heavy swell may be in evidence before there are any other signs. On the coasts of Sind, Cutch and Kathiawar the heavy swell begins in the middle of May and continues with varying intensity until the end of the monsoon; small vessels will not put to sea when the swell begins. On the eastern part of the Makran coast rough seas and a heavy southerly swell are experienced in June and continue throughout the season.

During the SW. monsoon the surface winds on the coast of India between Karachi and latitude 20° N. are mainly between SW. and WSW., and on the eastern part of the Makran coast they are westerly and south-westerly. The skies during this season are much more overcast than during the other months of the year, and much low cloud occurs. Days with a clear sky are rare, except on the Makran coast where the monsoon is not felt to so great an extent as on the coast of the Indian peninsula.

The rainfall during these months is associated with the SW. monsoon and also with any eastern depressions that occur. It is heaviest in the south of the region and decreases rapidly northwards. On the Makran coast the season is practically rainless and at Karachi, where there is, on the whole, very little rain, the SW. monsoon has not the same moderating effect on the hot weather as it has farther south. In the southern part of the region, where the rainfall is comparatively heavy, July is the wettest month, rain occurring on about one day in two.

Over most of the region June is the hottest month of the year on the average, but on the coast in the south the temperature becomes reduced slightly towards the end of June owing to the arrival of the SW. monsoon. The effect of the SW. monsoon is shown by a fall of temperature everywhere in July, and this fall is more pronounced on the coast of the Bombay Presidency than on the Makran coast. In August the temperature shows a further slight fall, but towards the end of September as the monsoon recedes the sky becomes clearer and the day temperatures rise again slightly.

The relative humidity is comparatively high throughout the season and is uniform along the coast; August is usually the month with the highest values.

During the post monsoon or interim period of October and November the weather is dry and in the latter part of the season the temperature falls rapidly. The surface winds over the whole region become light and variable, and land and sea breezes again prevail. It is the period of least cloudiness; there are many days with clear skies, and the rainfall is small in all parts. The day temperatures in October show a slight rise above those in September

owing to the departure of the monsoon, but in November there is a decided fall over the whole region.

The relative humidity everywhere falls with the withdrawal of the SW. monsoon, and the values in October are about 10 per cent. below those in September.

II—DEPRESSIONS AND TROPICAL CYCLONES

There are two types of depression that affect the area under consideration, known respectively as western depressions and eastern depressions; with the eastern depressions are included tropical cyclones. It is proposed here to deal briefly only with those depressions and tropical cyclones that affect this region, and their probable frequency of occurrence. For fuller information about tropical cyclones in the Indian ocean as a whole Volume I should be consulted.

I.—WESTERN DEPRESSIONS

Western depressions are dealt with more fully in Part 3. They may be experienced at any time during the six months from November to April, and on that account are often called winter depressions. They come from the west and move in an easterly direction. The average number of depressions likely to occur during the year is about 26, distributed throughout the months as follows: November, 3; December, January and March, 4 each; February and April, 5 each; May to October, practically none. Their frequency varies very much from year to year; during a period of 45 years the greatest number affecting north-west India in a year was 56, and the least number only 7.

Western depressions are vigorous over the Persian Gulf and decrease in intensity eastwards; their intensity sometimes increases again when they reach the Indian frontier and vigorous effects are noticed over north-west India. In the area under consideration here, namely the northern part of the Arabian sea, the Makran coast and the coasts of Sind, Cutch and Kathiawar, the passage of a western depression may give rise to local gales and squally weather. Western depressions are directly or indirectly responsible for the occurrence of most of the severe local storms of the hot weather.

A local storm associated with a western depression occurred at Karachi on November 27–8, 1928. The following description is taken from the *India Weather Review* for that year.

At 1910 (local time) of the 27th a sudden squall accompanied by blinding flashes of lightning and a torrential downpour of rain took place. The squall lasted three minutes and for two minutes the speed of the wind was about 40 knots. Another severe squall, also of short duration, passed over the town at 0230 on the 28th. A certain amount of damage was caused, houses and huts were unroofed, telegraph lines were damaged and trees uprooted. Many fishing boats capsized and two lives were lost.

2.—EASTERN DEPRESSIONS AND TROPICAL CYCLONES

These depressions originate in the Arabian sea and the Bay of Bengal or occasionally in central India; when not very vigorous they are known as depressions, but when they develop more violent characteristics they are called tropical cyclones.

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.

Eastern depressions and tropical cyclones are practically unknown in the cool season, when the north-easterly winds of the NE. monsoon are in full possession of the seas around India. During the SW. monsoon months also, from about mid June to September, when winds of oceanic origin dominate the whole region, fully developed tropical cyclones are extremely rare, though during this period depressions may occasionally affect the region. Some of these depressions form in the Arabian sea and others travel across India from the Bay of Bengal. The former generally originate somewhere off the coast of the Bombay Presidency, and tend to move in a north-north-westerly direction. They may enter India near Gujarat or travel in a more westerly direction into the extreme north of the Arabian sea and reach the Makran coast. These depressions are associated with a revival of the monsoon winds after a period of temporary inactivity; they cause heavy monsoon rain over the coast of India, but further west on the Makran coast they give only squally overcast weather and occasional passing showers, although there may be duststorms, rough seas and heavy swell.

The depressions which form at the head of the Bay of Bengal travel westwards over the land; they sometimes appear to die out over central India or the United Provinces, but become more active again over Rajputana where they meet the fresh monsoon air from the Arabian sea. They may then give rise to cloudy weather, stormy winds and rainfall over Sind and the extreme eastern section of the Makran coast. Sometimes one of these depressions passes through Sind and Gujarat and enters the North Arabian sea off Makran causing heavy rain, rough seas and squally weather between Pasni and Karachi, and light passing showers, duststorms, rough seas and squally weather farther west.

A storm such as this occurred in the vicinity of Karachi at the beginning of September 1926, and a brief account of it, based on information in the *India Weather Review*, is given here.

On August 31 a fall of pressure had occurred over the Gangetic plain and Rajputana, and it could be seen that a shallow depression was situated over the southern United Provinces, upper central India and east Rajputana.

By the morning of September 1 this low pressure area had developed into a well-marked depression, and by the morning of September 3 the depression could be classed as a typical eastern depression. Its centre was then situated just to the north-east of Bhuj (23° 15' N., 69° 40' E.) at 0800 (local time) and moderately strong winds were reported from land stations around the storm. At sea off the Kathiawan and Cutch coasts ships were experiencing rough seas, heavy swell and frequent heavy rain-squalls accompanied by winds of gale force.

The storm passed over Bhuj about midday on the 3rd, and at 1700 the wind at that place had risen to a gale and its direction was SW. The storm, at this time, was partly over the land and partly over the sea to the westward of Bhuj, and its further west-south-westerly movement appears to have stopped. The S.S. *Baroda* which was then probably about 100 miles off the coast reported that from midday she was experiencing westerly winds of Beaufort force 8 to 9, rough seas, continuous rain and frequent squalls.

The exact path followed by the centre of the depression after this is uncertain; it may have either kept over the land or followed the coast line. It moved, however, in a north-westerly direction, and by 0800 (local time) on September 4 the centre was situated about 50 to 100 miles south-east of Karachi.

At 0500 (local time) on the 4th, Karachi had strong north-north-easterly winds with squally weather, Bhuj had a strong southerly wind with squally weather, and the S.S. *Baroda* (about 200 miles south-south-west of Karachi) had winds of gale force from WSW. Subsequently during the 4th, ships continued to report gales and rough seas, but the wind at Karachi changed to north, indicating that the centre was still to the eastward of Karachi and moving in a northerly direction.

The slow northerly or north-north-easterly movement of the centre continued, the storm dissipating rapidly while passing over Sind. From the afternoon of the 4th, continuous rain fell at Karachi for 36 hours and a total of 359 mm. (14.1 in.) was recorded at Manora observatory, which is nearly double the normal annual amount for that place.

The log of S.S. *Varsova*, which was bound for Karachi from Bombay, showed that this storm had not weakened appreciably at sea until it passed near Karachi.

Fully developed tropical cyclones most frequently occur in the months before and after the SW. monsoon. On an average one or two severe cyclones may be expected to form in the Indian seas in the ante SW. monsoon period and two or three in the post SW. monsoon period, but not all of these, even when they form in the Arabian sea, affect the region under consideration here. A table of the frequency of tropical cyclones in the Arabian sea in the different months is given on page 8 of Part 5.

The tracks of tropical cyclones in each month, over the Arabian sea as a whole, are described in Part 5, pages 9-11. In the northern part of the sea the storms may move in any direction between west and north-east.

The number that have affected the Makran coast between Gwadar and Karachi from 1847 to 1929 is only 17; their distribution is as follows: April 1, May 4, June 9, September 2, November 1; there were none in any other months of the year. In addition, the coast south of Karachi is sometimes affected by storms which do not reach the Makran coast, more especially in October and November and occasionally also in June and July.

A very destructive feature of these storms on the coast of India is the storm wave which sometimes accompanies them. This is caused by the piling up of the water in the inner storm area which advances with the storm. If the storm strikes the coast when the normal tidal wave is at high water then any low-lying land may be suddenly flooded. Flooding to a depth of 30 feet has been known, and a tremendous loss of life in thickly populated districts may ensue.

The following is an account of a severe tropical cyclone which occurred in the Arabian sea in the vicinity of Karachi on June 3 to 6, 1907. All times quoted are local time.

On June 3 there was disturbed weather in the Arabian sea to the north-west of Bombay, and on the 4th the storm had its centre situated off the coast between Bombay and Karachi. The disturbance had still further developed on the 5th, and the centre had moved to the northward but was still over the sea, being at 0800 about 200 miles to the south of Karachi. At 0800 on the 6th the centre was close to Karachi where a strong gale, with a wind speed of about 65 knots, was reported. At noon a hard gale with hurricane squalls was being experienced and a high sea was running in the harbour at Karachi, the barometer being then at its lowest at that place, 988.8 mb. At 1300 the wind shifted to SSW. in most furious squalls, a wind speed of nearly 75 knots was said to have been reached by the anemometer. At 1800 the direction of the wind was W. by S. and the barometer had risen to 999.0 mb.; after this the weather moderated and by the following morning the storm has passed inland and had almost disappeared.

A ship which left Bombay on June 3 ran into this storm, and at midnight on June 5 to 6 the barometer on board had fallen to 988.8 mb. and a strong gale from ESE. was blowing, accompanied by terrific squalls of rain and a heavy confused sea. By 0300 on June 6 the wind had shifted to NNE. and the barometer had fallen to 979.3 mb., the lowest reading obtained. Later the wind shifted to NW. and the storm had evidently passed the ship by 0700, as the barometer was then rising and the wind was dropping.

The following description, based on the *India Weather Review* for 1920, refers to a severe Arabian sea storm that occurred in June 1920 and affected the Kathiawar coast. All the times quoted are local time.

The storm formed on June 6, 1920 in about Lat. 14° N. and Long. 70° E. and it appears to have moved in a north-north-westerly direction. On the morning of the 8th the position of the centre was about 17° N., 68° E., and it then appears to have taken a rather unusual course for a storm occurring in this season as it changed its course to north and north-east and advanced towards the Kathiawar coast. A storm of this type generally moves very rapidly on approaching the coast and dissipates quickly on proceeding inland, but in this case the storm moved remarkably slowly, covering a distance of roughly 100 miles in 36 hours so that at 0800 on the 11th it lay about 30 miles south-west of Veraval (20° 54' N., 70° 22' E.). The centre passed to the east of a ship bound from Basra to Bombay early on the morning of June 11, and from 0800 until noon this ship reported that the violence of the sea and its irregularity baffled description. The north-west squalls blew the ship bodily to the south-east at about 3.5 knots. Another ship, the S.S. *Chakdina*, whose noon position on the 11th was approximately 19° N., 70° E., also bound from Basra to Bombay, passed about 70 miles to the south of the centre of the storm and met with squalls of hurricane force, constant rain and a very high confused sea, and frequently shipped water. A native vessel, whilst proceeding from Goa to Broach, stranded

on a sandbank off the Luhara lighthouse in the Gulf of Cambay on the 11th and subsequently became a total loss; five of the crew of nine lost their lives.

The storm crossed the coast of Kathiawar at Veraval on the 11th. The barometer there fell 27.1 mb. between 0800 and 1700 on the 11th, and it rose in the rear of the storm 31.5 mb. by 1100 on the 12th; the depth below normal at 1700 on the 11th was 47.4 mb.

Still moving very slowly the centre lay not far from Rajkot, situated in the centre of Kathiawar, on the morning of the 13th, after which the storm rapidly weakened and disappeared on the morning of the 15th over north Gujarat.

During the first two days that the storm was over the land a great deal of damage was done to buildings, trees and telegraph lines but there was practically no loss of life. At Veraval the wind reached a maximum speed of about 83 knots on the 12th and continued with unabated fury till the 14th.

A couple of days after this storm subsided, the tide in the Gulf of Cambay rose to the highest level previously recorded, and it rose still higher on June 17 and 18, reaching to one foot above the previous maximum. Thirty-one villages in the Ahmedabad and Broach districts were flooded.

III—WIND

1.—SURFACE WINDS

Wind roses showing the mean frequencies of the wind from different directions for each of the twelve months are reproduced in Figs. 2-5. The two roses for the open sea are compiled from ships' observations and show both direction and force, but for the stations on the coast only the direction of the wind, at 0800 (local time), is shown as information of the force is not available. The corresponding data for the sea are given in Table II, and for places on the coast in the general climatological tables, except those for Gwadar which are included in Part 3.

In the general climatological tables additional data of the wind direction in the afternoon are included in order to show the diurnal variation, and information is given also of the average wind speed over the 24 hours. The percentage frequency of winds of different forces at the morning and afternoon hours of observation for Pasni, Karachi (Manora), Dwarka and Veraval is given in Table III.

Throughout the whole area the northerly winds of the NE. monsoon predominate from November to March, and the southerly winds of the SW. monsoon from June to September. In the transition months, April-May and October-November, when the monsoons are changing, the winds are variable in most places. The south-westerly winds of the SW. monsoon are much stronger than the north-easterly winds of the NE. monsoon as the pressure gradient is steeper.

Seasonal variation

Cool season (December to March).—December, January and February are the months when the NE. monsoon wind is steadiest; in March its steadiness begins to diminish everywhere and north-westerly winds become frequent. The predominating winds on the Makran coast in March are westerly or north-westerly.

In the northern part of the Arabian sea the wind is on the whole light, and it is not often that it exceeds Beaufort force 3; it blows from NNE. in December but it becomes north-westerly or even westerly in the latter part of the season.

On the eastern part of the Makran coast and on the coast of north-west India these monsoon winds are generally light and northerly, but winds from all directions between NW. and E. are frequent. From November to March the prevailing surface winds over Sind are from the land and the normal direction is between NW. and NE., the actual direction and strength of the wind being determined by the position and intensity of the winter anticyclone situated over north-west India.

Land and sea breezes are usually felt near the coast during the NE. monsoon. The sea breeze is generally felt in the daytime, but at times a wind from off the land may blow continuously for a day or two. On the Makran coast the sea breeze is so persistent that it almost completely overcomes the monsoon winds in the daytime, this is especially noticeable at the beginning and end of the season.

Western depressions sometimes pass from west to east through Iran to northern India during these months, and whilst one of these depressions is passing a change in wind direction takes place and southerly winds will probably be experienced.

Hot season (April and May).—The winds during these months are variable over most of the region. In the northern part of the Arabian sea in April the winds are mostly between SW. and N. in the east, and either SW. or W. in the west, but in May they are almost entirely W. or SW.

On the coasts in April the winds are mainly westerly and south-westerly, light to moderate, but northerly winds are still fairly frequent in the Gulf of Cambay. Near Karachi strong winds may be expected on about 8 days during the month. In May on the east Makran coast the winds are moderate to strong from a westerly to south-westerly direction.

SW. monsoon (June to September).—The time of onset of the SW. monsoon varies considerably in different places. In the western part of the north Arabian sea the SW. monsoon winds usually begin to blow in May but they do not reach the eastern part of the Makran coast or the coasts of Sind, Cutch and Kathiawar until June. At Karachi the SW. monsoon usually sets in between about June 6 and July 10.

On the coasts of Sind, Cutch, and Kathiawar, the monsoon starts with a few days or even a fortnight's hard blow from between SW. and WSW. After the first blow the wind generally moderates, but SW. winds continue to blow strongly throughout July and August. On the eastern part of the Makran coast the monsoon winds are W. to SW.; they become fully established in July when they blow with moderate strength. At night the wind is said to veer several points to the westward.

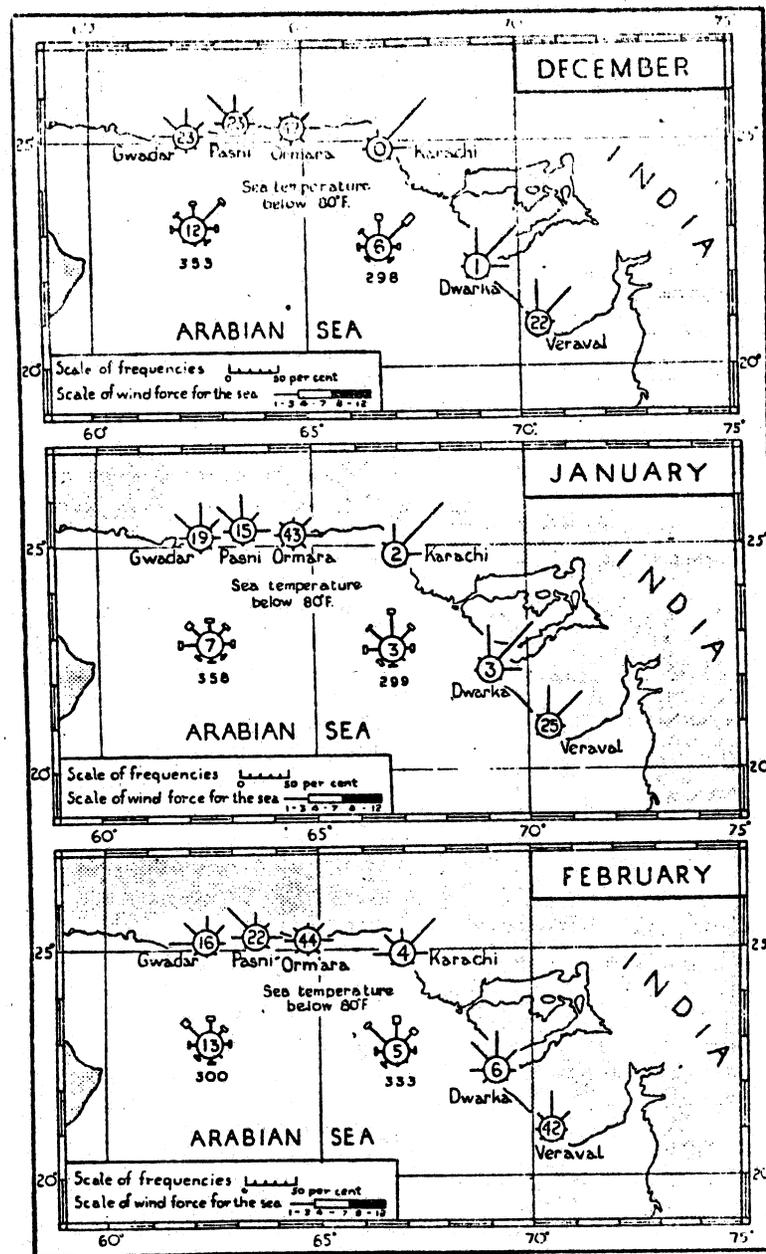


FIG. 2—SURFACE WINDS AND SEA TEMPERATURE—MONTHLY

The figures inside the circles indicate the percentage frequency of calms, and those below the roses for the sea areas the number of observations. On the roses for the coastal stations the wind force is not indicated, these roses refer to the morning hour of observation, approximately 0800 local time.

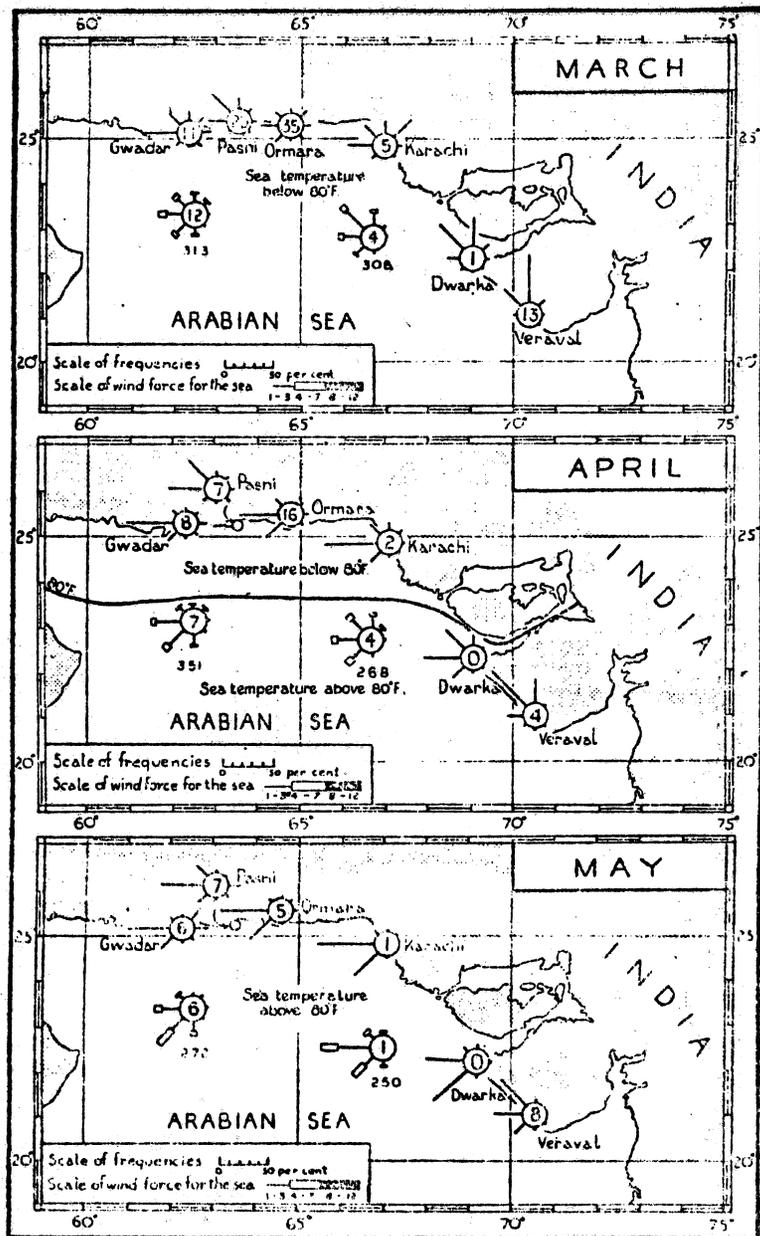


FIG. 3—SURFACE WINDS AND SEA TEMPERATURE—MONTHLY

The figures inside the circles indicate the percentage frequency of calms, and those below the roses for the sea areas the number of observations. On the roses for the coastal stations the wind force is not indicated; these roses refer to the morning hour of observation, approximately 0800 local time. The wind rose for Pasni for April and May is displaced slightly to the north. On the chart for April the isotherm of sea temperature for 80° F. is indicated by the thick line.

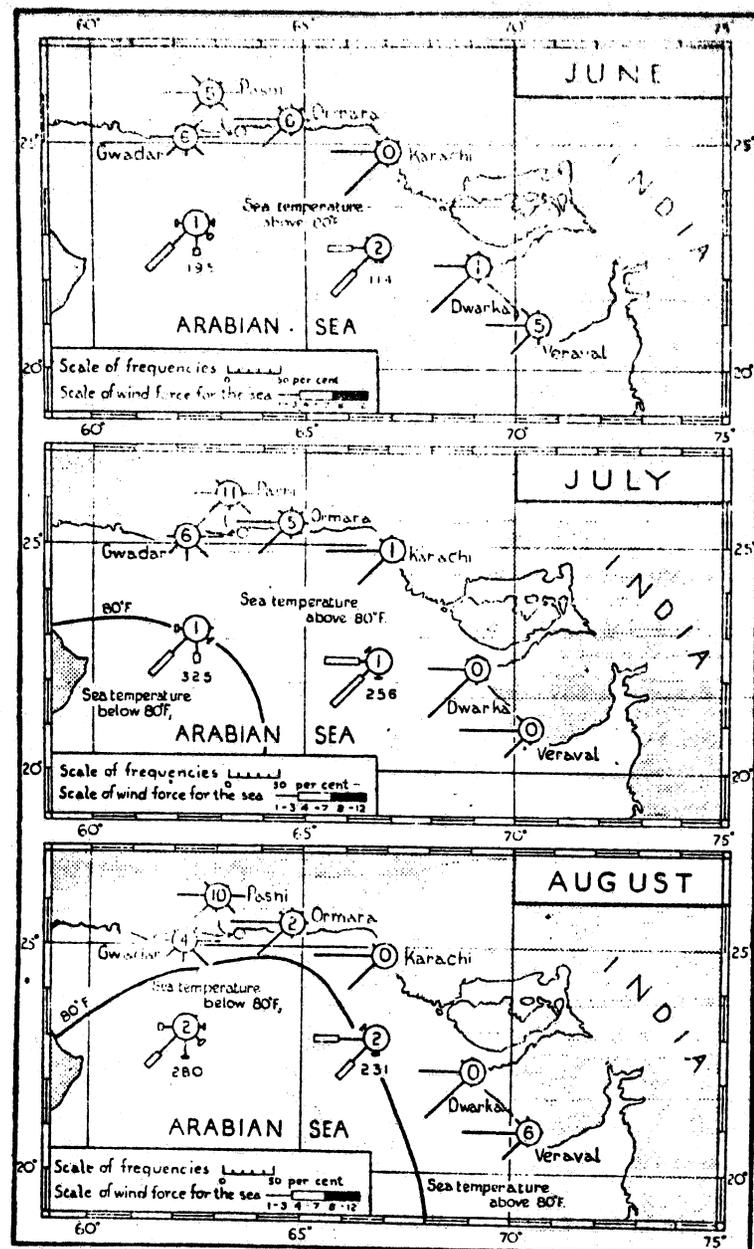


FIG. 4—SURFACE WINDS AND SEA TEMPERATURE—MONTHLY

8 The figures inside the circles indicate the percentage frequency of calms, and those below the roses for the sea areas the number of observations. On the roses for the coastal stations the wind force is not indicated; these roses refer to the morning hour of observation, approximately 0800 local time. The wind rose for Pasni is displaced slightly to the north. The isotherm of sea temperature for 80° F. is indicated by the thick line.

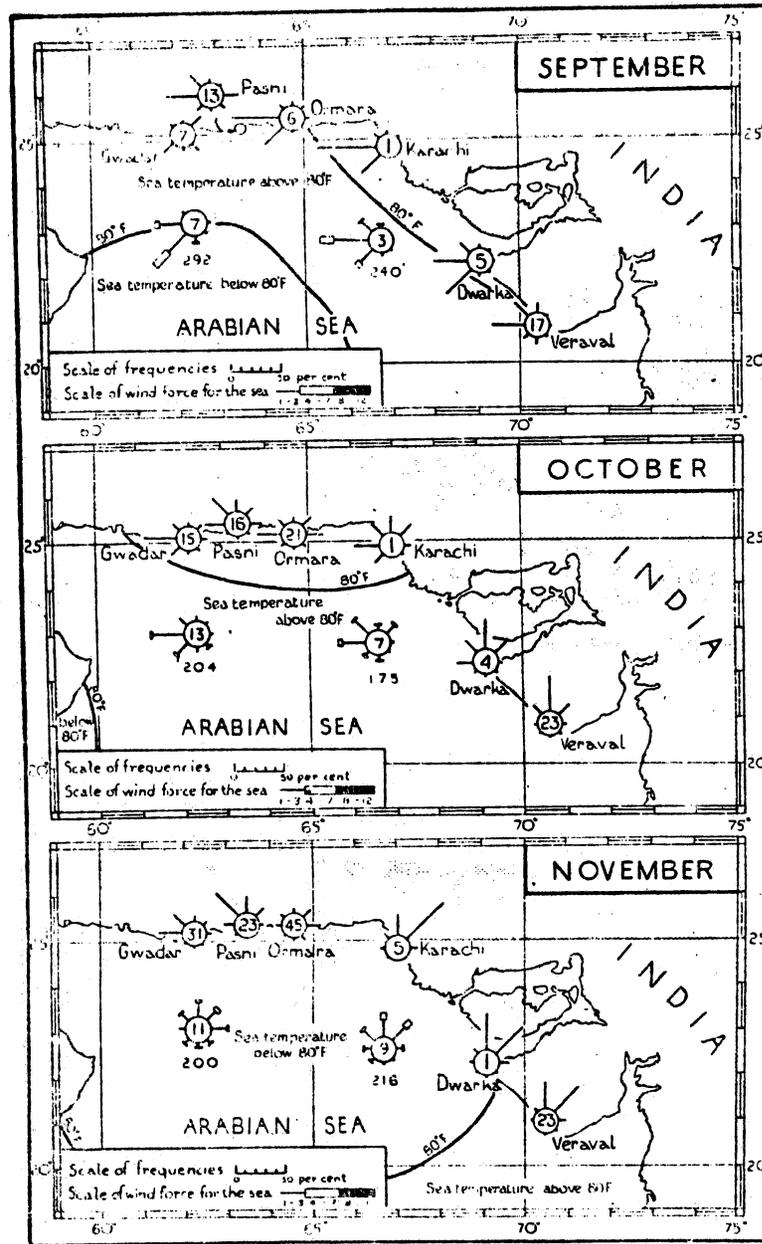


FIG. 5.—SURFACE WINDS AND SEA TEMPERATURE—MONTHLY

The figures inside the circles indicate the percentage frequency of calms, and those below the roses for the sea areas the number of observations. On the roses for the coastal stations the wind force is not indicated, these roses refer to the morning hour of observation, approximately 0800 local time. The wind rose for Pasni for September is displaced slightly to the north. The isotherm of sea temperature for 80° F. is indicated by the thick line.

The average force of the wind over the open sea in June and July is 5 or 6 of the Beaufort scale, but it reaches gale force at times in squalls. In August the force shows a marked decrease. North of latitude 20° N. the wind does not blow so strongly as farther south.

In September the SW. monsoon starts to recede over the whole area. The winds weaken rapidly and in most parts the influence of the monsoon comes to an end during this month, but it does not disappear from the western part of the north Arabian sea until the end of October.

Transition period (October and November).—After the withdrawal of the SW. monsoon the winds over the whole region become light and variable, and land and sea breezes prevail. The NE. monsoon winds normally begin to blow over this region in October; they set in earlier over the land than over the sea, and by the middle of November they are blowing fairly regularly. In October when the NE. monsoon is not in complete domination there are frequent calms and light winds from a westerly direction. In the neighbourhood of Karachi westerly winds lose their importance in November, and the winds are mainly northerly and light.

Land and sea breezes.—The diurnal variation in the direction of the wind in different parts of the coast is illustrated in Fig. 6 by wind roses showing the direction of the surface winds in the morning and afternoon in four months, each representative of one of the four seasons, namely, January, the NE. monsoon; April, the hot season; July, the SW. monsoon; and October, the interim period after the SW. monsoon. The corresponding data are given in the general climatological tables.

The regular alternation of land and sea breezes is only likely to be apparent when the prevailing wind is light; in this region, therefore, it is only likely to be experienced from October to March. During the SW. monsoon, when the wind blows strongly from the sea, there is very little change of direction during the 24 hours.

The direction and time of onset of land and sea breezes vary from place to place, and it is difficult to make accurate generalisations. Broadly speaking, however, in the region under consideration the land breeze weakens at about 0900 and dies away to a calm about noon; the sea breeze sets in soon afterwards and increases in strength as the afternoon advances. The wind falls calm at sunset, and continues calm until between 2000 and 2200 when the land breeze starts to blow again; this calm period in the evening does not occur in all places. At first the land breeze is a gentle fluctuating wind, but it soon becomes steady and continues so until 0900 or 1000 the next morning.

On the Makran coast the land breeze sets in at midnight or some hours later from between NNE. and ENE., veering gradually eastward; before noon a calm usually occurs, or a light SE. wind blows which veers to SW. in the afternoon.

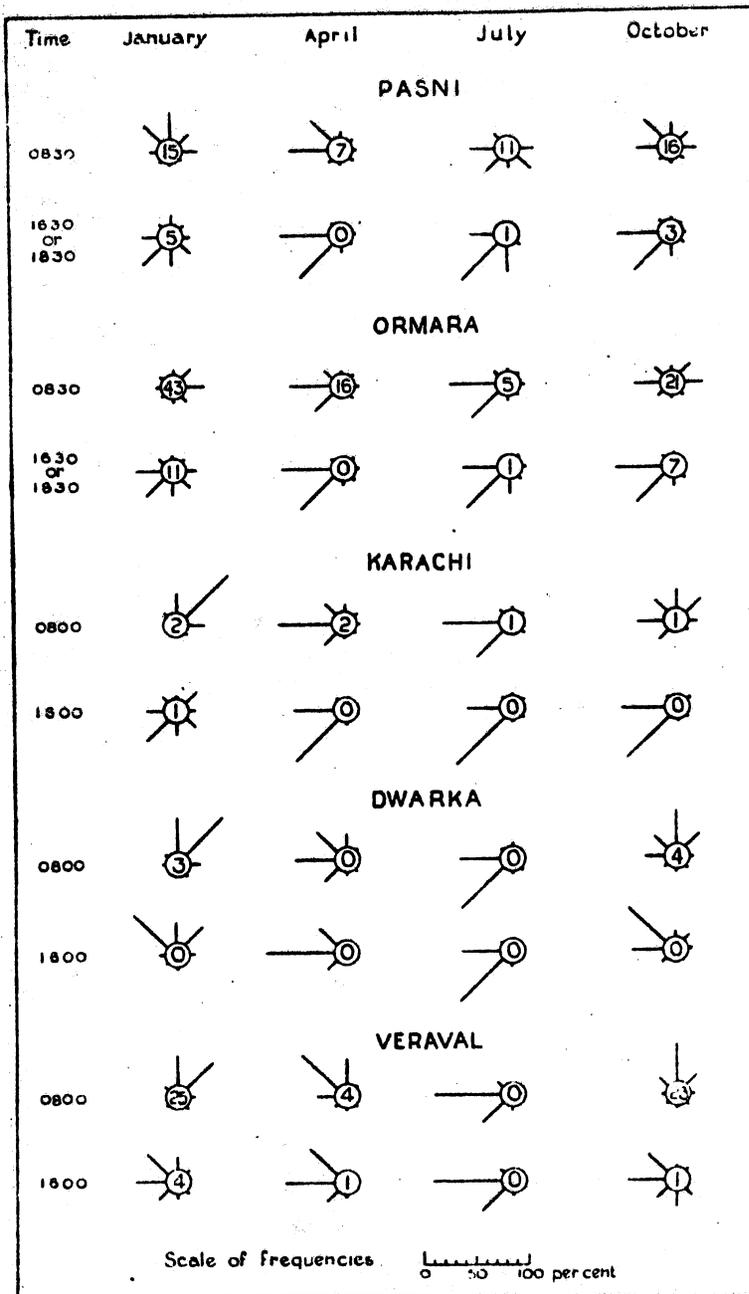


FIG. 6.—SURFACE WINDS—MORNING AND AFTERNOON

Figures inside the circles indicate the percentage frequency of calms. The standard of time is local time or differs from local time by less than half an hour. At Pasni and Ormara observations from Jan. 1930-June 1934 were at 1630, and from July 1934-Dec. 1937, at 1830.

At Karachi there are local land and sea breezes from October to March or April. The following table gives the average direction and speed of the wind at intervals of four hours in each month of the year. The large variation in direction during the NE. monsoon, compared with the comparative constancy during the SW. monsoon, is clearly shown. During the cool season calms are numerous during the night hours, from 2100 to 0800, but are rare from 1000 to 1900.

Karachi.—DIURNAL VARIATION OF WIND DIRECTION AND SPEED
Period: 1873-94

Time	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	<i>degrees from North</i>											
0000	331	280	259	251	248	239	244	248	250	262	298	9
0400	7	319	269	257	251	246	248	253	257	272	336	11
0800	26	356	274	258	251	249	252	254	259	282	10	24
1200	49	235	243	240	241	239	246	248	248	240	204	65
1600	228	238	240	238	238	235	239	241	243	237	231	214
2000	275	256	247	240	241	235	240	240	242	245	253	288
	<i>knots</i>											
0000	6.1	6.7	9.5	9.5	11.6	13.9	14.0	12.5	9.3	5.7	4.8	5.6
0400	6.3	6.4	8.2	9.1	11.2	13.6	13.8	12.8	9.3	5.5	4.6	6.0
0800	6.3	6.4	7.2	8.3	11.4	13.1	13.6	12.3	9.2	5.6	4.9	6.3
1200	7.1	7.9	10.2	11.9	14.2	14.9	14.7	13.3	11.9	8.6	5.7	6.9
1600	7.7	10.3	13.2	13.7	15.1	16.1	15.6	14.2	11.6	10.4	8.2	7.6
2000	6.9	8.5	11.3	11.2	12.8	14.7	14.2	12.8	9.5	7.4	6.2	6.3

Authority.—Bibliography No. 52.

Note.—Details of the site are not known with certainty but it was probably the regimental hospital 3 miles north-east of the town where the exposure was excellent. The sea is about 3 miles distant to south and south-east.

A recent study of the sea breeze at Karachi, based on observations at Manora situated on a small island to the south of the harbour and at Drigh Road 13½ miles to the NE. of Manora, indicates that at Drigh Road the sea breeze has some of the characteristics of a cold front; it sets in suddenly and is usually cooler, more humid and stronger than the preceding land breeze. During the period from October to April the average number of days when a definite sea breeze front reached Drigh Road or beyond varied from 8 in October and April to 13 in December. At Drigh Road the direction of the sea breeze is SW. or WSW.; it may set in any time between 1200 and 1800 or occasionally even later, the most usual hour being 1500 to 1600. The time of onset tends to be slightly later at the height of winter, when the prevailing wind blows most strongly from the land, than in the transition periods before and after the NE. monsoon. The sea breeze arrives between 1 and 3 hours earlier at Manora than at Drigh Road, the time taken to travel between the two places depending on the relative strength of the sea breeze and of the land wind which it displaces. The speed of the sea breeze is usually about 9 knots, but it varies from quite light airs to a speed of 16 knots.

The sea breeze has been known to penetrate as far as 84 miles inland in some regions, but towards the end of its travel it has only a small vertical depth.

On the coasts of Sind, Cutch and Kathiawar during December and January moderate land breezes usually blow in the morning and weak sea breezes in the afternoon; the land breeze is the predominating feature and sometimes persists continuously for 2 days or more. On the coast of Kathiawar the direction is NE. or N. in the morning, and NW. in the afternoon and evening. After January the sea breezes become gradually more pronounced, and from March onwards the land breezes are uncertain, seldom coming off until morning when a feeble land breeze sometimes develops; more often there are calms or light airs from north from about midnight to noon, when a sea breeze sets in from between SW. and NW. From April onwards the wind blows from the sea at night as well as by day, and the effect of the sea breeze is shown merely as a strengthening of the prevailing SW. wind without change of direction.

Gales, strong winds and squalls.—The percentage frequency of gales for two sea areas, compiled from ships' observations taken over a long period of years, is shown in the wind roses of Figs. 2-5 and in Table II. Frequencies for coastal places are given in Table III.

The frequency of strong winds at Pasni, Ormara and Karachi (Drigh Road) is given in the general climatological tables. The figures give the number of days with wind of force 6 or more on the Beaufort scale; they are based on 2 or 3 years' observations only.

Gales are by no means frequent. According to the ships' observations they have been recorded only in December, January and March, but at times the wind may reach gale force also during the squally weather of the SW. monsoon in association with eastern depressions. The strongest gales are associated with severe tropical cyclones but these are rare.

On the Makran coast during December and January strong north-easterly winds may be experienced and these are often accompanied by gloomy, squally weather. Western depressions which pass through the region during the winter months may give rise to gales and squally weather and severe local storms in the northern part of the Arabian sea, on the Makran coast and on the coasts of Sind, Cutch and Kathiawar.

Squalls at Karachi.*—The table on page 22 shows the average number of squalls that are likely to occur at Karachi airport (Drigh Road) during a normal year. A squall is taken to mean a sudden increase in wind velocity to about 26 knots or more, lasting for at least a minute and accompanied by marked changes both in wind direction and in one or more of the elements—temperature, pressure and relative humidity.

*The information in these paragraphs is taken from Bibliography No. 28.

Karachi (Drigh Rd.)—AVERAGE NUMBER OF SQUALLS

Period: July 1928 December 1935												
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
0.4	0.1	0.7	0.3	0.9	1.1	1.7	0.1	0.6	0.3	0.3	0.0	0.5

Authority.—Bibliography No. 28.

On the average 6 or 7 squalls occur during a year, and they are most frequent in May, June and July. They are invariably accompanied by thunderstorms, duststorms or both; but only about half the thunderstorms and duststorms that occur are associated with squalls satisfying the definition.

The squalls during the months from April to August are generally more violent than those during the rest of the year. The highest speed recorded is 56 knots in June.* A speed of 40 knots has been exceeded in all seasons. From November to March the squalls generally come from a direction between N. and W., and during the rest of the year from between N. and E. The change of direction during the squall is usually a veer and in extreme cases may be as much as 225°. The duration of the squall, i.e. the interval between the time when the sudden increase of wind occurs and when the speed falls again to about its original value, varies from about 10 minutes to an hour. The increase of speed during the squall may be as much as 20-25 knots a minute. From April to August, when insolation plays a large part in their development, the squalls are most likely to occur between 1500 and 2100 but in the cool season they may occur at any time of the day.

The conditions favourable for the occurrence of squalls may be briefly summarised as follows:—

From November to March the majority of the squalls are associated with the passage of the cold fronts of western depressions and are due to the undercutting of warm moist air by cold air. They are accompanied by the usual phenomena of a line-squall, namely cumuliform clouds, duststorms, thunderstorms, hail and rain. The cold front arrives first at higher levels, and in consequence a rise of pressure precedes the arrival of the squall by a few minutes and may give a useful warning of its approach.

From March onwards western disturbances take a more northerly course and, except on rare occasions, their cold fronts do not pass through Karachi but their passage to the north may cause an inflow of southerly moist winds of Arabian sea origin which, assisted by insolation, may give rise to unstable conditions and the associated phenomena of squalls, duststorms and thunderstorms. Instability may be caused also by the replacement of a layer of upper air by cold air from the rear of the disturbances.

In May and June squalls may be associated with depressions which form off the Konkan and Kathiawar coasts and move in a northerly direction causing duststorms, thunderstorms and rain in lower Sind.

In the latter half of June and throughout the monsoon period squalls are generally associated with the entry into Sind of moist old monsoon air or of Arabian sea monsoon air due to depressions from the Bay of Bengal moving west or west-north-west, intensification of the low-pressure area over Sind and Baluchistan, or the formation of a well-marked trough of low pressure over the extreme north of the Arabian sea.

In the transition period between the SW. and NE. monsoons, squalls are associated either with the passage westwards of depressions from the Bay of Bengal, in which case they come from a direction between NW. and NE. and most frequently from between N. and NE., or with the passage northward or north-eastward of depressions in the Arabian sea, in which case the squalls come from a SE.-SW. direction.

2.—UPPER WINDS

Observations of upper winds over the coast are available only for the air base at Drigh Road, Karachi ($24^{\circ} 54' N.$, $67^{\circ} 11' E.$). In the absence of another coastal station farther south the data for Ahmedabad ($23^{\circ} 02' N.$, $72^{\circ} 38' E.$) have been given. This station, although inland, is situated not far from the coast; it is about 50 miles north of the head of the Gulf of Cambay and about the same distance east of the little Rann of Cutch. It is probable that the upper winds are similar to those on the coast in the same latitude.

Wind roses for these two stations are reproduced in Figs. 7-14 and the corresponding data are set out in Table IV on pages 68-75. In September 1937 a pilot-balloon station was started at Bhuj in Kathiawar, but sufficient data are not yet available to provide reliable summaries. Observations of upper winds at Gwadar are given in Part 3 which should be consulted for information about the upper air circulation in that region.

In using the tables and diagrams it should be remembered that they 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, although even then 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 rapidly above 2,000 feet, and the winds at greater heights cannot be regarded as representative of normal conditions during the monsoon.

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 6,500, 16,000 and 33,000 feet respectively.

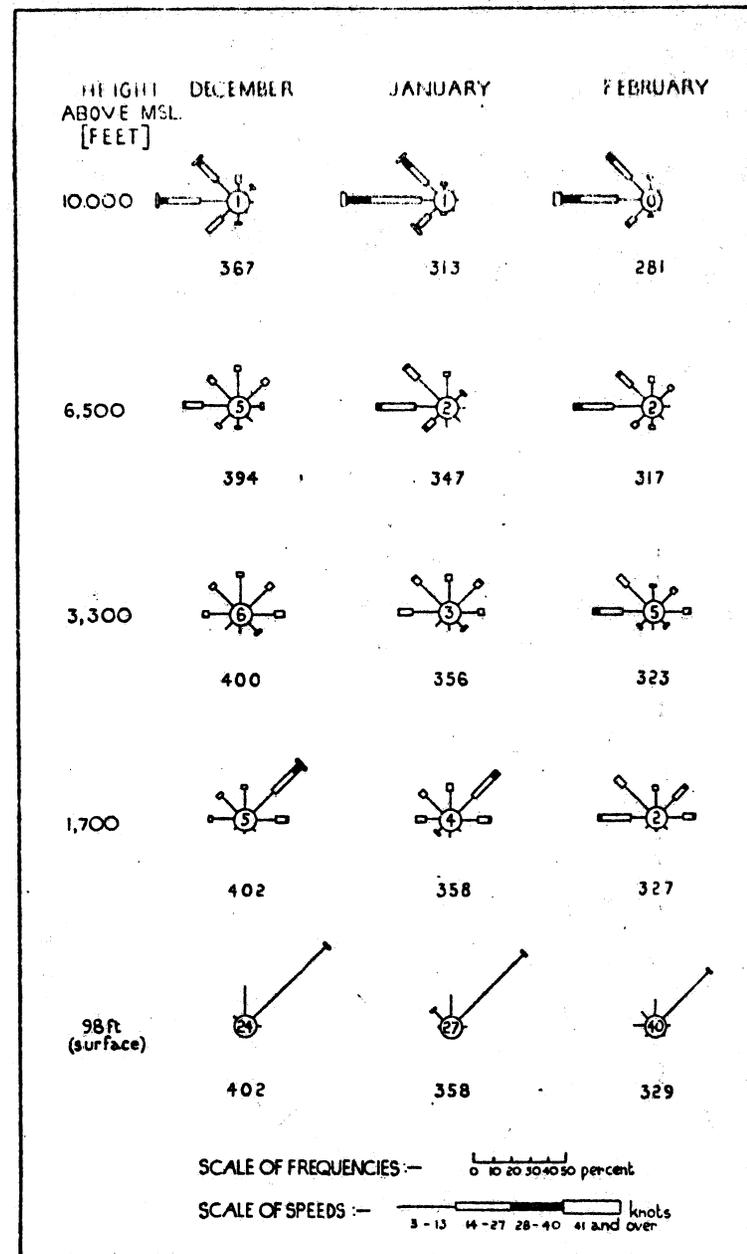


FIG. 7.—UPPER WINDS—MONTHLY

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

KARACHI
(Drigh Road)

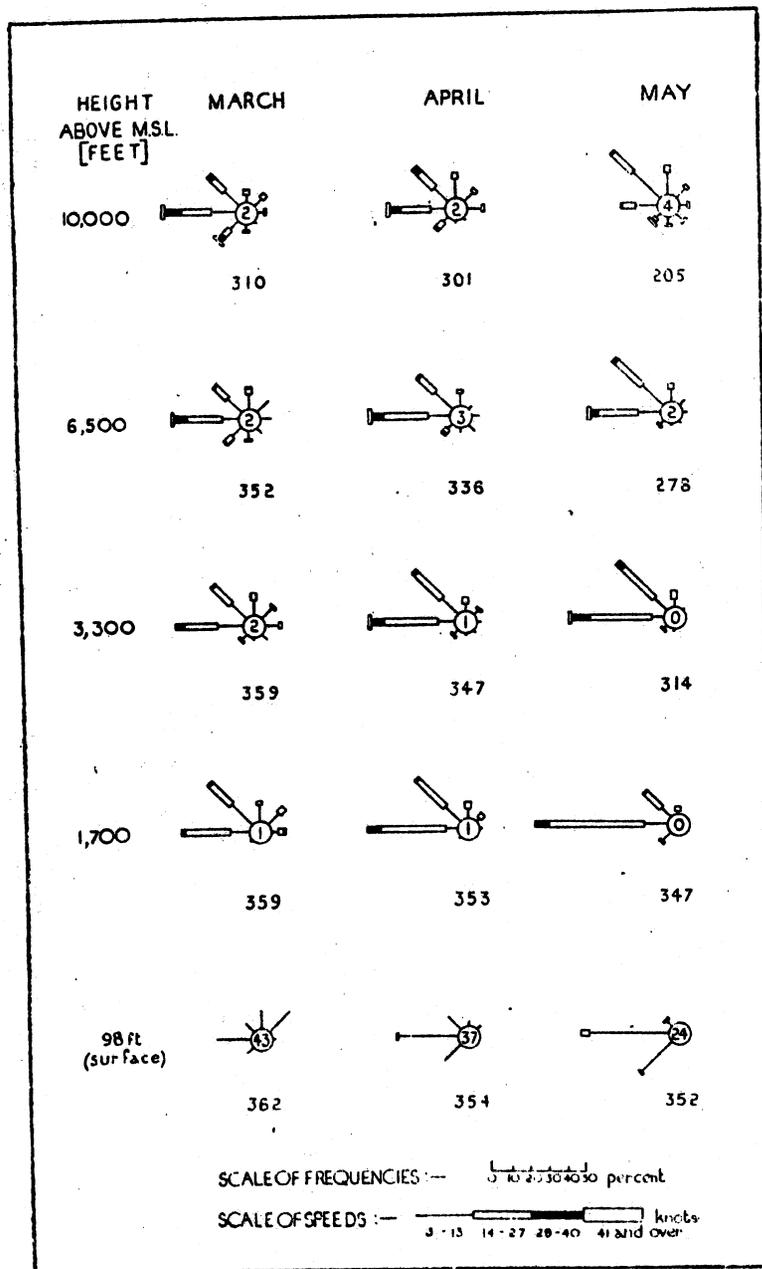


FIG. 8--UPPER WINDS--MONTHLY
Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.

KARACHI
(Drigh Road)

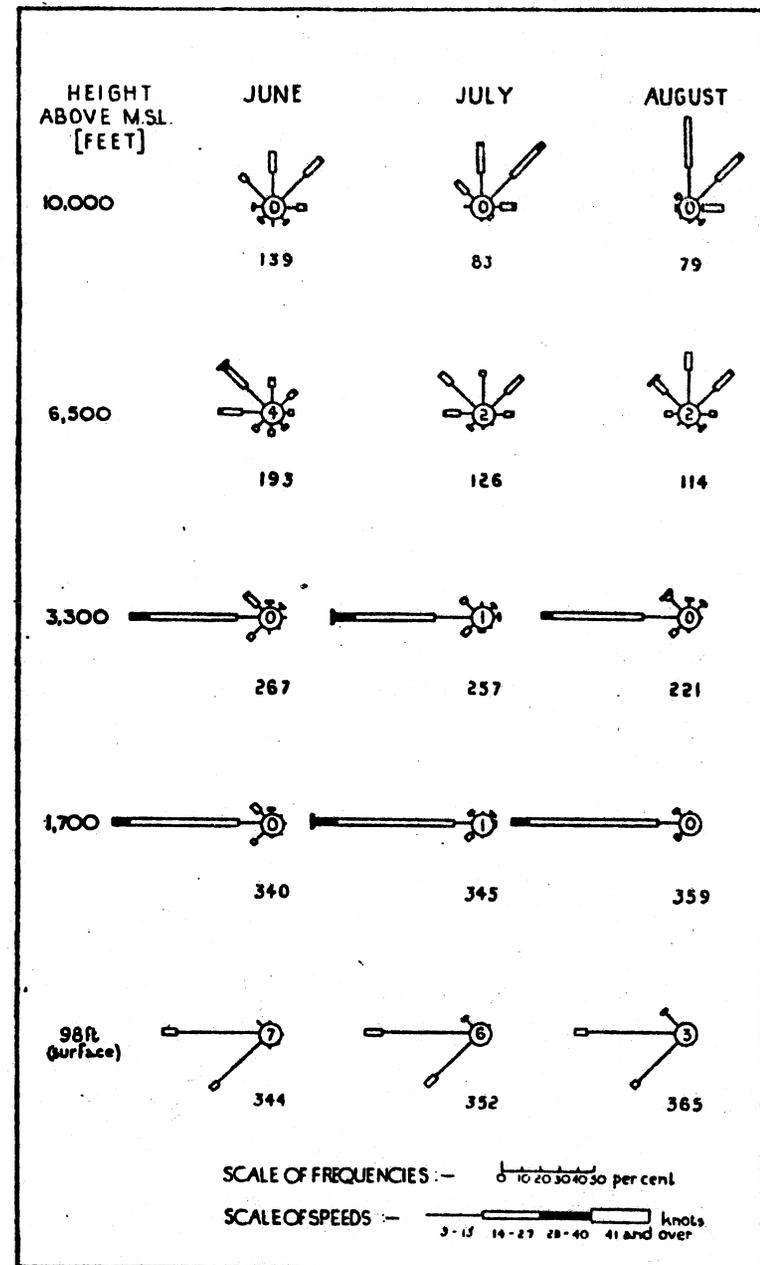


FIG. 9--UPPER WINDS--MONTHLY
Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.
The decrease in the number of observations above 1,700 ft. should be noted.

KARACHI
(Drigh Road)

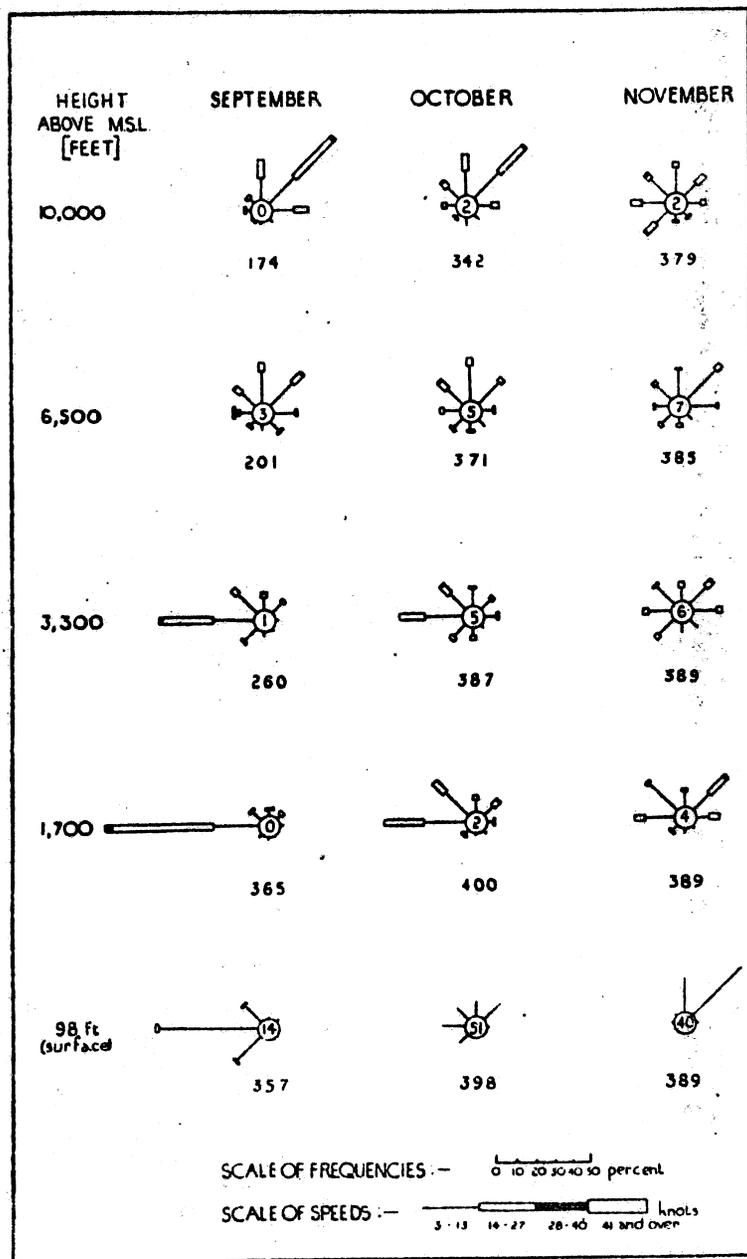


FIG. 10—UPPER WINDS—MONTHLY

Figures inside the circles indicate the percentage frequency of calms.
Figures below the roses indicate the number of observations.
Decrease in the number of observations above 1,700 ft. in September should be noted.

AHMEDABAD

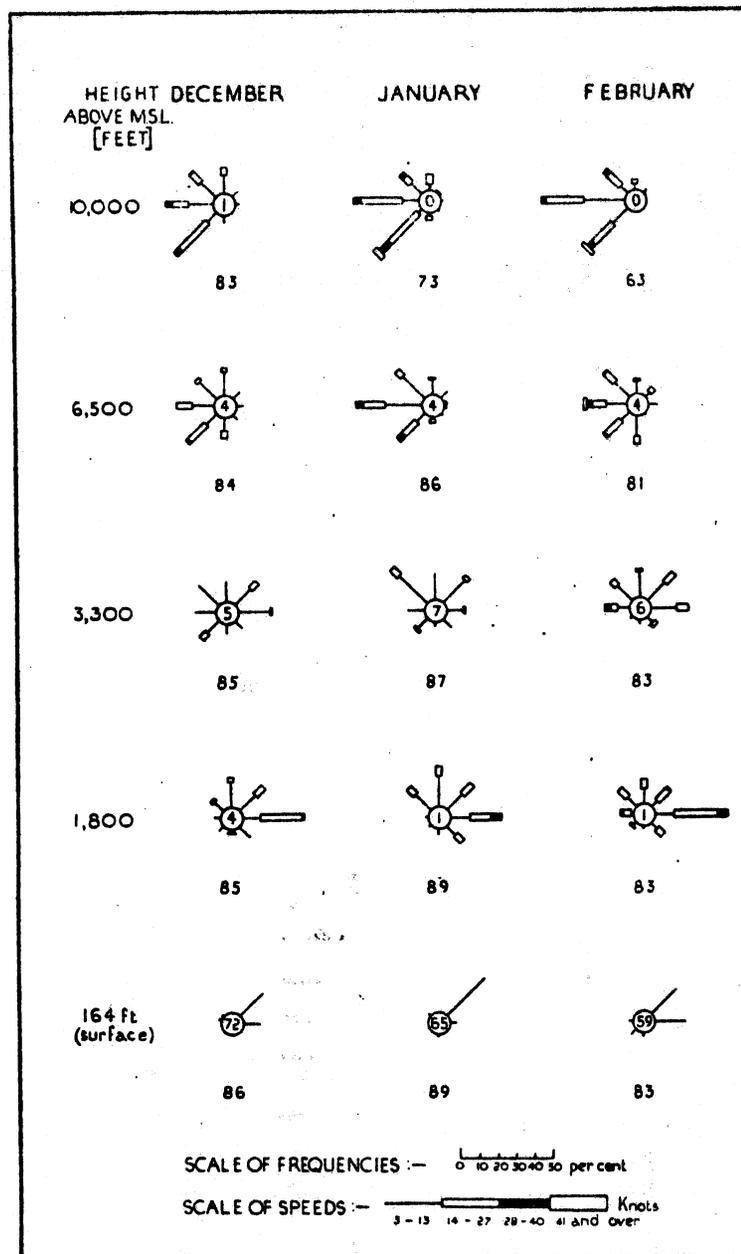


FIG. 11—UPPER WINDS—MONTHLY

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

Upper winds
AHMEDABAD

4 29

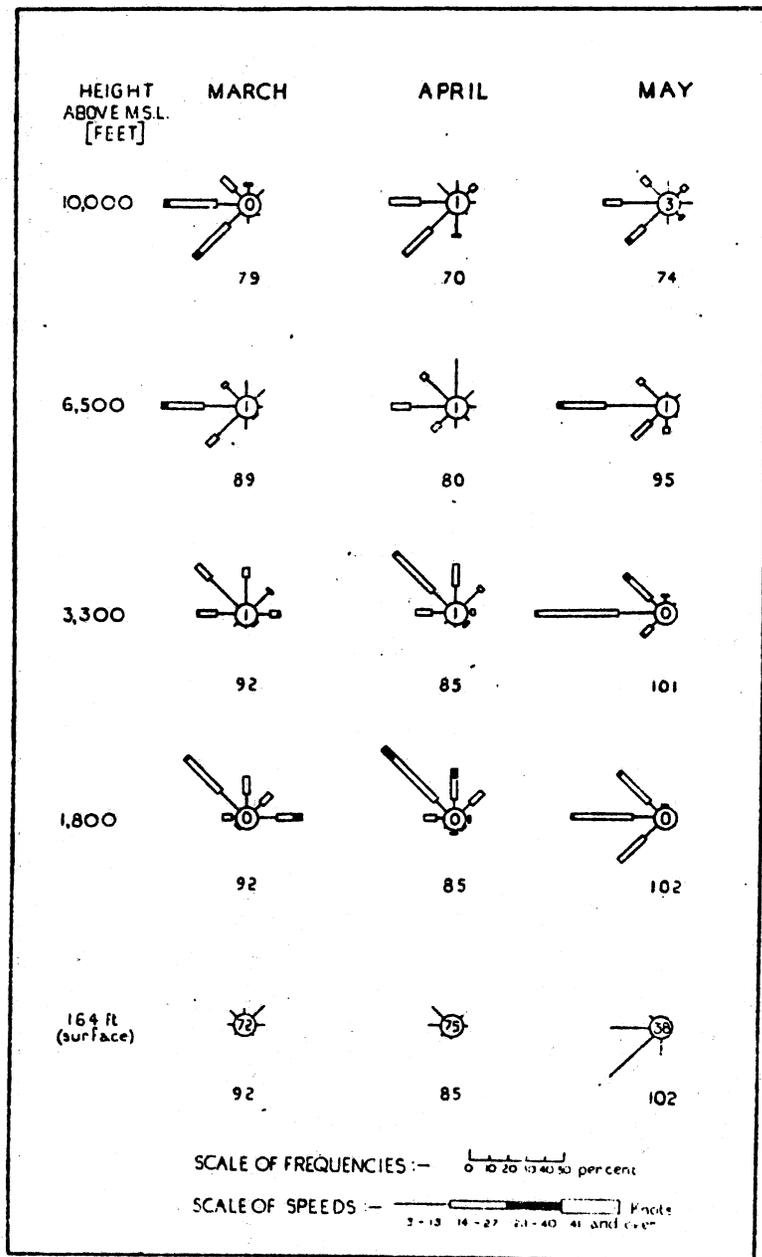


FIG. 12—UPPER WINDS—MONTHLY

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

4 30

Makran coast
AHMEDABAD

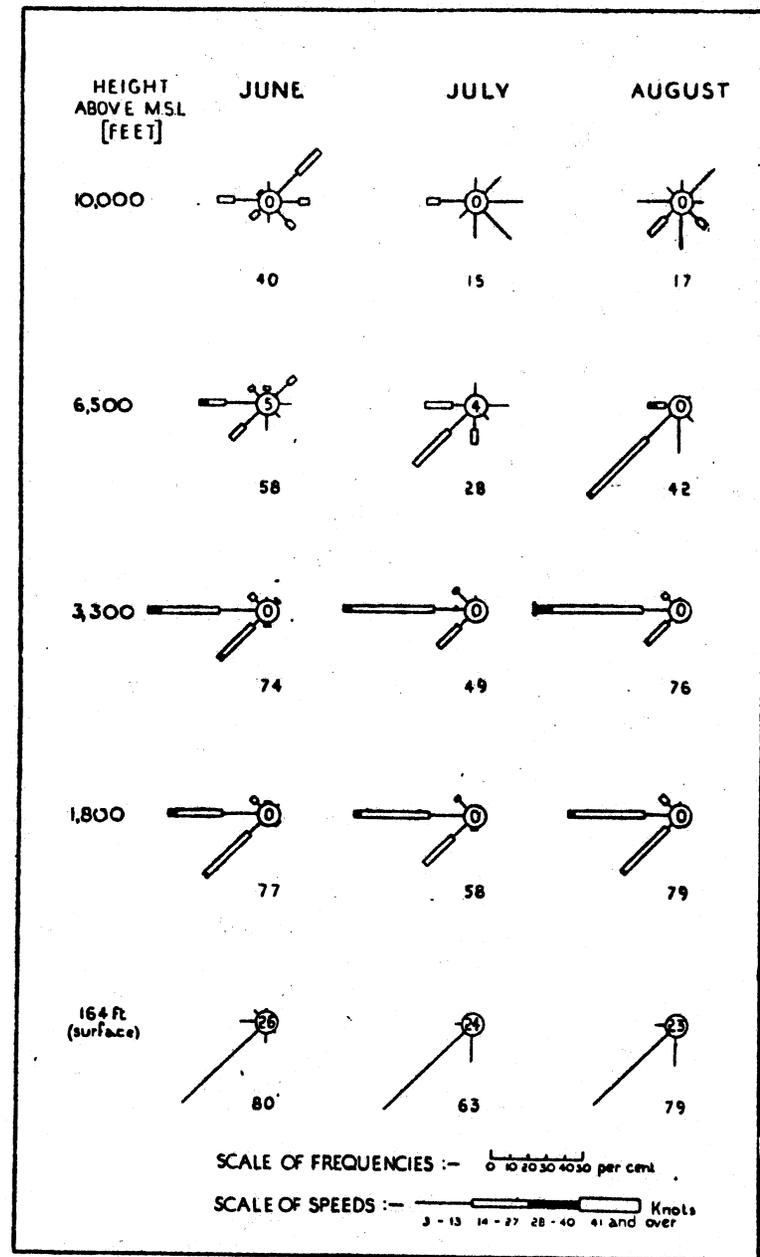


FIG. 13—UPPER WINDS—MONTHLY

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.

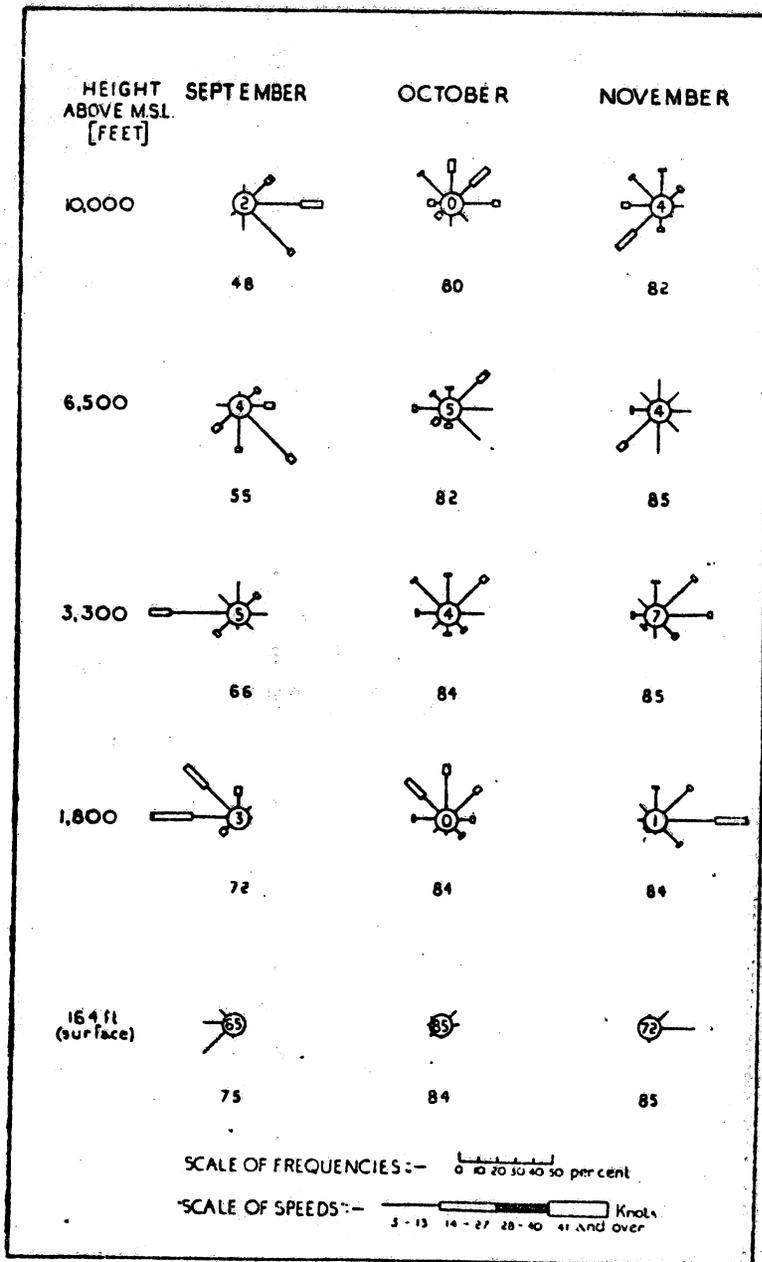


FIG. 14—UPPER WINDS—MONTHLY

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

Seasonal variation

Cool season (December to March). - In the cool season the upper air of the northern part of India, to which the region under consideration here belongs, lies within the general westerly circulation of middle latitudes.

The winds in the lower layers are affected by the high land, and the influence of the Himalayas is felt up to heights of 10,000 feet and beyond, over the whole of northern India.

North-easterly or easterly winds usually blow at the surface over the whole region except on the Makran coast where the wind tends to be northerly or north-westerly; the north-easterlies are comparatively shallow and give place to westerly winds at heights above about 3,000 feet. In latitude 20° N., which is the southern limit of the region, the height of the surface of separation between the north-easterlies of the lower levels and the westerlies of the higher levels lies at about 4,000 feet in January. This surface of separation is if anything at slightly higher levels over the land than over the sea in the same latitude. The strength of the westerly winds above the surface of separation gradually increases, at least up to the level of 10,000 feet and probably considerably beyond that height.

On the Makran coast the winds in the cool season are northerly up to about 3,000 feet and back to west above that height. There is very little change during the season except for a weakening of the upper westerlies in March.

At both Karachi and Ahmedabad the surface winds are light from NE. with very frequent calms, and their average speed in the lower layers, at 3,000 feet and below, is between 5 and 10 knots. At Karachi in December, NE. winds at 1,700 feet have a frequency of nearly 50 per cent. and their speed occasionally exceeds 40 knots; they decrease in both frequency and strength above that level, and at 3,300 and 6,500 feet winds are variable, with westerly winds becoming frequent; at 10,000 feet westerly winds prevail and may occasionally reach gale force. At Ahmedabad the prevailing winds at 1,800 feet are easterly; they become light and variable at 3,300 and westerly above that height.

The strength of the upper westerly winds increases in January and at the same time they extend to lower levels, but apart from this the winds in both January and February are similar to those in December at both places. At 10,000 feet the direction of the wind is between W. and NW. at Karachi and between W. and SW. at Ahmedabad and the speed from these directions may exceed 40 knots. The movement of the high clouds is from almost due W. at both places.

In March at Karachi calms are very frequent at the surface with W. and NW. winds prevailing from 1,700 feet upwards. The wind increases in strength and backs slightly in the upper levels. At 10,000 feet more than 75 per cent. of the observations show winds

from some westerly direction; these westerly winds not infrequently blow fresh or strong, occasionally exceeding 40 knots. Winds from N., NE. and sometimes E. may occur at all levels but southerly winds are rare. At Ahmedabad conditions are not very different except that at 1,800 feet the wind usually blows from some direction between NW. and E. backing gradually with increasing height until at 10,000 feet south-westerly winds are the most frequent. The winds at Ahmedabad are generally lighter at all levels than at Karachi. At the levels of the medium and high clouds W. winds prevail at both places.

Hot season (April and May).—On the Makran coast the surface winds from south of west veer to west at 1,700 feet and to slightly north of west at higher levels; they are light to moderate in strength, and tend to be stronger in May than in April. The surface winds on the rest of the coast throughout these months are very light and calms are frequent.

At Karachi westerly winds prevail at the surface; they are very persistent at 1,700 feet where they blow with moderate strength, and at 3,300 feet and above they occasionally exceed a speed of 40 knots; above the surface the direction of the prevailing winds gradually veers to between W. and NW. especially in May when NW. winds definitely predominate at 10,000 feet.

At Ahmedabad calms prevail at the surface in April with NW. and N. winds at 1,800 and 3,300 feet, becoming W. and SW. at 10,000 feet. In May light SW. winds begin to make their appearance at the surface and winds between SW. and NW. blow with great persistence up to 6,500 feet.

At the level of the high clouds the wind is W. at Karachi and between W. and SW. at Ahmedabad.

SW. monsoon (June to September).—During these months the SW. monsoon winds blow persistently at the surface.

On the Makran coast from Pasni eastwards the direction of these winds is more west-south-westerly or westerly than south-westerly, but to the westward of Pasni, where the coast lies to some extent under the lee of the Arabian peninsula, the winds become southerly or even south-easterly as they tend to turn up into the Gulf of Oman.

In the northern part of the region the height to which the south-westerly winds extend is not very great, and in the upper levels the winds blow chiefly from NW., N. or NE. On the Makran coast the upper limit of the monsoon winds is marked by an "inversion" or increase in temperature with height. In mid-summer this inversion is at a height of about 4,000 feet. Above that level the winds blow from NW., becoming N. and NE. at 10,000 feet. The height of the inversion decreases towards the west until at Gwadar it lies at only about 3,000 feet or even lower. This inversion probably marks the surface of separation between the NW. winds of the Persian gulf and the cooler SW. monsoon winds above which they rise.

Further south the SW. monsoon winds reach to much greater heights, and at Ahmedabad they extend up to about 8,000 feet and possibly even higher. At both Karachi and Ahmedabad the surface winds are comparatively light; at Karachi they blow from SW. or W. and at Ahmedabad chiefly from SW.; they veer to west above the surface, and their strength increases up to 3,300 feet, at which height they are usually moderate (14-27 knots) and not infrequently fresh (28-40 knots). At Karachi, the strength is sometimes greater in July than in June but it shows a definite decrease in August; no marked variations are noticeable at Ahmedabad. Easterly winds are rare below 3,000 feet.

At Karachi the wind roses show a distinct change between 3,300 and 6,500 feet, and the upper limit of the surface wind current of the SW. monsoon lies somewhere between those levels. At about 6,500 feet and above the winds are for the most part northerly, and at 10,000 feet in July and August N. and NE. winds show a decided predominance.

At Ahmedabad the SW. winds extend to somewhat higher levels but the number of observations is too few to draw any definite conclusions.

In September at Karachi at 1,700 and 3,300 feet the wind is chiefly from W. and light or moderate in strength; in the higher levels it becomes northerly with NE. winds predominating at 10,000 feet. At Ahmedabad the number of observations is too few to give reliable results but there is evidence of a general weakening of the monsoon. The predominant winds at 1,800 and 3,300 feet are W. and NW. Above that height the direction tends to become easterly.

Observations of the movement of medium and high clouds show that at Karachi during the SW. monsoon the wind above about 15,000 feet is NE. or E., veering slightly with increasing height. At Ahmedabad the direction is more variable at 16,000 feet, but from June to August it is easterly at 30,000 feet. These winds are part of the general easterly circulation which is characteristic of high levels in the equatorial regions.

As has been pointed out the frequency of overcast skies during the SW. monsoon makes any statement based on the results of pilot balloon observations rather unreliable; ascents reaching to high levels are limited to conditions when the sky is clear and the results are therefore not truly representative. There seems, however, to be fairly good evidence that the thickness of the monsoon wind current is greater in July and August than in June, and that in those months it extends up to about 8,000 feet.

Post SW. monsoon or interim period (October and November).—In October SW. monsoon conditions still persist to some extent. Over most of the region calms are very frequent at the surface. On the Makran coast the wind below about 13,000 feet in October,

and below 10,000 feet in November, is from some northerly direction and it becomes westerly at greater heights. At Karachi, westerly winds prevail up to 3,300 feet, with N. or NE. winds at higher levels as in September. At Ahmedabad light or moderate northerly winds blow at 1,800 and 3,300 feet but above that the wind is very variable.

In November winter monsoon conditions set in. Light northeasterly winds blow at the surface at Karachi, but farther south there are calms. In the upper levels the winds are variable at Karachi with a predominance of easterlies at Ahmedabad at 1,800 and 3,300 feet. The winds are light or moderate in strength but may occasionally become fresh at 10,000 feet. The change over to westerly winds at 6,500 feet which is characteristic of the winter months is not yet in evidence in November, although there is some indication of it at 10,000 feet.

The direction of motion of high clouds is W. or SW. at both places.

IV—VISIBILITY

Table V gives the percentage frequency of visibilities between different limits in the morning and afternoon in the different months of the year at Pasni, Karachi (Manora), Dwarka and Veraval. 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. The morning observations are made at 0800 local time by which time the early morning mist and fog may have dispersed.

On the whole the visibility throughout the region is good compared with that usually recorded in more temperate climates. The period with the best visibility is from September to February. The main causes of bad visibility are early morning fog, dust or rain. Fog usually lasts for only a few hours, and the weather generally clears by midday.

Bad visibility due to dust haze is most prevalent on the Makran coast where the periods between falls of rain may be long and the land dries up. On the eastern part of the Makran coast dust haze is most likely to occur in May and June before the arrival of the SW. monsoon, but it may occur also at other times of the year.

Seasonal variation

Cool season (December to March).—The visibility during the month of December is on the whole good except during rain, and there are not, as a rule, more than 3 days with rain during the month; there may also be fog in the early morning.

On the Makran coast fog may occur once or twice in January and two or three times in February and March. Early morning fogs occur in March for about an hour before and after sunrise, and these may extend along the coast to Karachi. Towards the

end of the month moderately strong winds during the day begin to raise the dust and hence reduce the visibility.

During this season severe duststorms or sandstorms may occur after the passage of a western depression, i.e. in the cold front region, if the depression has not been accompanied by rain. These storms sometimes carry the dust as far eastwards as Karachi.

On the coasts of Kathiawar, Cutch and Sind on a small number of occasions in December the visibility may be poor on account of either fog or dust haze. During January and February after a calm night dense banks of fog occasionally come off the land; they drift seaward with the land winds and return with the sea breeze until the heat of the day disperses them.

Hot season (April and May).—On the Makran coast in April the visibility is only fair to good owing to dust haze which persists for a few days even after the strong winds associated with duststorms have subsided. These duststorms, associated with high winds, occur even more frequently in May, when there are 3 or 4 a month, and the resultant dust haze may impair the visibility on from 6 to 10 days during May. Morning fog is also likely to be experienced once or twice during the month.

On the Kathiawar, Cutch and Sind coasts during April and May the visibility is also poor on a few occasions, owing to fog or dust haze.

SW. monsoon (June to September).—The visibility is fair to poor over the Makran coast during June owing to dust haze; the atmosphere begins to get clearer in July, but misty and hazy conditions may still prevail in the early morning. The visibility definitely improves in August, and remains generally good throughout August and September. In September morning fog lasting for a short period may occur on from 1 to 3 days during the month, but on the whole the visibility is good on from 60 to 90 per cent. of occasions. In some years during this month duststorms may be induced on the Makran coast by eastern depressions and this will cause a deterioration in the visibility.

On the coasts of Kathiawar, Cutch and Sind, the SW. monsoon is felt to a greater extent than on the Makran coast, and the warm moist air of the monsoon may cause hazy conditions at sea near the coast so that the land cannot be seen from a distance; otherwise during these months the visibility in this region is nearly always moderately good, except inland where the hills are often covered with low clouds.

Post SW. monsoon or interim period (October and November).—On the Makran coast during these months the visibility is almost invariably good except in the early morning or the late evening, when a certain amount of haze over the sea decreases the visibility; in the neighbourhood of Karachi fog may be experienced occasionally in the morning. Morning fog occurs on 4 or 5 days during October and on 2 or 3 days in November.

On the coasts of Cutch and Sind, and in the Gulf of Cutch, dense banks of fog occasionally come off the land after a calm night in October; they drift seaward with the land wind and return with the sea breeze until the heat of the day disperses them.

V—CLOUD

Step diagrams showing the monthly variation of mean cloud amount at 0800 local time are reproduced in Fig. 15; the corresponding data are given in the general climatological tables on pages 61-5 and for Gwadar in Part 3.

Table VI shows the monthly frequencies of different amounts of cloud in the morning and afternoon at Pasni, Karachi (Manora), Dwarka and Veraval.

Observations of the amount of low cloud, i.e. of cloud with base below 8,000 feet, are available only for a short period of years, but owing to their importance in air navigation a supplementary table of the results is given on page 39. In view of the shortness of the period the figures must be regarded as giving only a general indication of the normal. The table shows for each month the total amount of cloud, the amount of low cloud, and also the difference between the two. The results are given for the morning and afternoon hours of observation separately.

General.—Detailed observations of cloud throughout the 24 hours are available only for Karachi where there is a meteorological observatory. The figures quoted in the following paragraphs refer to the morning hour of observation, i.e. about 0800 local time.

The cloud amount in this region depends very much on the time of the year, the amount is greatest during the months of the SW. monsoon when the sky is frequently overcast with low cloud.

The average cloud amount for the year is from 3 to 4 tenths, this includes all types of cloud. From June to September when the SW. monsoon winds are blowing the average amount is between 6 and 7 tenths; during the other months the average is between 2 and 3 tenths. The month with least cloud is November, when the average for the region is only 1 or 2 tenths.

Seasonal and diurnal variation

Cool season (December to March).—There is very little cloud in this season, and such as there is, is usually associated with the passage of western depressions. The amount diminishes eastwards and southwards; at Gwadar in the extreme west the sky is on the average between 3 and 4 tenths covered, whereas at Veraval in the south the average is between 1 and 2 tenths.

On the Makran coast the chances of the sky being 7 tenths or more covered at 0800 are 25 per cent. compared with about 10 per cent. at Veraval, and the chances of the cloud amount being 3 tenths or less are 65 per cent. at Pasni compared with 80 per cent. at Veraval.

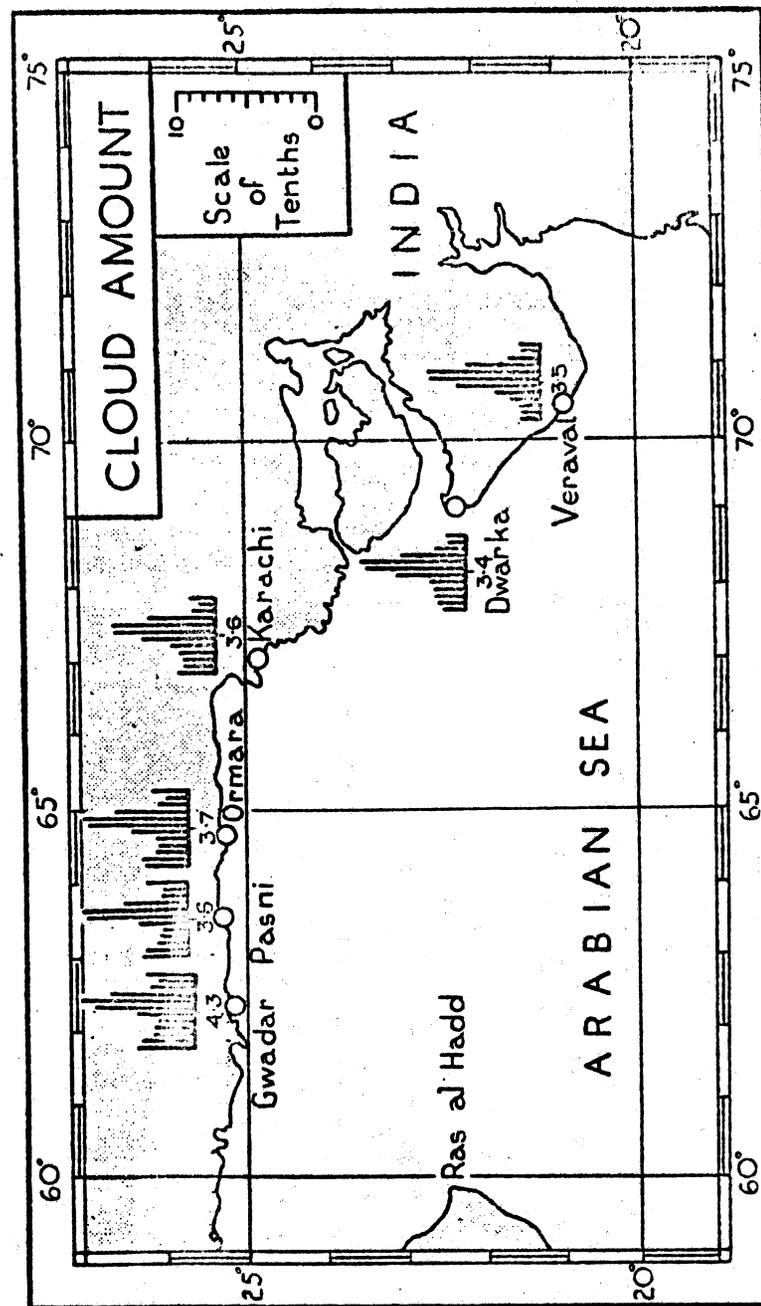


FIG 15—MONTHLY VARIATION IN MEAN CLOUD AMOUNT
The figures below the step diagrams indicate the mean annual amount of cloud. The diagrams are for 0800 local time.

MONTHLY AVERAGES OF THE AMOUNT OF CLOUD OF ALL TYPES
COMPARED WITH THAT OF LOW CLOUD

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	<i>tenths</i>												
PASNI													
0800. Total	3.4	3.2	2.3	2.2	1.9	3.6	7.3	7.7	4.6	1.9	1.8	3.0	3.6
Low	1.6	1.5	1.0	0.8	1.3	2.4	4.9	5.9	3.7	1.5	0.7	1.6	2.2
Diff.	1.8	1.7	1.3	1.4	0.6	1.2	2.4	1.8	0.9	0.4	1.1	1.4	1.4
1630. † Total	2.9	2.5	2.0	2.1	1.5	1.8	4.3	4.0	1.2	0.3	1.6	2.5	2.2
Low	1.3	1.1	0.9	0.7	0.9	1.2	2.5	3.3	0.9	0.2	0.8	1.3	1.3
Diff.	1.6	1.4	1.1	1.4	0.6	0.6	1.8	0.7	0.3	0.1	0.8	1.2	0.9
ORMARA													
0800. Total	3.1	3.3	2.4	2.2	2.3	4.1	7.1	7.6	5.4	2.2	1.7	2.6	3.7
Low	1.4	1.7	1.4	1.3	1.9	3.5	5.9	6.1	4.2	1.9	0.6	1.5	2.6
Diff.	1.7	1.6	1.0	0.9	0.4	0.6	1.2	1.5	1.2	0.3	1.1	1.1	1.1
1630. † Total	2.5	2.7	1.8	1.9	1.6	1.7	4.1	3.6	1.4	0.4	1.3	2.3	2.1
Low	1.3	1.2	0.9	1.0	0.9	1.2	2.5	2.4	1.0	0.1	0.5	1.3	1.2
Diff.	1.2	1.5	0.9	0.9	0.7	0.5	1.6	1.2	0.4	0.3	0.8	1.0	0.9
KARACHI (MANORARA)													
0800. Total	3.3	3.6	2.4	2.4	3.0	5.5	8.3	8.2	5.8	1.6	2.3	2.7	4.1
Low	0.8	1.7	1.1	0.8	2.4	4.5	6.4	6.8	4.5	1.2	0.5	1.2	2.7
Diff.	2.5	1.9	1.3	1.6	0.6	1.0	1.9	1.4	1.3	0.4	1.8	1.5	1.4
1600. Total	2.7	2.9	2.3	2.0	2.2	4.2	7.0	7.0	3.7	0.9	2.0	3.0	3.3
Low	0.7	1.1	0.7	0.6	1.5	3.4	4.6	4.9	2.6	0.5	0.5	0.8	1.8
Diff.	2.0	1.8	1.6	1.4	0.7	0.8	2.4	2.1	1.1	0.4	1.5	2.2	1.5
DWARKA													
0800. Total	2.3	3.1	2.6	2.7	3.7	6.1	9.0	9.3	6.5	2.3	2.4	2.7	4.4
Low	0.3	0.7	0.5	0.6	1.7	4.3	5.6	5.8	3.2	0.8	0.6	0.5	2.1
Diff.	2.0	2.4	2.1	2.1	2.0	1.8	3.4	3.5	3.3	1.5	1.8	2.2	2.3
1600. Total	2.2	2.6	1.8	1.3	3.2	6.1	8.7	8.7	5.6	1.7	2.3	1.9	3.8
Low	0.2	0.5	0.2	0.4	1.2	3.9	4.6	5.5	3.2	0.7	0.5	0.2	1.8
Diff.	2.0	2.1	1.6	0.9	2.0	2.2	4.1	3.2	2.4	1.0	1.8	1.7	2.0
VERAVAL													
0800. Total	1.6	2.0	1.6	2.0	3.3	6.5	8.6	8.7	6.6	2.8	2.3	2.0	4.0
Low	0.3	0.8	0.5	1.2	2.0	4.2	5.9	6.2	4.4	1.1	0.5	0.5	2.3
Diff.	1.3	1.2	1.1	0.8	1.3	2.3	2.7	2.5	2.2	1.7	1.8	1.5	1.7
1600. Total	1.7	1.6	1.2	1.1	2.3	6.1	8.1	8.0	6.0	2.8	2.3	1.8	3.6
Low	0.3	0.5	0.3	0.7	1.1	3.7	5.2	5.2	3.8	1.3	0.8	0.4	1.9
Diff.	1.4	1.1	0.9	0.4	1.2	2.4	2.9	2.8	2.2	1.5	1.5	1.4	1.7

Authorities.—Bibliography Nos. 50, 52.

Periods.—Pasni, 1928-37; Ormara, Mar. 1928-Feb. 1938; Karachi, Dwarka, Veraval, 1933-7. Monthly averages of the total cloud amount at 0800 for longer periods are given in the general climatological tables for Karachi, Dwarka and Veraval.

Note.—The standard of time is local mean time or differs from that by less than 20 min.

† Before July, 1934, the observations were made at 1830.

The proportion of low cloud to high cloud is also greater in the west than in the south—at Pasni about half the cloud is low cloud, whereas at Veraval only about a quarter is low cloud.

At Karachi there is on the average a slight increase in the cloud amount in the early morning and a decrease in the evening, but as the total cloud amount, at any time, is small, its diurnal variation is not likely to be of much practical importance.

Hot season (April and May). The mean cloud amount over the whole area during April and May is between 2 and 3 tenths and shows little regular variation from place to place.

On the Makran coast the sky is less cloudy than in the cool season owing to the decrease in the frequency of western depressions. On the coast south of Karachi, on the other hand, there is a slight increase in cloudiness during the hot season, the increase being more noticeable in May than in April; it is associated with a change from the northerly land winds to the westerly or south-westerly sea winds, which are a prelude to the arrival of the monsoon.

The chances of there being 7 tenths or more of cloud at 0800 are between 10 and 20 per cent. in April and between 15 and 25 per cent. in May. The chances of there being 3 tenths or less of cloud are about 75 per cent. in April; in May the chances are less especially in the south.

At Karachi the cloudiness in April shows very little regular variation during the day. In May the amount is greatest at about sunrise and shows a definite decrease of about 2 tenths between sunrise and noon; it increases again slightly in the early evening and then decreases until about midnight. As the total cloud amount is small its diurnal variation is not likely to be of much practical importance.

SW. monsoon season (June to September).—The amount of cloud during this season is high compared with the other months of the year, and much low cloud occurs especially in the early morning. The increase in cloud amount is due to the arrival of the SW. monsoon and occurs earlier in the south than in the north and west. In June and to some extent also in July there is a well marked decrease in cloudiness from south to north in contrast with conditions during the cool season; but in August the distribution is fairly uniform with about 8 tenths of the sky covered with cloud. There is a well-marked decrease in cloudiness in September when the amount is only 5 tenths.

On the Makran coast the amount of cloud varies from about 4 or 5 tenths in June, to 7 or 8 tenths in August, and diminishes to between 5 and 6 tenths in September. On the coasts of Kathiawar and Sind the cloud amount is between 5 and 6 tenths in June increasing to 7 or 8 tenths in July and August and falling off to about 5 or 6 tenths in September when the amount is similar to that in June. On the Makran coast completely cloudless skies are infrequent in July and August; south of Karachi they are rare throughout the season. Skies more than 7 tenths cloud-covered at 0800 occur on about 50 per cent. of occasions in June and September, and on

between 80 and 90 per cent. in July and August. In all months they are more frequent south of Karachi than on the Makran coast.

On the Makran coast during the first half of June convectional clouds appear during the afternoons and from the middle of the month low clouds are often stratiform in type. These stratiform clouds are considered to be closely associated with the inversion of temperature in the upper air that is found over this region. (See page 52).

The low cloud has a definite diurnal variation and is more frequent in the forenoon than in the afternoon especially on the Makran coast. At Karachi the cloud amount in July and August varies from about 6 tenths at 2000 or 2100 to about 8 tenths at 0300. This night oscillation appears to be an important feature. The decrease from the 0300 maximum to the evening minimum is slow and irregular; there is some evidence of a slight rise from 0800 to 1000.

Post SW. monsoon or interim period (October and November).—Throughout the region this is the period of least cloudiness.

On the Makran coast these months are very similar to those of March and April, the mean cloud amount being about 2 tenths. On the coasts of Kathiawar and Sind the cloudiness is even less, the amount varying between about 1 and 2 tenths.

The chances of the sky being 7 tenths or more cloud-covered at 0800 are about 15 per cent., whereas the chances of the amount being 3 tenths or less are about 75 per cent.

The diurnal variation is small and irregular; there is, if anything, a slight increase of cloud in the early morning and a decrease in the evening; owing to the small amount of cloud experienced during these months the variation is not likely to be of much importance.

Height.—Observations of the height of cloud have been made only in recent years and sufficient data have not yet accumulated to give a reliable normal. One source of information is to note the height at which pilot balloons are lost in cloud, but these results take no account of occasions when rain was falling or when cloud was so low as to make a pilot-balloon ascent impracticable. This limitation, however, is not so great in this region as in the rainier regions to the southward. Table A on page 42 gives the results obtained by this method at Karachi and Ahmedabad, a similar table for Gwadar is given in Part 3.

Of greater practical importance from the point of view of aviation is information of the height of the cloud base on occasions when the sky is overcast. The limited number of observations available are summarised in Table B.

Skies 9 or 10 tenths covered with cloud below 1,000 feet are rare, during the period 1937-8 they occurred on less than 5 days a year in the morning and never in the afternoon.

TABLE A—HEIGHT OF BASE OF LOW CLOUD
Percentage number of days on which balloons became invisible between definite limits of height.

Height	Karachi (Drigh Rd.)				Ahmedabad			
	Jan.	Apr.	July	Nov.	Jan.	Apr.	July	Nov.
<i>feet</i>	<i>a.m. p.m.</i>	<i>a.m. p.m.</i>	<i>a.m. p.m.</i>	<i>a.m. p.m.</i>	<i>a.m. p.m.</i>	<i>a.m. p.m.</i>	<i>a.m. p.m.</i>	<i>a.m. p.m.</i>
Above 10,000	88 79	79 83	25 21	99 88	94 92	90 88	13 23	96 96
8,000-10,000	3 6	4 4	4 5	-6 3	2 3	2 5	4 2	3 2
6,500-8,000	4 5	3 3	4 5	0 0	-8 0	3 3	5 11	0 0
5,000-6,500	1 4	3 4	13 8	-7 2	-8 2	2 2	13 24	0 0
3,300-5,000	3 6	5 4	22 30	0 1	0 0	0 0	19 21	-8 0
1,600-3,300	1 1	5 1	31 29	0 0	0 0	-8 0	27 5	0 0
1,000-1,600	0 0	-7 0	-6 0	0 0	0 0	0 0	4 0	0 0
Below 1,000	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
No ascent	0 4	0 7	-6 2	0 6	2 3	2 2	15 14	0 2

Authority.—Bibliography No. 7.

Periods.—Karachi, Nov. 1927-July 1932.

Ahmedabad, a.m. July 1928-July 1932; p.m. Nov. 1930-July 1932.

TABLE B—FREQUENCY OF SKY 9 OR 10 TENTHS OVERCAST WITH CLOUD BELOW 8,000 FEET

Period: 1937-8

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	<i>days</i>												
Gwadar*													
morning ..	2	1	1	<1	0	7	8	18	7	3	0	0	47
afternoon ..	<1	<1	0	0	0	0	2	7	1	0	0	<1	12
Karachi (Drigh Rd.)													
morning ..	1	1	0	<1	7	8	12	10	12	2	0	<1	54
afternoon ..	1	0	<1	0	1	2	11	13	3	0	0	<1	32
Ahmedabad													
morning ..	0	0	0	0	1	6	9	5	3	<1	0	<1	25
afternoon ..	0	0	0	0	0	4	7	7	3	<1	0	0	21

Authority.—Bibliography No. 51.

* At Gwadar observations are lacking in November and December, 1938.

The following notes summarise briefly the information season by season:—

Cool season (December to March).—Cloud at very low levels is rare. Skies 9 or 10 tenths overcast with cloud below 1,000 feet have been recorded on rare occasions in all parts of the coast in the morning but never in the afternoon. At Gwadar skies 9 or 10 tenths overcast with cloud below 8,000 feet are recorded on 1 or 2 days per month; they are less frequent at Karachi and are very rare south of Karachi.

Hot season (April and May).—Low cloud continues to be infrequent in April but its frequency increases in May especially at Karachi.

SW. monsoon (June to September).—Skies 9 or 10 tenths overcast with cloud below 8,000 feet are comparatively frequent. At Gwadar and Karachi the most frequent height of the cloud base on these occasions is between 2,000 and 3,000 feet; the cloud frequently descends below 2,000 feet but rarely below 1,000 feet. The cloud base at Ahmedabad tends to be at a greater height in the afternoon than in the morning.

Post SW. monsoon or interim period (October and November).—There is very little low cloud in this season. In 1937 at Gwadar, and in 1937 and 1938 at Karachi and Ahmedabad, skies 9 tenths or more covered with cloud below 8,000 feet were never recorded in November, and on over 95 per cent. of occasions pilot-balloon ascents were not interrupted by cloud below 10,000 feet.

VI—RAIN AND HAIL

I—RAIN

Step diagrams showing the monthly averages of rainfall and rain days are reproduced in Figs. 16 and 17 and the corresponding data for Pasni, Ormara, Karachi, Dwarka and Veraval are given in the climatological tables on pages 61-5; for Gwadar the data are given in Part 3 and for Surat in the table below:—

Surat.—MEAN MONTHLY RAINFALL AND NUMBER OF RAIN DAYS
Period: 43 years

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Rainfall ..	4	2	0.5	1	6	212	424	192	150	44	5	1	1,041
	<i>millimetres</i>												
Rain days ..	0.2	0.2	0.1	0.0	0.4	8	16	13	7	2	0.3	0.1	47
	<i>days</i>												

Authority.—Bibliography No. 1.

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.—In respect of rainfall the region may be divided roughly into two parts. In the first, which includes the Makran coast from Gwadar eastwards to the neighbourhood of Ormara, the rainfall is scanty, and such falls as occur are almost entirely in the winter. In the second, from Karachi southwards to latitude 20° N., the rainfall is heavier and increases towards the southern limit; except for very light falls it is confined to the summer months. The region between Ormara and Karachi may get rain in either summer or winter but the annual total is small.

Annual rainfall.—The Makran coast between Gwadar and Karachi may be regarded almost as a desert in respect of its rainfall, which is uncertain and scanty. Sometimes for two or three consecutive years there is less than 75 mm. (3 in.) of rain in the year.

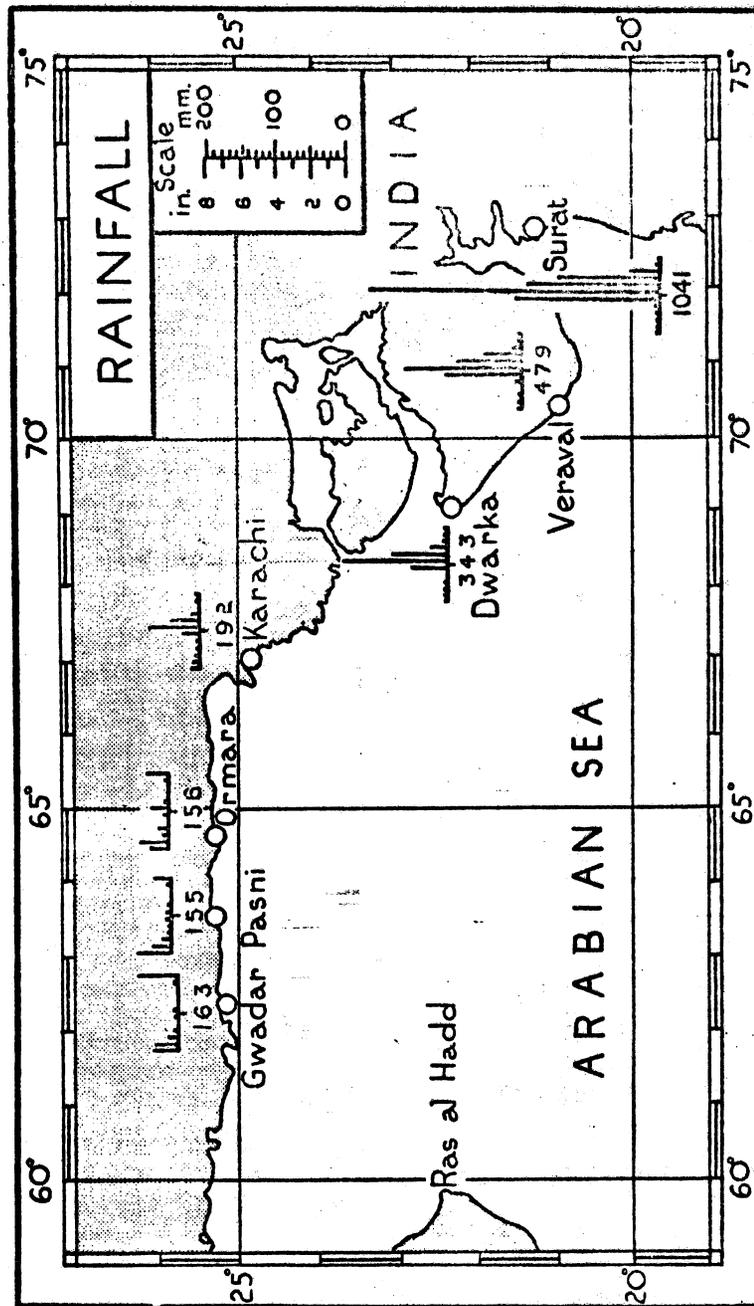


FIG 16—MONTHLY VARIATION OF RAINFALL
The figures below the step diagrams indicate the total annual amount of rain in millimetres.

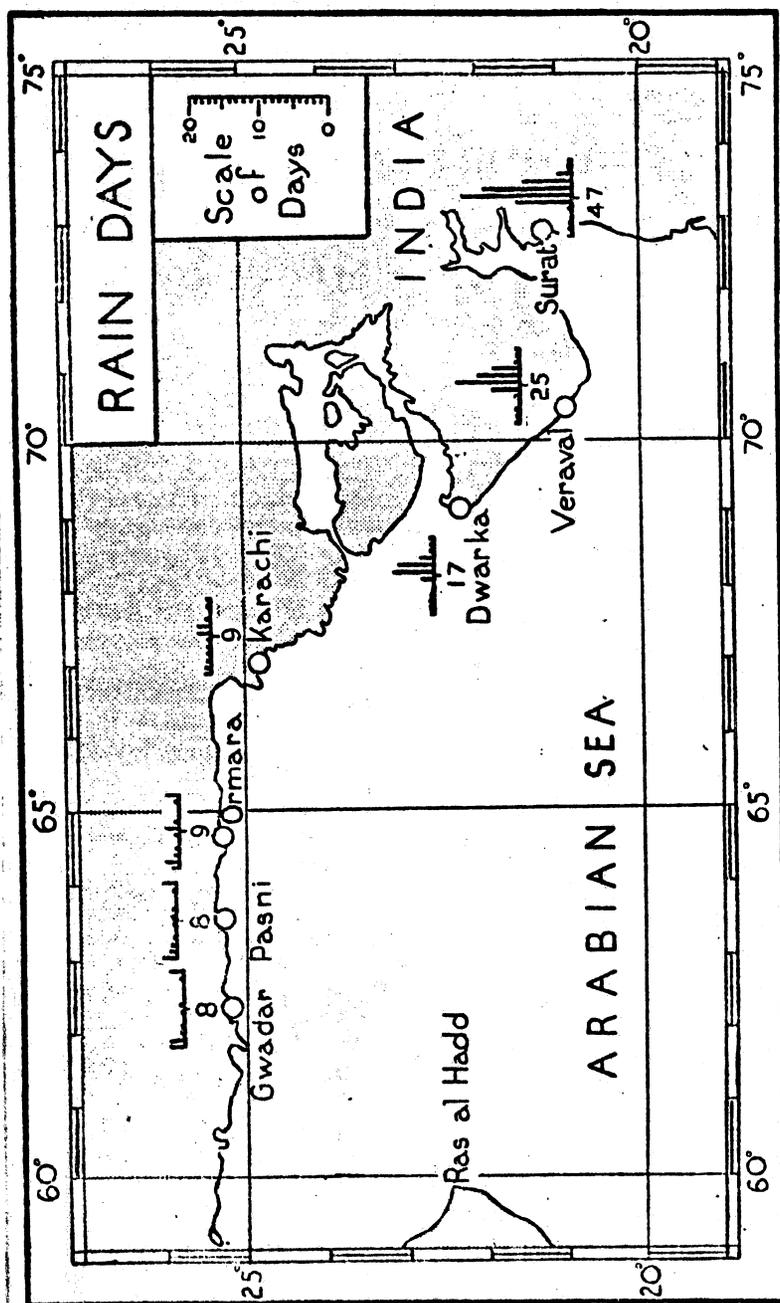


Fig. 17—MONTHLY VARIATION IN THE FREQUENCY OF RAIN DAYS
The figures below the step diagrams indicate the total number of rain days in the year. A rain day is taken as one on which 2.54 mm. (0.1 in.) or more of rain falls.

Rain exceeding one tenth of an inch (2.54 mm.) falls on an average of only 8 or 9 days in the year and in all parts the average fall is less than 200 mm. (8 in.); at Pasni and Ormara it amounts to only just over 150 mm. (6 in.). Along the coast to the south-eastward of Karachi the rainfall increases very rapidly, and at places which are exposed to the winds of the SW. monsoon the annual fall in the year is 6 or 7 times as great as on the Makran coast. At Dwarka the average total is 343 mm. (13.5 in.) and at Surat it rises to 1,041 mm. (41.0 in.). Even in the regions of greatest rainfall, however, the number of days with rain exceeding one tenth of an inch (2.54 mm.) is only 47, and at Karachi there are on the average only 9 days with rain a year.

In the province of Sind which is one of the driest and hottest parts of India, the average rainfall for the year is about 150 mm. (6 in.) of which 125 mm. (5 in.) falls between June and September.

Seasonal variation

Cool season (December to March).—The rain that falls in this season is associated almost entirely with western depressions, and on the coast these depressions rarely cause rain farther east than Karachi. Even on the coast to the west of Karachi rain of more than one tenth of an inch (2.54 mm.) falls only on one or two days a month. The months with the heaviest rain are from December to February, and the total for the three months varies from about 125 mm. (5 in.) at Gwadar in the west to 27 mm. (about 1 in.) at Karachi. South-eastward of Karachi the season is usually almost rainless, and the average monthly falls are less than 5 mm. (0.2 in.). The rainfall during the cool season is very variable from year to year; even on the Makran coast it is not infrequent for any of the months to be rainless, whereas in other years the rainfall may be fairly heavy. (See page 47).

Hot season (April and May).—Western depressions cease to affect the region during these months, and the season is practically rainless; in fact rain only occurs in occasional years. The average number of rain days is less than one all along the coast, and the total rainfall does not exceed 15 mm. (0.6 in.) on the average. Such rain as occurs is chiefly associated with thunderstorms.

SW. monsoon (June to September).—The rainfall during these months is associated with the SW. monsoon and also with eastern depressions which are related thereto.

In the region affected by the monsoon the rainfall shows a very rapid increase as soon as the monsoon sets in. It is heaviest in the south and decreases rapidly northwards. It is felt to some extent at Karachi, but on the Makran coast to the west the season is practically rainless, though on rare occasions there may be a fairly heavy fall even as far west as Gwadar.

July is the wettest month with an average of 424 mm. (16.7 in.) at Surat compared with about 200 mm. (8 in.) in June and August. Farther north the amounts are considerably less, 153 mm. (6.0 in.) at Dwarka in July and only 75 mm. (2.9 in.) at Karachi. In the south it rains on about one day in two in July, whereas at Karachi there is an average of only two rain days in the month.

The intensity of the rainfall may be judged by the fact that in London it would take about 17 days in summer to give the amount of rain which falls at Karachi in 2.

In September the rainfall is still comparatively heavy in the southern part of the region and the amounts associated with eastern depressions may be sometimes exceptionally large. On September 4 to 6, 1926, an eastern depression passed over Karachi which gave a total of 359 mm. (14.1 in.) in 36 hours, an amount which is nearly double the normal for the whole year at that place. The rainfall associated with these depressions, however, seldom extends as far westward as Pasni.

Post SW. monsoon or interim period (October and November).—October is practically rainless except in the extreme south of the region, and in November the amount of rain is small in all parts. Surat has an average of 44 mm. (1.7 in.) in October falling on an average of two rain days, but elsewhere in the region rain is rare, especially on the Makran coast. In November the average amount all along the coast is only about 5 mm. (0.2 in.). On the Makran coast from Gwadar to Ormara western depressions begin to affect the region but they are infrequent and cause only a small amount of rain.

Extremes of annual and monthly rainfall.—The following table gives the greatest and least amounts of rainfall that have occurred in each month and in the year at a number of stations on the coast.

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) Ormara (10 yrs.)	87 0(3)	177 0(3)	22 0(6)	77 0(7)	1 0(9)	45 0(8)	153 0(4)	13 0(8)	2 0(9)	1 0(9)	15 0(8)	157 0(3)	818 55
(b) Karachi (82 yrs.)	86 0(26)	75 0(33)	97 0(45)	121 0(69)	47 0(71)	269 0(46)	473 0(11)	359 0(14)	300 0(38)	40 0(74)	118 0(65)	36 0(13)	711 72
(c) Dwarka (36 yrs.)	25 0(23)	73 0(21)	59 0(26)	24 0(31)	8 0(29)	306 0(6)	551 1	356 1	390 0(3)	158 0(26)	24 0(31)	13 0(30)	949 26
(a) Veraval (36 yrs.)	13 0(25)	19 0(23)	22 0(31)	1 0(35)	181 0(27)	454 <1	635 28	583 8	458 0(2)	288 0(24)	29 0(29)	28 0(32)	1,328 69
(a) Surat (45 yrs.)	92 0(33)	43 0(32)	8 0(39)	32 0(37)	128 0(32)	595 2	964 22	456 19	480 5	429 0(17)	91 0(25)	42 0(34)	1,714 363

Authorities.—Bibliography Nos. (a) 50, (b) 10.

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.

The annual rainfall shows considerable variation from one year to another. In the south where the rainfall is normally greater than elsewhere it never fails entirely; it would appear that the rainfall is most liable to failure in the neighbourhood of Karachi which is situated on the eastern limit of the rain of the cool season and near the northern limit of the SW. monsoon rain and either or both of these may fail. In some years, on the other hand, the rainfall is exceptionally heavy.

On the Makran coast any month may be rainless, and from April to June and in September and October rain rarely falls. During the cool season, which is normally the rainy season on this coast, any of the months is likely to be rainless once in 3 or 4 years.

On the coasts of Kathiawar and Sind any month except July and August may occasionally be rainless, and even in those months, when normally the rain exceeds about 200 mm. (8 in.), falls of less than 30 mm. (1 in.) have been recorded. At Surat the months of the cool season are more frequently rainless than not.

The variability in the number of rain days is similar to that in the amount of rain. The greatest number of days of rain ever recorded in the year in this region is 71 at Surat in 1917 and the lowest is 2 at Dwarka in 1918. In some years rainy days may be almost continuous at places exposed to the SW. monsoon and 27 rain days were recorded at Surat in July 1912.

During the cool season the number of rain days in a month has reached 7 on the Makran coast but south of Karachi it rarely exceeds 4.

Maximum rainfall in 24 hours.—Figures of the maximum rainfall in 24 hours in each month are given in the general climatological tables on pages 61-5.

On the Makran coast the rainfall is sometimes heavy, although the amounts are comparatively small compared with the high values that are sometimes recorded between June and September on the coasts which are exposed to the SW. monsoon. In the neighbourhood of Gwadar the heaviest falls occur in the cool season, and as much as 130 to 150 mm. (5 to 6 in.) have been measured in a day in both December and January. Heavy rainfall is unknown at all points on the Makran coast in the months of May and October. Farther to the east, at Karachi, the rainfall in the cool season is comparatively light and is not likely to exceed 50 mm. (2 in.) in a day, but during the SW. monsoon 182 mm. (7.2 in.) fell on one occasion in June and 206 mm. (8.1 in.) once in September.

On the coasts of Sind, Cutch and Kathiawar to the south-east of Karachi the rainfall is never very heavy in the cool season, and rarely exceeds 50 mm. (2 in.) in 24 hours; during the SW. monsoon, however, exceptionally heavy falls are sometimes recorded especially at Surat in the south where on one occasion in July a fall of 457 mm. (18.0 in.) was recorded in a single day.

2.—HAIL.

Hail is a very rare occurrence at places on the coast. During a period of nearly 40 years it was recorded on only 4 occasions at Karachi, 2 at Dwarka, 1 at Veraval and never at Surat. Except for one record at Karachi in December the remaining 6 cases were all in the months from March to July. Hail is likely to be associated with thunderstorms.

VII—TEMPERATURE

1.—AIR TEMPERATURE

The monthly averages of air temperature, together with the means of the daily and monthly maximum and minimum temperatures and the highest and lowest temperatures recorded during a long period of years, are given in the climatological tables on pages 61-5 for the coastal stations of Pasni, Ormara, Karachi (Manora), Dwarka and Veraval. Similar data for Gwadar are given in Part 3.

The temperature of the air over the sea in two 5-degree areas is given in the table below.

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

Areas.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	<i>degrees Fahrenheit</i>											
20-25° N.												
60-65° E.	72	73	76	80	83	84	82	81	80	81	78	75
65-70° E.	73	73	76	80	83	84	83	81	81	81	79	75

Authority.—Bibliography No. 53.

The average annual temperature is remarkably uniform over the whole region, and lies between about 80° F. on the shores of the Gulf of Cambay in the south and 77° F. on the Makran coast. Over the open sea it is about 79° F.

The difference between the average temperature of the hottest and coldest months of the year is about 12° F. over the open sea, about 15° F. on the coast of Kathiawar and rather more than 20° F. on the Makran coast. The highest temperature ever recorded is 118° F. at Karachi in May, and the lowest 31° F. at Pasni in February. The lowest temperature that has ever been recorded on the shores of the Rann of Cutch is 36° F. in February 1916.

Seasonal variation

Cool season (December to March).—January is the coolest month of the year in all parts of the region. The mean temperature in that month is 65° F. on the Makran coast rising to just over 70° F. in the Gulf of Cambay, and to 72° or 73° F. over the open sea.

On the Makran coast the temperature at night falls on the average to about 56° F. and rises by day to 75° F. Further south in the Gulf of Cambay the night minima are only two or three degrees higher than on the Makran coast whereas the day maxima are some 7° or 8° F. higher.

From December to February the mean temperature varies very little, it falls slightly from December to January and rises again in February. The differences amount to about 3° or 4° F. on the Makran coast and to only 1° or 2° F. south of Karachi.

Frost is almost unknown on the coast although on one occasion at Pasni the temperature fell to 31° F. in February. Low temperatures such as this are probably recorded during the passage of a cold front in rear of a western depression. South of Karachi the temperature rarely, if ever, falls below 40° F.

Comparatively high temperatures are sometimes recorded in this season, and even in January temperatures of over 90° F. have been reached on the Kathiawar coast and of over 85° F. on the Makran coast. In March the temperature on all parts of the coast may rise to 100° F., although such high temperatures are only reached occasionally; Karachi has recorded 106° F. in that month, and Surat 110° F.

Hot season (April and May).—Towards the end of the cool season and in April the temperature rises rapidly until in May the mean temperatures are some 10° F. higher than in February over the sea, and between 10° F. and 18° F. higher on the coasts; the most rapid rise is experienced on the Makran coast.

May is one of the hottest months of the year and from then onwards there is little further increase. The average temperature over the sea in that month is 83° F., on the coasts it is between 82° and 86° F. During the day the temperature rises to over 85° F. and in some parts to over 90° F., and falls at night to between 75° and 80° F. Some of the highest temperatures ever experienced in the region have occurred in May; in all parts temperatures exceeding 104° F. have been recorded and on one occasion the temperature at Karachi rose to 118° F. Except in the vicinity of Pasni, on the Makran coast, where a temperature of 56° F. has been recorded, the temperature in May rarely, if ever, falls below 65° F.

Along the shores of the Rann of Cutch during this season hot winds may be very unpleasant, and an average maximum temperature of over 100° F. has been reached.

SW. monsoon (June to September).—June is the hottest month of the year, the average temperature over the sea is 84° F. and on the coasts between 84° and 87° F., being rather higher on the Makran coast than further south. The daily range is comparatively small: the temperature rises by day to just over 90° F. on the Makran coast and to just under 90° F. south of Karachi, and falls at night to about 80° F. in all parts. The highest and lowest temperatures shown in the tables are 115° and 61° F., both at Pasni.

The effect of the SW. monsoon is shown by the fall of temperature in July, this fall is more pronounced on the coasts of Sind, Cutch and Kathiawar than on the Makran coast. At the height of the monsoon the temperatures in the south are some 4° or 5° F. lower than on the Makran coast. In the Gulf of Cambay they are about 80° F. compared with about 85° F. at Ormara and Pasni. The fall in temperature after the arrival of the monsoon is more noticeable in the maximum temperatures than in the minimum; the increase in cloud amount and the associated decrease of solar radiation reduces the maximum temperatures during the day but has little effect on the temperatures at night; in fact, lower temperatures have been recorded at night in June than in July. The extreme range of temperature is from 110° F. to 65° F.

The temperatures in August show a further slight fall. In the latter part of September as the SW. monsoon recedes the sky becomes clearer and the day temperatures rise slightly, whereas the night temperatures continue to fall; consequently the mean temperatures in September differ little from those of August. The average temperature for the whole region, both land and sea, is about 81° F.; on the coast it falls to about 76° F. at night and rises to 85° or 90° F. by day. The extreme range is from 106° F. to 57° F., but the temperature rarely falls below 65° F. and not often below 70° F.

Post SW. monsoon or interim period (October and November).—In October the day temperatures are higher than in September, although the night temperatures are lower; at Veraval the rise in the day temperatures is 6° F. On the Makran coast the result is a slight fall in the mean temperature for the day, whereas in the south the mean remains the same as in September.

In November there is a definite fall over the whole region amounting to about 6° F. on the Makran coast and 3° or 4° F. elsewhere; the average temperature is between 73° and 78° F. on the coasts, increasing from north to south, and about 79° F. over the sea. The temperatures vary from between 60° F. and 69° F. at night to 85° or 90° F. by day. Even in November the temperature has been known to rise to 100° F.; it may fall below 50° F., and at Pasni it has been known to fall to 37° F.

2.—UPPER AIR TEMPERATURE

Observations of temperature of the upper air to a height of 10,000 feet are available for Drigh Road, Karachi, based on 510 observations taken during aeroplane flights. The average monthly temperatures are shown in the table on page 52.

At heights below 3,000 feet the lowest temperatures occur in January and the highest in May; there is a slight rise in temperature between September and October which is attributed to the disappearance in October of the low clouds which are nearly always present from early morning to midday between June and September.

Karachi.—AVERAGE TEMPERATURE OF THE UPPER AIR

Time of obs.: 0900 to 1200* Period: 1929-35

Height above M.S.L.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<i>feet</i>	<i>degrees Fahrenheit</i>											
10,000	43	42	46	51	58	62	61	61	57	49	48	44
8,000	47	45	51	58	64	68	67	66	63	55	50	47
6,000	52	52	58	66	73	76	73	72	71	63	56	53
4,000	58	58	66	73	79	79	74	75	75	72	64	59
2,000	63	65	74	80	83	81	78	77	76	80	72	66
1,000	66	69	78	84	86	85	83	81	80	84	77	70
500	68	71	80	87	89	87	86	83	83	86	79	72
Surface	70	73	82	89	92	90	89	86	85	89	81	73

Authority.—Bibliography No. 42.

* All ascents started between the hours of 0900 and 1200, and more than half between the hours of 1000 and 1100. The up and down flight generally took about an hour to complete.

At heights above 3,000 feet the lowest temperatures tend to occur in February and the highest in June, slightly later in the year than in the lower layers.

The rise of temperature is most rapid between February and April. In the lower layers the fall is most rapid between October and November and in the upper layers between September and November. There is not much change of temperature between June and September nor between December and February. The annual range in the monthly means is between 20° and 25° F. being rather greater at 6,000 feet than above and below that level.

The temperature experienced on any flight is liable to differ very much from the mean, especially in the cool season. In January for example temperatures of 17° F. above the mean and 25° F. below the mean have been experienced. During the SW. monsoon the differences are less, but even in that season the temperature may fluctuate 10° or even 15° F. above or below the mean. The range in the extreme values is greatest at about 3,000 feet.

In the winter months in the early morning there is often an increase of temperature with height from the surface up to 3,000 feet, but it disappears after sunrise and would probably be obliterated by 1000.

A characteristic feature of the ascents from April or May to September and especially in July and August is that at a height of about 2,000 feet from the surface the temperature increases with height. The height at which the increase begins is usually marked by stratus or stratocumulus clouds. The region of increasing temperature extends from about 1,000 to 3,000 feet in April and May and is at a somewhat higher level, 2,000 to 5,000 feet from June to September. The height at which the increase begins, its vertical extent and its magnitude vary from day to day and with time of day so that its existence is shown on the table of average values

merely as a reduction of the lapse rate. On clear summer afternoons the inversion vanishes and high lapse rates develop in the lower layers.

The "inversion" separates two different air masses. Below the inversion the air is moist sea air moving from W. or SW., whereas above the inversion the air is dry and moves from a northerly direction. The inversion vanishes when the old monsoon air, brought by depressions from the Bay of Bengal, replaces the dry warm air above the inversion or when fresh monsoon air comes in great depth and replaces the previously existing air. The destruction or weakening of the inversion is a preliminary condition for the occurrence of adverse weather phenomena.

Detailed information of temperature at heights above 10,000 feet is not available, but there is evidence that in the cool season freezing temperatures are likely to occur between 12,000 and 13,000 feet, and during the SW. monsoon above 16,000 feet.

At the heights at which temperatures at or below the freezing point have been recorded, the air is generally only about half saturated, so that ice formation does not appear to be a serious problem, at any rate within the lowest 10,000 feet. Ice formation on the wind-screen was experienced by planes flying at 13,000-14,000 feet in thick altostratus cloud on December 17, 1937, when the temperature was between 22° and 25° F.

3.—SEA TEMPERATURE

The position of the isotherm of sea-surface temperature 80° F. is shown on the monthly charts of surface wind, Figs. 3-5. No isotherm is shown on the charts from December to March because in that season the temperature everywhere lies between 70° and 80° F., nor in May and June because the temperature then exceeds 80° F. over the whole region.

The mean temperature in all months of the year is shown in the following table compiled from ships' observations during the years 1855-1917.

MEAN TEMPERATURE OF THE SEA SURFACE

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	<i>degrees Fahrenheit</i>											
Makran coast	72	72	73	79	83	84	82	81	80	80	79	76
Arabian sea 20-24° N.	74	74	76	80	83	83	80	78	80	81	79	77
Coasts of Kathiawar Cutch and Sind	75	75	77	80	83	84	81	81	80	81	80	77

Authority.—Bibliography No. 44.

The figures give an approximate mean for the sea off the coast, or, in the case of the Arabian sea, for the area 20-24° N., 60-66° E.; the average values in different parts of the coast may be 1° or 2° F. above or below the figures shown in the table.

In all parts of the region the temperature of the sea surface is lowest in January and February and highest in May or June, the range in the monthly means being about 10° or 12° F.

4.—RELATIVE VALUES OF SEA AND AIR TEMPERATURE

The difference between the temperature of the surface of the sea and that of the air above it is comparatively small at all times of the year. In general the air is slightly warmer than the sea from April to October and the sea is slightly warmer than the air from November to February. In March there is very little difference between the two.

In the northern portion of the open waters of the Arabian sea the difference in temperature between the sea and the air nowhere exceeds 2° F. at any time during the year. Near the coast, however, the difference in temperature may be a little larger and off the Makran coast it may amount to as much as 3½° F.

VIII—HUMIDITY

The mean monthly relative humidity and the mean wet-bulb temperature at the morning and afternoon hours of observation at Pasni, Ormara, Karachi (Manora), Dwarka and Veraval, are given in the general climatological tables on pages 61-5. The data are based on records taken over a period of only about five years so that the figures are liable to some uncertainty. The diurnal variation of relative humidity is large (see page 56). The following description of the seasonal distribution of humidity is based on the observations at about 0800 local time at which hour the humidity is not far below its highest value of the 24 hours.

The mean relative humidity at 0800 taken over the whole year is about 75 per cent. It is lowest in the Gulf of Cambay and at Veraval in the south where the mean is rather less than 70 per cent., and highest at Gwadar in the west where it exceeds 80 per cent.

In all parts the highest monthly means are during the SW. monsoon between May or June and September, and in most parts the lowest are in January, but the annual variation between the two extremes is irregular. In all parts February is exceptional in showing higher values than either of the adjacent months, and on the Makran coast November is exceptional in showing lower values; but whether this irregularity is a real phenomenon or is due to the shortness of the period is uncertain.

The annual range is least on the Makran coast where it is between 10 and 20 per cent.; south of Karachi the range is much higher; at Dwarka it is nearly 30 per cent., and at Veraval 50 per cent.

Seasonal variation

Cool season (December to March).—Throughout this season the mean relative humidity is higher on the Makran coast than elsewhere and decreases eastwards. In January when the humidity reaches its lowest values of the year the mean at Gwadar at 0800 is about 75 per cent., at Ormara 65 per cent., at Karachi and Dwarka between 50 and 55 per cent. and at Veraval less than 40 per cent. The humidity shows remarkable changes from month to month; it decreases between December and January, increases very rapidly again in February, especially in the south, and decreases again in March.

At Karachi low relative humidity is of frequent occurrence from December to the end of March during which period dry north-westerly winds from the Baluchistan Plateau prevail. These exceptionally dry land winds occur after the passage of cold-weather storms from Sind into Rajputana and Central India and also during the existence of strongly marked hot-weather depressions in March. A relative humidity as low as 6 per cent. has been observed on these occasions in January and March.

Hot season (April and May).—In April the relative humidity at 0800 on the coast is between 70 and 80 per cent. and in May between 75 and 85 per cent. with no regular variation from place to place. At the head of the Gulf of Cambay the humidity is lower, namely, 50 per cent. in April and just over 60 per cent. in May; a more rapid increase occurs in this region between May and June.

At Karachi low relative humidity is experienced in April when strongly marked hot-weather depressions are situated over Upper Sind, south-west Punjab and north-west Rajputana.

SW. monsoon (June to September).—The relative humidity during this period is very uniform along the coast, the average being for the most part between 80 and 85 per cent.; the decrease inland is much less than in the cool season. On the Makran coast the humidity tends to rise slightly between June and September, but the amount of the rise is less than 5 per cent. From Karachi southwards there is a rise of about 5 per cent. between June and August with a tendency to fall in September.

Post SW. monsoon or interim period (October and November).—With the withdrawal of the monsoon the relative humidity falls rapidly everywhere. At Gwadar, where the effect of the monsoon is less noticeable, the fall between September and October is less than 5 per cent., but elsewhere it is about 10 per cent. and at Veraval as much as 16 per cent. The fall continues, but more slowly, in November.

Diurnal variation.—The diurnal variation of relative humidity is dependent very largely on the diurnal variation of temperature. At sea where the diurnal range of temperature is small the diurnal

range of humidity is also small; but on land, especially in the season when skies are clear, the range of humidity during the day is comparable with and in some seasons even greater than the annual range of the monthly means.

Mean hourly values are available only for Karachi. They are based on observations taken many years ago when the exposure of the thermometers differed from that at the present time, so that the exact values are subject to some uncertainty and are not strictly comparable with those given in the general climatological tables. The results are set out in the following table which gives the highest and lowest hourly values of humidity, the hours when they occur, and the difference between the two.

Karachi.—DIURNAL VARIATION OF MEAN RELATIVE HUMIDITY
Period: 19 years.

Month	Maximum		Minimum		Range
	Time	%	Time	%	
January	0600	68	1400	41	27
February	0600	71	1200-1300	39	32
March	0500-0600	81	1200	45	36
April	0500	83	1100-1200	51	32
May	0500	89	1100-1300	62	27
June	0500	85	1300	62	23
July	0400-0500	88	1200-1300	70	18
August	0000-0600	86	1300-1400	69	17
September	0500	89	1300	63	26
October	0500-0600	83	1200-1300	47	36
November	0500-0600	64	1200-1300	36	28
December	0500	60	1300	35	25

Authority.—Bibliography No. 52.

The results show that the highest humidity of the day occurs at about sunrise, between 0500 and 0600 in most months of the year but slightly earlier in the summer than in the winter. The lowest values are between midday and 1400. The range in the hourly values is least in July and August when it is less than 20 per cent. and greatest in March and October when it rises to 35 per cent. In most of the other months the range is between 25 and 30 per cent. The humidity falls rapidly between 0800 and 1000 and rises rapidly between 1600 and 1900.

From these results it can be inferred that the values of relative humidity at 0800 given in the general climatological tables are likely to be slightly below the highest values of the day, and those at 1600 are likely to be somewhat above the lowest values.

The data in the general climatological tables show that at 1600 in January the relative humidity is between 15 and 20 per cent. lower than at 0800, whereas from June to August the difference is

only about 5 per cent. Veraval is exceptional in showing appreciably higher values at 1600 than at 0800 throughout the months from October to April; no doubt this is to be attributed to a change from land to sea breeze in the afternoon. The situation of Veraval, with high land to the north-east, probably augments the sea breeze and at the same time prevents the NE. monsoon from exercising its full effect.

Humidity in the upper air.—The following table gives the humidity in the upper air over Karachi; it is based on the same aeroplane flights as the-table of upper-air temperatures on page 52. The data are based on observations of dry- and wet-bulb temperatures.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<i>feet</i>							<i>per cent.</i>					
10,000	37	40	35	49	31	30	50	54	46	41	31	32
8,000	33	35	37	41	27	29	49	52	43	39	32	34
6,000	34	34	36	38	25	30	51	53	39	38	31	37
4,000	36	36	36	39	30	49	69	67	50	37	30	38
2,000	43	41	41	49	55	72	81	81	76	41	33	38
1,000	45	44	45	51	61	72	77	78	75	42	35	39
500	46	46	47	50	61	69	72	74	71	43	36	39
Surface	46	48	49	50	61	66	68	71	68	44	37	40

Authority.—Bibliography No. 42.

On the average the lowest humidities of less than 30 per cent. occur at about 6,000 feet and above in May and June, and the highest humidities of over 80 per cent. at about 2,000 feet in July and August. This is the height at which during those months a sheet of stratus cloud exists almost daily in this region.

The rapid fall of humidity in the lowest levels between September and October due to the replacement of moist air from W. or SW. by dry air from E. or NE. is well marked. In general, humidity decreases with height up to 6,000 feet, except during the SW. monsoon when there is an increase up to about 2,000 feet. The existence from May to September of a dry air mass of continental origin above the moist sea air, to which reference has already been made on page 53, is shown by the rapid fall of humidity above 2,000 feet in May, June and September, and above 3,000 feet in July and August.

Records of individual flights show that relative humidities of over 80 per cent. have been recorded at nearly all levels and 90 per cent. has been exceeded at many heights especially during the months from April to September. Very dry air, with humidity below 10 per cent., has been found at heights above 3,000 feet from October to March and also in May to June.

Wet-bulb temperature.—The average values of wet-bulb temperature at the morning and afternoon hours of observation are

included in the general climatological tables. Such values give a good idea of the combined effect of high temperature and humidity on human comfort, and it is considered that when the wet bulb temperature exceeds 78° F. hard manual labour is impracticable except for quite short periods of time. The results show that the average wet-bulb temperature at all places on the coasts exceeds the critical limit only during the months from May to July; in August and September it lies sometimes above the limit and sometimes below.

IX—MISCELLANEOUS

I.—THUNDERSTORMS

The average number of days per month on which thunderstorms occur at Pasni, Karachi, Dwarka, and Veraval is given in the general climatological tables on pages 61-5. The duration of the records is, however, too short to give more than a very general indication of the annual variation.

Thunderstorms are by no means frequent in any part of the region and are least so on the Makran coast; their frequency increases slightly southward of Karachi, the annual total there being between 10 and 15.

Thundery weather is occasionally caused in association with tropical depressions and cyclones; on the Makran coast it occurs chiefly in the transition months between the monsoons, and southward of Karachi at any time between April and November. At Karachi the chance of there being a thunderstorm is greatest in July, at Dwarka in June and at Veraval in June, September or October. In the cool season thunderstorms sometimes accompany the cold fronts of western depressions.

The total number of thunderstorms at Karachi varies very much from year to year; in the period 1914-23 the year when thunderstorms were most frequent was 1917 with 25, and the years when they were least frequent were 1918 and 1920 with only 5 each.

Spells of thundery weather at Karachi are somewhat rare but occasionally thunderstorms are severe. Not infrequently they are accompanied by squalls. On June 29, 1936, for example, the wind speed during a thunder-squall reached 70 knots and did considerable damage to buildings at the Aircraft Depot at Drigh Road. The squall was accompanied by a sharp fall in temperature of 18° F., by a rise of 35 per cent. in relative humidity, and by a fall of 8 mm. (0.3 in.) of rain in 15 minutes.

A special study of thundery conditions at Karachi during the periods before and after the squalls has shown that the thundery conditions occurred when the inversion of temperature, which is characteristic of the monsoon months, was absent, and when there was a layer of air sufficiently deep to give an appreciable amount of energy of latent instability when raised to a certain level. The

upward convection might be caused either by insolation, the arrival of sea air or by convergence. It may be noted that in the first two cases the thunderstorms will occur only in the afternoons and evenings, whereas, when the ascent is caused by convergence, the thundery conditions may occur at any time of the day.

The conditions for thunderstorms are similar to the conditions for squalls described on page 22.

2.—DUSTSTORMS

Dust- or sandstorms are fairly frequent in the arid regions of Baluchistan and Sind during the dry hot weather from March to June. Duststorms are most frequent in the afternoon, but they may occur at any hour of the day, and are by no means uncommon even at night. The dust may sometimes extend up to a height of 10,000 feet.

The following table gives the average number of duststorms that have occurred on the east Makran coast from Gwadar to Karachi in the different months of the year. The criterion used for a duststorm is that the visibility is 5 or less on the international scale (i.e. visibility less than 2 nautical miles) and the wind speed on the surface is above 22 knots.

East Makran coast.—

AVERAGE NUMBER OF OCCASIONS IN EACH MONTH ON WHICH
DUSTSTORMS WERE REPORTED

Period: 2-3 years

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Gwadar ..	0	1	2	0	3	1	0	0	0	1	0	0	8
Pasni ..	1	1	2	1	3	2	1	0	1	1	0	2	15
Ormara ..	0	0	2	2	4	4	1	0	1	2	0	0	16
Karachi ..	1	2	1	3	3	4	1	0	0	0	1	1	17

Authority.—Bibliography No. 17.

On the Makran coast from Gwadar to Karachi duststorms are most frequent during the months of March, April, May, and June, and of these May is the most windy and dusty month.

From June to September duststorms may occur occasionally owing to the passage of an eastern depression along the Makran coast; these eastern depressions may have originated either in central India or off the coast of the Bombay Presidency owing to the revival of the SW. monsoon after a period of inactivity. Secondaries to these depressions are one of the chief causes of duststorms in this area.

Duststorms occasionally occur during the months from October to February, but they are not so frequent as in the other months of the year. They are usually caused by the passage of the cold front of a western depression and are not infrequently followed by thunderstorms.

3. SEA AND SWELL

Table VII shows the percentage frequency of different states of the sea at two hours of observations, one in the morning and the other in the afternoon at Pasni, Karachi (Manora), Dwarka and Veraval.

Over the whole area rough seas as a rule are only experienced during the months of the SW. monsoon, i.e. from June to September, except on the Makran coast where they are liable to occur also from December to February associated with the eastward passage of western depressions.

On the east Makran coast from Gwadar to Karachi the arrival of the SW. monsoon is announced in June by a heavy southerly swell, which in this month will probably be out of proportion to the amount of wind experienced. This heavy swell rolls up on this coast throughout the months of the SW. monsoon, and will vary from a high to a long low swell according to the weather. At Gwadar the swell comes from a more southerly direction than at Karachi and it is longer.

After the first burst of the SW. monsoon in June the wind may moderate a little in July in which case moderate to rough seas may be experienced alternating with a few quiet days. During this season, also, eastern depressions may occasionally pass over the region and cause rough seas and squally weather.

On the coasts of Sind, Cutch and Kathiawar a heavy swell generally begins in the middle of May, and from then onwards coasting steamers and small vessels usually cease to put to sea; this heavy swell continues with varying intensity until the end of the SW. monsoon. At Surat and in the Gulf of Cambay the southerly winds and unsettled weather that precede the setting in of the SW. monsoon may begin any time after the middle of April or early in May and cause a considerable sea. The West Coast of India Pilot gives the following warning to sailing vessels anchored in Surat roads at this season:—"It is considered dangerous for sailing vessels drawing much water to remain in the roads after the middle of April, for in the latter part of this month, and early in May, strong southerly winds frequently blow during the springs, and cause a considerable sea." At Karachi heavy rollers and swell are experienced outside the harbour from the middle of May until the end of September.

4.—TURBULENCE AND BUMPINESS

During the SW. monsoon bumpiness is generally associated with the cloudy conditions then prevalent.

At Karachi and on the Makran coast where there is often a low-lying inversion at some height between 3,000 and 6,000 feet during the months from May to September, turbulence is generally confined to the layer below this inversion.

TABLE I—GENERAL CLIMATOLOGICAL TABLES

Pasni. 25° 16' N., 63° 29' E., 10 ft.

Times of obs. : 0830 and 1630 (Z-4½)**

Month	Pressure at M.S.L.		Air Temperature						Rain			Thunder	Strong winds†	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.	mm.	in.	days	mm.	in.	††	Observations at 0830 (Z-4½)														
January	1019	65	75	55	81	47	89	39	50	2.0	2	151	5.9	0.2	0	5	26	12	14	1	1	1	8	22	15	2	69	3.4	55
February	1016	67	77	56	86	45	95	31	29	1.1	1	82	3.2	0	1	5	14	7	14	3	1	11	28	22	2	79	3.2	59	
March	1013	73	85	62	95	53	102	47	14	0.6	0.8	87	3.4	0	0	5	12	6	7	2	1	19	27	25	2	66	2.3	65	
April	1010	79	90	68	100	61	107	50	7	0.3	0.4	36	1.4	0	0	6	7	4	4	5	2	4	38	29	7	71	2.2	72	
May	1005	84	94	74	106	68	110	56	1	0.1	0	8	0.3	0	0	7	2	2	14	6	1	11	41	16	7	74	1.9	78	
June	1000	86	94	78	104	73	115	61	9	0.4	0.3	127	5.0	0.2	4	6	2	2	18	12	3	14	33	12	5	74	3.6	80	
July	999	Data not available	85	91	78	98	74	107	9	0.4	0.6	71	2.8	0	3	5	1	1	13	17	8	18	24	8	11	3	77	7.3	80
August	1002	83	89	76	94	72	105	63	6	0.2	0.5	42	1.7	0	3	5	0	2	15	13	5	21	28	6	10	0.6	77	7.7	77
September	1007	81	90	72	100	67	105	57	0	0.0	0	1	0.1	0	2	6	4	1	15	7	2	9	32	17	13	0.8	81	4.6	75
October	1012	79	91	67	99	59	105	51	0	0.0	0	2	0.1	0	2	5	11	10	12	4	2	2	20	23	16	2	70	1.9	71
November	1016	73	85	60	93	51	100	37	5	0.2	0.3	51	2.0	0	1	4	18	11	4	0	0	11	32	23	0.2	62	1.8	64	
December	1018	67	78	56	85	47	90	40	25	1.0	2	67	2.6	0	3	4	19	12	8	3	1	8	27	23	0.6	72	3.0	59	
Year	1010	77	87	67	—	—	115	31	155	6.2	8	151	5.9	0.4	28	5	9	6	11	6	2	7	23	21	15	19	73	3.6	70

Authorities.—Bibliography Nos. 17, 27, 50, 52, 53.
 Periods.—Pressure, 10 years.
 Temp. and rain, 19-20 years.
 No. of days with thunder, poor visibility, 1933-7.
 Strong winds, 2-3 years.
 Wind (speed), 1911-30; (direction), 1930-7.
 Relative humidity, July, 1934-June, 1938.
 Cloud amount and wet-bulb temperature, 1928-37.
 Notes.—**Before July, 1934, the observations were at 1830 (Z-4½).
 † Observations at 0800 (local time).
 * (max. + min.).
 ‡ Day with 2.54 mm. (0.1 in.) or more of rain.
 †† Day with wind of force 6 or more.
 ††† Mean of 24 hours.
 †††† No. of days with visibility less than 2 nautical miles.

Month	Observations at 1630 (Z-4½)**												
January	10	5	7	14	16	25	15	3	5	2	53	2.9	61
February	2	1	7	10	14	33	27	3	3	2	59	2.5	63
March	0	1	1	4	10	47	34	1	1	2	50	2.0	69
April	0	1	1	1	5	45	47	1	0	5	65	2.1	76
May	0	0	0	1	5	47	45	2	0	5	67	1.5	81
June	1	0	3	5	13	47	32	0	0	5	71	1.8	82
July	Data not available	0	0	1	5	22	50	21	1	1	72	4.3	81
August	0	0	1	4	17	53	25	0	1	0	71	4.0	78
September	0	0	0	1	7	53	38	1	0	0.8	71	1.2	77
October	1	1	1	4	11	38	38	3	3	0.8	61	0.3	75
November	1	2	1	5	15	40	31	2	4	0.4	53	1.6	70
December	5	3	4	15	15	28	19	3	8	0.8	58	2.5	65
Year	2	1	2	6	12	42	31	2	2	26	63	2.2	73

Table I—General climatological tables

TABLE I—continued

Ormara. 25° 15' N., 64° 39' E., 16 ft.

Times of obs.: 0830 and 1630 (Z-4)**

Month	Pressure at M.S.L.		Air Temperature						Rain			Thunder	Strong winds	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.					NW.	Calm
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	mm.	in.	mm.	in.	days	Observations at 0830 (Z-4)													
January ..	1018		65	73	56	80	44	85	36	28	1.1	1	1	4	5	13	17	7	3	2	5	5	43		66	3.1	56
February ..	1015		68	76	60	85	49	89	43	42	1.6	2	2	5	5	11	13	6	2	3	10	6	44		77	3.3	61
March ..	1013		75	83	66	93	56	98	49	5	0.2	0.4	3	7	4	11	9	2	1	10	19	9	35		76	2.4	67
April ..	1009		82	90	74	100	66	104	61	13	0.5	0.6	4	10	2	4	4	3	1	22	38	10	16		75	2.2	74
May ..	1005		86	93	80	105	75	117	71	1	0.1	0	0	11	1	5	7	1	0	30	47	5	6		76	2.3	79
June ..	1000		87	93	82	100	78	104	76	5	0.2	0.3	6	11	9	6	7	0	1	28	45	6	6		78	4.1	81
July ..	999	Data not available	86	90	81	96	78	101	76	28	1.1	2	3	8	2	2	4	2	4	33	42	6	5		79	7.1	80
August ..	1002		83	87	79	93	75	101	70	2	0.1	0.2	2	2	1	2	2	1	2	36	50	5	2		80	7.6	77
September ..	1006		82	87	76	97	71	106	66	1	0.1	0	2	2	9	2	3	4	2	28	48	6	6		82	5.4	75
October ..	1012		80	90	71	99	61	101	56	1	0.1	0	1	1	6	4	12	17	4	7	23	10	21		71	2.2	72
November ..	1016		74	85	64	93	55	95	52	2	0.1	0.1	1	1	4	5	12	16	9	2	1	5	45		67	1.7	67
December ..	1018		68	77	59	84	49	88	45	31	1.2	2	2	4	4	11	18	8	3	2	4	3	47		69	2.6	60
Year ..	1010		78	85	71	106	43	117	36	156	6.1	9	36	7	3	8	10	3	2	17	28	6	23		75	3.7	71

Authorities.—Bibliography Nos. 17, 50.

Periods.—Pressure, temp., rain and cloud amount, Mar. 1928–Feb. 1938.

Strong winds, 2–3 years.

Wind (speed and direction), 1930–7.

Relative humidity, July, 1934–June, 1938.

Wet-bulb temperature, Feb. 1928–Jan. 1938.

Notes.—** Before July, 1934, the observations were at 1630 (Z-4).

† Observations at 0830 (Z-4).

‡ (max. + min.).

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

|| Day with wind of force 6 or more.

†† Mean of 24 hours.

‡‡ The period is too short to give a reliable mean.

Month	Observations at 1630 (Z-4)**										Poor visibility	Relative humidity %††	Cloud amount	Wet-bulb temperature °F.
	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Speed in knots				
January ..	2	3	11	11	13	22	21	6	11	11	50	2.5	60	
February ..	1	4	6	7	8	32	32	1	9	9	59	2.7	64	
March ..	0	1	1	2	8	42	40	2	4	4	61	1.8	69	
April ..	1	1	1	2	4	44	47	1	0	0	59	1.9	75	
May ..	0	0	0	2	5	46	47	1	0	0	65	1.6	79	
June ..	1	1	1	3	11	41	40	2	1	1	69	1.7	82	
July ..	1	1	1	4	15	45	32	1	1	1	71	4.1	80	
August ..	0	0	0	2	14	46	37	1	1	1	73	3.6	77	
September ..	0	0	0	2	6	46	45	1	0	0	68	1.4	76	
October ..	1	1	1	3	8	37	41	2	7	7	54	0.4	73	
November ..	2	1	5	7	14	30	28	2	11	11	51	1.3	69	
December ..	1	2	7	10	15	26	20	1	18	18	53	2.3	63	
Year ..	1	1	3	5	10	38	36	2	5	5	61	2.1	73	

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Makran coast

TABLE I—continued

Karachi (Manora). †† 24° 48' N., 66° 59' E., 13 ft.

Times of obs.: 0800 (local time) and 1600 (Z-4)††.

Month	Pressure at M.S.L.		Air Temperature							Rain			Thunder	Strong winds†	Speed in knots	Wind									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.	Calms						
January ..	1017	3-7	67	76	58	83	47	89	40	13	0.5	1	42	1.6	0.4	2	7	19	59	15	<1	0	0	0	4	2	1	52	2.6	50
February ..	1015	3-7	69	78	61	86	49	93	43	10	0.4	1	26	1.0	0.7	2	8	13	35	12	1	0	4	18	13	4	3	72	2.3	61
March ..	1012	3-4	74	82	68	97	57	106	47	8	0.3	0.7	49	1.9	0.7	4	10	14	26	5	1	0	6	26	17	5	1	70	2.4	65
April ..	1008	3-1	78	85	74	98	66	111	57	4	0.2	0.2	104	4.1	0.6	8	11	8	5	3	<1	<1	15	51	15	2	1	77	2.6	73
May ..	1004	3-1	83	89	79	102	74	118	65	2	<1	0.1	31	1.2	1	6	13	1	1	0	1	33	57	6	1	1	80	3.3	79	
June ..	999	2-4	85	91	83	101	79	114	68	22	<1	0.6	182	7.2	0.3	9	14	<1	2	0	<1	1	49	45	2	0	81	5.4	81	
July ..	999	2-4	83	88	81	96	77	110	73	75	2.9	2	154	6.1	3	7	14	2	<1	0	3	0	37	53	4	1	84	7.3	80	
August ..	1001	2-4	81	85	78	91	76	99	73	42	1.7	2	107	4.2	2	4	13	0	0	0	0	0	38	58	4	0	85	7.5	78	
September ..	1006	2-7	80	86	77	93	73	106	69	11	0.4	0.6	53*	2.1	2	3	10	3	1	0	0	0	27	59	9	1	84	4.8	76	
October ..	1011	3-1	79	88	73	99	64	108	57	<1	<1	0	6	0.2	0.5	3	7	18	17	7	1	0	13	26	17	1	75	1.6	73	
November ..	1015	3-4	75	85	67	94	57	100	48	1	<1	0.1	22	0.9	0	1	6	23	52	7	0	0	1	5	7	5	67	1.1	66	
December ..	1017	3-7	68	78	59	86	50	91	39	4	0.1	0.5	22	0.9	0.4	1	10	9	60	22	3	0	0	3	3	0	67	1.9	58	
Year ..	1009	3-1	77	84	71	103	47	118	39	192	7.5	9	182*	7.2	12	50	10	9	22	6	<1	<1	19	33	8	2	75	3.6	70	

Authorities.—Bibliography Nos. 17, 27, 46, 50, 52, 53.
Periods.—Pressure (average) and cloud amount, 32 years.
 Pressure (daily range), 20 years.
 Temp. (average, mean daily max. and min.), 13 years.
 Temp. (mean highest and lowest, extremes), and rain, 43 years.
 No. of days with thunder 1914-23.
 Strong winds, 2-3 years. Wind (speed), 1873-94.
 Wind (direction), poor visibility, relative humidity and wet-bulb temperature, 1933-7.

Notes.—†† Manora is a small island to the south of Karachi harbour.
 † Local time is 2 min. slow on Z-4.
 ‡ Corrected to mean of 24 hours.
 †† Difference between means at 1000 and 1600 local time.
 † Day with 2.54 mm. (0.1 in.) or more of rain.
 * 206 mm. (8.1 in.) fell in 24 hours in Sept., 1926.
 † Day with wind of force 6 or more at Drigh Road.
 †† Mean of 24 hours.
 † No. of days with visibility less than 2 nautical miles.

Month	Observations at 1600 (Z-4)††															
January ..	2	15	7	12	11	29	16	7	<1	1	1	36	58			
February ..	<1	7	2	4	4	49	32	1	0	0	2	57	66			
March ..	1	<1	1	2	<1	54	40	<1	0	0	6	60	70			
April ..	0	0	0	0	0	59	39	<1	0	0	7	71	76			
May ..	0	0	0	0	3	62	35	0	0	0	2	74	81			
June ..	<1	0	<1	1	3	67	26	1	0	0	2	75	82			
July ..	1	1	0	<1	1	65	30	1	0	4	78	81				
August ..	0	0	0	0	<1	61	37	<1	0	1	78	79				
September ..	2	<1	0	0	0	59	37	1	0	2	76	78				
October ..	0	<1	0	<1	1	57	40	<1	0	4	69	77				
November ..	0	7	3	3	2	48	35	2	0	4	58	72				
December ..	0	6	8	11	14	44	15	1	<1	0	51	65				
Year ..	<1	3	2	3	3	55	32	1	<1	10	65	74				

Table I—General climatological tables

TABLE I—continued

Dwarka. 22° 22' N., 69° 05' E., 37 ft.

Times of obs. : 0800 (local time) and 1600 (Z-4)**

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Month	Pressure at M.S.L.		Air Temperature						Rain			Thunder	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.	mm.	in.	days	Observations at 0800 (local time)**																	
January ..	1016	Data not available	69	78	60	85	54	92	46	2	0.1	0.2	20	0.8	0.2	7	32	50	10	1	0	0	1	3	3	0	56	1.7	56
February ..	1015		70	78	63	87	54	96	47	8	0.3	0.5	64	2.5	0.2	8	27	16	6	<1	0	6	14	24	6	0	72	2.0	64
March ..	1012		75	82	71	93	61	99	46	5	0.2	0.4	47	1.9	0	8	30	10	4	<1	0	3	14	37	1	0	67	2.2	67
April ..	1009		79	85	76	90	72	100	63	1	<1	0.1	24	1.0	0.2	8	13	1	0	<1	3	17	39	26	0	0	77	2.4	74
May ..	1006		83	88	80	91	77	108	68	0.3	<1	0	8	0.3	0	10	5	0	1	0	3	46	39	6	0	0	79	2.6	78
June ..	1001		84	89	82	93	78	98	73	54	<1	0	194	7.6	2	11	2	<1	1	4	53	33	5	<1	2	2	80	5.1	80
July ..	1000		82	87	81	91	76	96	73	153	6.0	6	274	10.8	1	13	3	0	0	<1	1	56	38	1	0	7	84	7.4	79
August ..	1003		80	85	78	87	75	88	71	81	3.2	5	302	11.9	0	11	<1	0	0	0	<1	54	42	3	0	3	84	7.8	77
September ..	1007		81	85	78	88	75	99	72	27	1.1	2	136	5.3	0.2	7	3	<1	1	3	5	35	32	15	5	1	70	4.8	76
October ..	1011		80	87	76	96	69	100	64	9	0.4	0.3	138	5.4	0	6	31	18	3	3	3	4	17	17	4	0	70	2.3	74
November ..	1013		77	87	69	94	62	99	57	0.8	<1	0.1	21	0.8	0.4	6	37	39	10	<1	<1	<1	4	7	1	0	64	1.3	69
December ..	1015		70	81	61	87	54	91	47	1	<1	0.2	13	0.5	0.2	6	27	44	20	<1	0	<1	2	5	1	0	61	1.5	61
Year ..	1009		78	84	73	98	52	108	46	343	13.5	17	302	11.9	4	8	17	15	5	1	2	23	23	12	2	16	73	3.4	71

MAHARAJA COAST

Authorities.—Bibliography Nos. 27, 50, 52, 53.
Periods.—Pressure, temp., rain (average fall and no. of days) and cloud amount, 20 years.
 Rain (max. fall in 24 hours), 1901-36.
 No. of days with thunder, wind (direction), poor visibility, relative humidity and wet-bulb temperature, 1933-7.
 Wind (speed), 1901-20.
Notes.—** Local time is 6 min. fast on Z-4.
 † Corrected to mean of 24 hours.
 ‡ Day with 2.54 mm. (0.1 in.) or more of rain.
 †† Mean of 24 hours.
 ††† No. of days with visibility less than 2 nautical miles.

Month	Observations at 1600 (Z-4)**										Poor visibility †	Relative humidity %	Cloud amount	Wet-bulb temperature °F.
	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm					
January ..	19	23	5	0	<1	1	7	44	0	0	57	59		
February ..	6	6	<1	0	<1	6	43	37	0	1	63	67		
March ..	3	3	1	<1	0	3	44	45	0	0	70	70		
April ..	0	0	0	0	0	13	66	21	0	0	70	70		
May ..	<1	0	<1	0	4	35	55	5	0	0	70	70		
June ..	0	0	0	0	2	61	35	2	0	2	70	70		
July ..	0	0	0	0	3	59	37	1	0	6	80	79		
August ..	0	0	0	0	0	55	44	<1	0	2	79	77		
September ..	<1	0	<1	0	3	35	46	15	0	1	77	77		
October ..	6	8	2	0	0	7	29	48	0	0	64	70		
November ..	15	14	3	0	1	2	15	50	0	0	64	70		
December ..	24	22	4	0	0	3	13	33	<1	0	65	64		
Year ..	6	6	2	<1	1	24	36	25	<1	14	76	73		

See page 30

TABLE I—continued

Veraval. 20° 53' N., 70° 26' E., 19 ft.

Times of obs. : 0800 (local time) and 1600 (Z-4)**

Month	Pressure at M.S.L.		Air Temperature						Rain			Thunder	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 ..	1014		71	82	60	89	57	94	40	1	<	0.1	13	0.5	0.2	4	30	36	3	1	0	1	0	4	25	0	38	1.4	52
February ..	1013		71	81	61	91	52	96	40	1	<	0.2	17	0.7	0.1	5	28	13	3	1	0	1	3	9	42	0	61	1.4	61
March ..	1011		75	85	65	97	57	105	49	2	<	0.2	19	0.7	0.1	6	49	10	1	1	0	0	2	24	13	0	52	1.5	63
April ..	1008		79	86	72	97	65	105	57	0	0	0	1	1	0.5	6	24	>	0	1	3	3	16	48	4	0	69	2.2	73
May ..	1006		82	86	79	91	73	104	66	8	0.3	0.4	123	4.9	2	7	4	0	0	2	4	16	29	37	8	0	81	3.2	78
June ..	1002		84	86	81	89	77	93	74	114	4.5	4	199	7.8	3	9	1	0	0	1	9	29	42	13	5	2	84	8.0	80
July ..	1001		82	84	80	87	76	93	70	174	6.8	9	259	10.2	0.8	10	0	0	0	0	3	27	62	8	0	7	89	8.0	78
August ..	1004		80	82	78	85	75	89	73	96	3.8	6	270	10.6	0.1	9	3	0	1	0	1	25	57	7	8	3	89	8.1	77
September ..	1007		80	83	77	88	73	98	69	59	2.3	4	277	10.9	4	5	11	1	1	2	7	34	20	17	12	2	85	5.3	77
October ..	1010		81	89	73	98	67	102	61	17	0.7	0.7	174	6.8	4	4	37	15	5	4	1	1	3	12	23	0	59	2.2	72
November ..	1012		78	89	68	95	62	99	57	5	0.2	0.1	90	3.5	0.6	4	27	34	8	3	1	0	1	4	23	0	50	1.3	66
December ..	1014		73	84	62	91	55	95	46	2	<	0.2	26	1.0	0	4	32	37	4	1	1	0	0	3	22	0	40	1.5	59
Year ..	1009		78	85	71	100	50	105	40	479	18.8	25	277	10.9	15	6	21	12	2	1	2	9	21	16	16	16	66	3.5	70

Authorities.—Bibliography Nos. 27, 46, 50, 52.

Periods.—Pressure, temp., rain (average fall and no. of days), wind (speed) and cloud-amount, 30-31 years, 1890-1920.
 Rain (max. fall in 24 hours), 1890-1936.
 No. of days with thunder, 1914-23.
 Wind (direction), relative humidity and wet-bulb temperature, 1933-7.

Notes.—** Local time is 12 min. fast on Z-4.

† Corrected to mean of 24 hours.

‡ (max. + min.).

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

¶ Mean of 24 hours.

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

Month	Observations at 1600 (Z-4)**																Sec page 39
	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Poor visibility†	Relative humidity%	Cloud amount	Wet-bulb temperature °F.				
January ..	13	4	0	3	6	14	28	28	4	0	52		65				
February ..	1	0	0	0	4	14	52	28	1	0	70		70				
March ..	2	0	0	3	4	6	44	40	1	0	71		73				
April ..	0	0	0	0	3	13	48	35	1	0	78		77				
May ..	0	1	1	1	4	15	52	27	0	0	81		80				
June ..	0	0	0	0	7	42	46	5	0	3	81		81				
July ..	0	0	0	0	1	29	65	5	0	3	86		79				
August ..	0	0	0	0	0	26	62	12	0	2	84		78				
September ..	1	1	0	1	5	16	46	25	5	2	83		78				
October ..	1	3	0	10	15	14	33	23	1	0	70		78				
November ..	1	2	1	9	22	18	29	13	5	0	65		75				
December ..	4	3	1	10	12	11	33	23	3	0	57		69				
Year ..	2	1	<	3	7	18	45	22	2	10	73		75				

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.

20°-25° 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..	10	3	.2	10	4	.4	10	3	.2	5	.6	0	2	2	0	4	.8	0	15	4	0	13	6	.1	7	68	24	.9	358
February	12	5	0	9	2	0	9	1	0	5	.1	0	5	1	0	3	3	0	7	2	0	16	7	0	13	67	20	0	300
March ..	9	1	0	3	1	0	1	0	0	3	.1	0	9	2	0	15	3	0	17	8	0	11	5	.6	12	67	20	.6	313
April ..	1	1	0	2	.6	0	3	0	0	4	.1	0	14	.5	0	23	6	0	25	5	0	7	1	0	7	79	14	0	351
May ..	.9	0	0	3	0	0	1	0	0	3	.3	0	11	5	0	17	20	0	18	8	0	7	.6	0	6	60	34	0	272
June ..	0	0	0	0	.2	0	1	3	0	4	5	0	15	6	0	21	36	0	5	3	0	0	0	0	1	46	53	0	195
July ..	.3	0	0	0	0	0	3	0	0	7	1	0	14	10	0	22	61	0	5	5	0	.2	0	0	.9	52	47	0	325
August ..	0	0	0	.7	0	0	5	1	0	9	2	0	19	.9	0	26	18	0	10	6	0	.3	0	0	2	70	28	0	280
September	.4	0	0	0	0	0	3	0	0	4	.3	0	8	1	0	28	19	0	23	5	0	1	.2	0	7	67	26	0	292
October..	5	0	0	4	0	0	1	0	0	5	.5	0	7	0	0	17	2	0	31	2	0	12	.3	0	13	82	5	0	204
November	16	2	0	14	4	0	18	1	0	5	.7	0	3	.5	0	5	.5	0	8	.3	0	11	.5	0	11	79	10	0	200
December	13	3	0	27	3	0	10	2	0	5	2	0	2	.3	0	.9	.2	0	9	.6	0	9	2	0	12	75	13	0	353

Mahan coast

20°-25° N., 65°-70° E.

January..	24	3	0	16	4	0	7	2	0	2	.5	0	2	3	0	12	3	0	17	2	0	3	81	16	0	299			
February	15	9	0	12	6	0	7	.9	0	2	.2	0	.8	.1	0	5	1	0	7	2	0	23	4	0	5	72	23	0	333
March ..	13	2	0	5	.3	0	.7	.2	0	.3	0	0	5	0	0	13	1	0	18	5	0	27	6	0	4	81	15	0	308
April ..	11	3	0	2	.6	0	.7	0	0	.4	0	0	4	0	0	15	9	0	21	8	0	15	6	0	4	70	26	0	268
May ..	1	.6	0	.4	0	0	.2	0	0	.4	0	0	7	1	0	14	14	0	32	17	0	8	3	0	1	63	36	0	250
June ..	0	0	0	0	0	0	0	0	0	0	0	0	.4	3	0	21	34	0	15	24	0	.9	0	0	2	38	60	0	114
July ..	.4	.4	0	0	0	0	0	0	0	.4	0	0	2	1	0	11	41	0	8	33	0	.6	3	0	.8	22	77	0	256
August ..	.4	0	0	0	0	0	0	0	0	0	.4	0	2	.7	0	21	21	0	25	25	0	3	.5	0	2	50	48	0	231
September	1	.6	0	.4	0	0	0	0	0	.6	0	0	3	0	0	18	7	0	35	15	0	15	.8	0	3	74	23	0	240
October	6	1	0	11	1	0	3	.3	0	2	0	0	7	1	0	7	2	0	24	4	0	20	2	0	7	81	12	0	175
November	18	8	0	19	8	0	8	.7	0	.5	0	0	2	0	0	3	.9	0	6	.7	0	15	2	0	9	71	20	0	216
December	16	5	0	24	11	.4	8	2	0	3	1	0	.1	0	0	2	.5	0	7	2	0	10	2	0	6	70	24	.4	248

Authorities.—Bibliography Nos 3, 53.

TABLE III—MONTHLY FREQUENCY OF WINDS OF DIFFERENT FORCES AT COASTAL STATIONS

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

0800 local time. Period: 1933-7

Month	PASNI†				KARACHI (Manora)				DWARKA				VERAVAL			
	C	I	II	III	C	I	II	III	C	I	II	III	C	I	II	III
January	18	69	13	0	2	88	10	0	3	90	7	0	25	75	0	0
February	31	62	6	.7	4	85	11	0	6	82	12	0	42	57	1	0
March	31	63	6	0	5	85	10	0	.6	80	19	0	13	86	.6	0
April	8	88	4	0	2	80	18	0	0	80	20	0	4	93	3	0
May	9	88	3	0	1	53	46	0	0	75	25	0	8	89	3	0
June	7	87	6	0	0	39	91	0	.7	43	56	0	5	63	31	.7
July	15	83	2	0	.6	36	63	0	0	24	76	0	0	34	66	0
August	14	85	1	0	0	29	71	0	0	46	54	0	6	47	47	0
September	15	84	.7	0	1	72	27	0	5	78	17	0	17	69	14	0
October	21	74	5	0	.6	95	4	0	4	91	5	0	23	77	0	0
November	29	66	5	0	5	90	5	0	1	92	7	0	23	76	1	0
December	34	60	6	0	0	90	10	0	1	90	9	0	22	78	0	0
1600 (Z-4½)*																
January	5	81	14	0	.6	73	26	0	0	73	27	0	5	75	20	0
February	3	75	21	.7	0	39	61	0	0	75	25	0	.7	72	27	0
March .. .. .	.6	73	26	0	0	19	81	0	0	68	32	0	.6	53	46	0
April	0	35	65	0	0	10	90	0	0	51	49	0	.7	53	46	0
May	0	41	59	0	0	6	94	0	0	35	65	0	0	72	28	0
June	0	43	57	0	0	9	91	0	0	27	73	0	0	56	44	0
July	0	60	40	0	0	15	85	0	0	19	81	0	0	30	70	0
August	0	64	36	0	0	11	89	0	0	35	65	0	0	54	46	0
September	0	51	46	0	0	25	75	0	0	73	27	0	5	65	30	0
October	0	74	26	0	0	41	59	0	0	85	15	0	.6	89	10	0
November .. .. .	.7	92	7	0	0	57	43	0	0	83	17	0	5	91	4	0
December .. .. .	.5	89	8	0	.6	82	17	0	.6	80	19	0	3	89	8	0

Table III—Wind force at coastal stations

4 67

Authority—Bibliography No. 52.

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

* Zone time (Z-4½) differs from local time by less than 20 min.

† At Pasni observations up to June 1934 were at 0830 and 1830 (Z-4½) and from July 1934 onwards at 0830 and 1630 (Z-4½).

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.)

Karachi (Drigh Road). 24° 54' N., 67° 11' E. 98 ft. Time of obs: about sunrise: Period*: Sept., 1925-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 ..	12	0	0	0	49	-8	0	0	2	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	1	0	0	0	7	-6	0	0	27	358
1,700 ..	10	4	-3	-3	11	14	5	0	8	6	-8	0	2	0	0	0	3	0	0	0	3	-6	0	0	7	6	0	0	13	3	-3	0	4	358
3,300 ..	11	3	0	-3	13	3	1	0	9	3	-3	0	4	-8	0	0	3	-3	0	0	4	-3	0	0	14	7	-3	0	16	4	-6	0	3	356
6,500 ..	11	1	-6	0	5	-6	0	0	4	0	0	0	4	0	0	0	4	-3	0	0	4	5	2	0	11	17	3	0	16	8	-6	0	2	347
10,000 ..	2	2	0	0	1	0	0	0	-6	0	0	0	1	0	0	0	-3	2	0	0	5	8	1	-6	7	27	12	3	7	12	6	1	1	313
Low cloud ..		1				4				2				0				1				22				64				7			0	131
Medium cloud		0				0				0				0				0				10				81				8			0	69
High cloud ..		0				0				0				0				0				7				80				12			0	209
FEBRUARY																																		
Surface ..	9	0	0	0	35	-6	0	0	2	0	0	0	-6	0	0	0	0	0	0	0	2	-3	0	0	7	0	0	0	5	0	0	0	40	329
1,700 ..	9	2	0	0	8	7	2	0	9	5	-6	0	2	-3	0	0	-6	0	0	0	2	0	-3	0	9	15	2	0	19	6	0	0	2	327
3,300 ..	7	1	0	0	8	2	-6	0	10	3	-6	0	3	1	0	0	3	-3	0	0	4	1	0	-3	11	12	4	-3	14	7	-3	0	5	323
6,500 ..	7	3	0	0	7	2	0	0	4	-3	0	0	3	-3	0	0	4	2	0	0	6	3	-3	0	15	17	5	-3	10	8	2	-3	2	317
10,000 ..	5	2	0	-4	2	-4	-4	0	-4	-4	0	0	-7	0	0	0	1	0	-7	0	7	4	2	0	13	20	10	4	10	13	4	0	0	281
Low cloud ..		1				1				1				1				1				14				62				17			1	87
Medium cloud		1				0				0				0				0				8				79				11			0	78
High cloud ..		1				0				0				0				0				8				79				11			1	161
MARCH																																		
Surface ..	10	0	0	0	15	0	0	0	1	0	0	0	-3	0	0	0	0	0	0	0	5	0	0	0	18	-3	0	0	7	0	0	0	43	362
1,700 ..	9	2	0	0	8	4	0	0	4	3	-6	0	0	-3	0	0	-3	0	0	0	1	0	0	0	10	24	2	0	15	15	1	0	8	359
3,300 ..	8	4	0	0	7	1	0	0	6	2	0	0	4	0	0	0	1	-3	0	0	3	-8	0	0	14	17	5	-3	11	13	1	0	2	359
6,500 ..	8	2	-6	0	8	0	0	0	5	0	0	0	3	-3	0	0	4	1	0	0	7	4	1	-3	9	18	7	-6	10	9	-9	0	2	352
10,000 ..	4	2	-6	0	5	3	0	0	3	-6	0	0	1	0	0	0	2	-6	-3	0	6	5	3	1	13	16	9	2	10	9	3	0	2	310
Low cloud ..		0				0				0				1				0				11				75				12			1	74
Medium cloud		0				0				0				0				0				25				75				0			0	54
High cloud ..		0				0				0				0				0				15				78				5			1	174

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: 1925-35

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.)

Karachi (Drigh Road)—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 ..	3	0	0	0	3	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	12	3	0	0	32	8	0	0	10	3	0	0	37	354
1,700 ..	5	4	0	0	2	3	0	0	9	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7	35	7	3	12	20	6	0	6	353
3,300 ..	4	4	0	0	3	1	0	0	2	3	0	0	9	0	0	0	1	0	0	0	3	6	0	0	9	29	7	6	12	19	2	0	6	347
6,500 ..	6	2	0	0	2	0	0	0	4	3	0	0	4	0	0	0	2	3	0	0	4	2	2	0	11	24	7	2	13	11	9	0	3	336
10,000 ..	10	3	0	0	6	2	0	0	7	1	0	0	2	0	0	0	2	0	0	0	3	4	2	3	7	16	6	2	10	11	4	3	2	301
Low cloud ..	0				0				0				0				0				15				79				5				0	117
Medium cloud ..	1				1				0				0				0				9				78				4				6	58
High cloud ..	1				0				0				0				0				15				76				7				1	202
MAY																																		
Surface ..	3	0	0	0	3	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	22	1	0	0	42	4	0	0	4	9	0	0	24	352
1,700 ..	1	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3	0	0	0	6	9	0	0	12	50	7	3	7	11	9	0	0	347
3,300 ..	4	5	0	0	1	0	0	0	3	3	0	0	3	0	0	0	6	0	0	0	2	1	0	0	6	33	10	6	9	23	4	0	3	314
6,500 ..	7	3	0	0	4	4	0	0	2	0	0	0	7	4	0	0	1	4	0	0	3	1	0	0	12	21	4	2	15	19	2	4	2	278
10,000 ..	11	4	0	0	6	2	0	0	4	1	0	0	4	5	0	0	3	1	0	0	3	1	5	5	11	7	1	0	20	14	5	0	4	205
Low cloud ..	0				1				0				0				0				12				84				3				0	310
Medium cloud ..	3				5				0				0				0				12				49				21				10	25
High cloud ..	0				0				0				0				1				11				74				12				2	68
JUNE																																		
Surface ..	6	0	0	0	3	0	0	0	6	0	0	0	6	0	0	0	9	0	0	0	31	5	0	0	43	7	0	0	4	3	0	0	7	344
1,700 ..	2	6	0	0	6	3	0	0	6	3	0	0	6	3	0	0	6	0	0	0	6	3	0	0	12	56	9	0	4	5	0	0	3	340
3,300 ..	2	7	0	0	2	4	7	0	2	4	0	0	7	4	0	0	2	4	0	0	7	3	0	0	11	46	10	4	4	7	7	0	0	267
6,500 ..	8	4	5	0	6	4	5	0	2	3	0	0	3	2	0	0	3	3	0	0	5	2	0	0	10	10	2	0	14	13	2	5	4	193
10,000 ..	13	10	0	0	18	11	1	0	6	4	1	0	3	1	0	0	4	0	0	0	3	7	0	0	4	1	0	0	14	4	0	0	0	139
Low cloud ..	1				2				3				1				2				18				71				2				0	507
Medium cloud ..	10				28				29				3				0				4				15				7				3	33
High cloud ..	1				17				38				9				16				5				9				1				6	41

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.)

Karachi (Drigh Road)—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	1	0	0	0	0	3	0	0	3	0	0	0	3	0	0	0	26	7	0	0	45	9	0	0	5	6	0	0	6	352				
1,700 ..	6	0	3	0	1	9	0	0	3	1	0	0	3	0	0	0	6	3	0	0	2	4	0	0	9	61	12	9	2	2	3	0	6	345				
3,300 ..	2	4	4	0	2	1	4	0	2	8	0	0	8	4	0	0	4	8	0	0	3	5	0	0	19	40	11	8	6	3	0	0	8	257				
6,500 ..	15	2	8	0	11	10	8	0	5	4	8	0	8	0	0	0	2	0	0	0	4	8	0	0	7	7	8	0	18	7	8	0	2	126				
10,000 ..	12	13	2	0	16	21	4	0	4	6	2	0	0	2	0	0	1	0	0	0	0	0	0	0	4	0	0	0	5	7	1	0	0	83				
Low cloud ..	1				2				1				1				12				77				4				0	784								
Medium cloud	12				30				35				5				1				4				8				6				1	124				
High cloud ..	2				17				62				11				0				0				2				2				5				5	73
AUGUST																																						
Surface ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	30	4	0	0	47	6	0	0	10	5	0	0	3	365				
1,700 ..	8	3	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	12	68	8	0	4	1	3	0	3	359				
3,300 ..	3	5	0	0	4	5	0	0	5	0	0	0	0	0	0	0	1	0	0	0	3	3	0	0	19	48	5	0	9	2	0	5	0	221				
6,500 ..	18	9	0	0	14	11	9	0	5	3	9	0	4	9	0	0	9	0	0	0	2	0	0	0	3	4	0	0	11	9	0	9	2	114				
10,000 ..	15	27	0	0	15	16	3	0	1	11	0	0	3	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	3	0	0	0	79				
Low cloud ..	1				1				0				0				0				9				84				4				0	641				
Medium cloud	5				38				38				5				1				0				7				4				1	117				
High cloud ..	8				24				42				17				0				0				0				0				0				8	67
SEPTEMBER																																						
Surface ..	9	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	6	0	0	52	2	0	0	11	6	0	0	14	357				
1,700 ..	2	5	0	0	2	2	0	0	5	0	0	0	3	0	0	0	1	0	0	0	2	3	0	0	24	53	3	0	6	1	0	0	0	365				
3,300 ..	6	2	8	0	7	2	0	0	8	4	0	0	8	0	0	0	2	0	0	0	9	1	0	0	22	27	1	0	14	4	0	0	1	260				
6,500 ..	17	5	0	0	16	7	5	0	11	1	0	0	6	1	0	0	3	0	0	0	3	5	0	0	6	1	5	5	10	4	1	0	3	201				
10,000 ..	12	9	0	0	19	27	2	0	11	8	0	0	2	0	0	0	1	0	0	0	0	6	0	0	2	1	0	0	3	2	0	0	0	174				
Low cloud ..	1				3				1				0				1				5				88				2				0	453				
Medium cloud	0				37				29				19				2				5				7				0				0	27				
High cloud ..	1				7				22				24				10				7				6				6				18				18	74

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.

470

Makran coast

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.)

Karachi (Drigh Road)—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 ..	9	0	0	0	12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	14	0	0	0	9	0	0	0	51	398				
1,700 ..	6	2	0	0	6	4	.7	0	3	1	0	0	2	0	0	0	.5	0	0	0	3	.5	0	0	22	22	.3	0	17	8	0	0	2	400				
3,300 ..	9	1	0	0	6	2	0	0	6	.8	0	0	2	.3	0	0	4	2	0	0	9	2	0	0	20	14	.3	0	12	5	.5	0	5	387				
6,500 ..	19	4	0	0	15	3	0	0	6	1	.3	0	5	.3	0	0	4	.6	0	0	7	.6	0	0	9	2	.3	0	12	5	.6	0	5	371				
10,000 ..	13	8	0	0	19	19	1	.3	7	4	0	0	3	.3	0	0	4	0	0	0	1	.9	.3	0	5	.6	.6	0	8	3	.9	0	2	342				
Low cloud ..	3				13				2				1				4				12				60				5				1	169				
Medium cloud	5				5				12				5				17				40				9				1				7	49				
High cloud ..	0				2				5				2				0				45				19				17				9				9	50
NOVEMBER																																						
Surface ..	19	0	0	0	37	.3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.5	0	0	0	1	0	0	0	40	389				
1,700 ..	8	2	0	0	12	11	2	0	6	6	0	0	1	0	0	0	2	0	0	0	4	.5	0	0	15	6	0	0	20	2	0	0	4	389				
3,300 ..	7	3	0	0	12	3	1	0	12	3	.3	0	6	.3	0	0	5	.3	0	0	11	2	0	0	12	3	0	0	13	1	0	0	6	389				
6,500 ..	14	.5	0	0	21	4	.3	0	13	1	0	0	4	0	0	0	3	2	.3	0	7	2	0	0	7	1	0	0	11	.8	.5	0	7	385				
10,000 ..	13	3	.3	0	9	6	0	0	7	3	0	0	3	.8	0	0	2	.8	0	0	9	6	.5	0	12	6	.3	0	13	2	2	0	2	379				
Low cloud ..	0				1				2				1				3				30				50				14				0	48				
Medium cloud	1				5				0				0				4				55				31				4				0	59				
High cloud ..	0				0				0				0				0				18				65				9				7				7	170
DECEMBER																																						
Surface ..	16	0	0	0	54	1	0	0	2	.2	0	0	.2	0	0	0	0	0	0	0	.2	0	0	0	0	0	0	0	2	0	0	0	24	402				
1,700 ..	11	2	0	0	15	15	5	.5	10	5	.7	0	2	.2	0	0	1	0	0	0	.7	0	0	0	11	2	0	0	11	2	.2	0	5	402				
3,300 ..	14	2	0	0	13	4	.3	0	12	4	0	0	6	.5	0	0	3	0	0	0	5	.3	0	0	11	3	0	0	14	2	.3	0	6	400				
6,500 ..	14	2	.3	0	12	3	.3	0	5	1	0	0	4	.3	0	0	4	.8	0	0	8	2	.3	0	13	9	.5	0	11	4	.8	0	5	394				
10,000 ..	4	4	.3	0	4	.5	.3	0	2	.3	0	0	.8	0	0	0	4	.8	0	0	6	11	.3	0	14	18	4	.8	10	12	2	.8	1	367				
Low cloud ..	6				4				0				1				4				17				52				15				2	77				
Medium cloud	1				0				0				0				4				26				62				7				0	88				
High cloud ..	2				0				0				0				1				12				73				13				0				0	212

Authorities.—Bibliography Nos. 35, 51, 52.

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

4 71

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.)

Ahmedabad. 23° 02' N., 72° 38' E., 164 ft.

Time of obs. : morning.

Period*: May, 1928—Dec., 1929; 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	28	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	65	89
1,800 ..	16	5	0	0	11	8	0	0	10	11	6	0	6	5	0	0	3	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	12	5	0	0	1	89
3,300 ..	14	0	0	0	17	2	0	0	8	1	0	0	6	0	0	0	2	0	0	0	7	1	0	0	9	0	0	0	21	5	0	0	7	87				
6,500 ..	8	1	0	0	5	0	0	0	0	1	0	0	1	0	0	0	1	2	0	0	6	10	4	0	20	12	4	0	17	4	0	0	4	86				
10,000 ..	3	6	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	3	0	0	3	21	7	3	8	23	4	0	8	4	3	0	0	73				
Low cloud ..	0				0				0				0				10				61				16				12				0	36				
Medium cloud	0				0				0				0				3				29				68				1				0	25				
High cloud ..	0				0				0				0				0				16				75				8				0	88				
FEBRUARY																																						
Surface ..	0	0	0	0	18	0	0	0	16	0	0	0	0	0	0	0	1	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	59	83				
1,800 ..	8	5	0	0	4	8	1	0	10	24	6	0	4	4	0	0	1	0	0	0	2	1	0	0	1	4	2	0	7	6	0	0	1	83				
3,300 ..	14	1	0	0	13	7	0	0	14	6	0	0	4	2	0	0	2	0	0	0	1	0	0	0	6	4	4	0	11	4	0	0	8	81				
6,500 ..	7	1	0	0	3	3	0	0	5	0	0	0	1	0	0	0	11	4	0	0	6	11	1	0	11	7	3	1	12	7	1	0	4	81				
10,000 ..	3	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	14	3	2	21	22	2	0	5	9	3	0	0	63				
Low cloud ..	4				0				0				0				5				46				25				20				0	33				
Medium cloud	0				0				0				0				0				46				54				0				0	35				
High cloud ..	1				0				0				0				0				8				71				19				0	82				
MARCH																																						
Surface ..	3	0	0	0	9	0	0	0	5	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	5	0	0	0	72	92				
1,800 ..	7	9	0	0	5	7	0	0	10	8	5	0	0	0	0	0	0	0	0	0	0	1	0	0	2	5	0	0	14	26	1	0	0	92				
3,300 ..	14	5	0	0	12	1	0	0	7	3	1	0	0	1	0	0	1	0	0	0	3	0	0	0	10	9	1	0	21	10	0	0	1	92				
6,500 ..	8	0	0	0	7	0	0	0	2	0	0	0	0	1	0	0	6	0	0	0	16	7	0	0	17	20	3	0	10	2	0	0	1	89				
10,000 ..	4	1	0	0	5	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	9	21	4	0	11	25	3	0	5	8	0	0	0	79				
Low cloud ..	0				0				0				5				5				41				43				5				0	8				
Medium cloud	0				0				0				3				3				24				71				0				0	16				
High cloud ..	4				0				0				0				0				21				60				14				0	54				

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 : 1928-35.

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Mahran coast

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.)

Ahmedabad—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 ..	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	7	0	0	0	9	0	0	0	75	85
1,800 ..	5	11	5	0	6	8	0	0	1	1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	4	6	0	0	8	33	8	0	0	85
3,300 ..	9	11	0	0	11	2	0	0	2	2	0	0	1	1	0	0	1	0	0	0	2	0	0	0	7	8	0	0	11	28	1	0	1	85
6,500 ..	20	0	0	0	7	0	0	0	4	0	0	0	3	0	0	0	5	0	0	0	7	5	0	0	19	10	0	0	16	3	0	0	1	80
10,000 ..	6	0	0	0	3	3	0	0	3	0	0	0	1	0	0	0	10	1	0	0	13	19	1	0	13	17	0	0	9	0	0	0	1	70
Low cloud ..		1				1				0				1				4				31				51				11			1	66
Medium cloud		0				0				0				0				12				42				46				0			0	29
High cloud ..		4				0				0				0				2				27				54				13			0	65
MAY																																		
Surface ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	31	0	0	0	20	0	0	0	3	0	0	0	38	102
1,800 ..	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	18	0	0	12	31	1	0	6	20	2	0	0	102
3,300 ..	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	6	1	0	18	42	1	0	5	15	3	0	0	101
6,500 ..	2	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	5	3	0	0	6	12	0	0	26	22	3	0	12	3	0	0	1	95
10,000 ..	7	0	0	0	4	3	0	0	7	0	0	0	3	1	0	0	5	0	0	0	12	9	3	0	18	9	1	0	9	5	0	0	3	74
Low cloud ..		1				3				0				1				2				32				50				7			0	118
Medium cloud		3				17				0				0				8				28				42				3			0	13
High cloud ..		4				0				0				0				0				32				54				8			0	15
JUNE																																		
Surface ..	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5	0	0	0	56	0	0	0	8	0	0	0	3	0	0	0	26	80
1,800 ..	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	9	31	1	0	18	26	4	0	3	3	0	0	0	77
3,300 ..	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	5	22	3	0	19	31	7	0	3	4	0	0	0	74
6,500 ..	2	2	0	0	10	5	0	0	7	0	0	0	3	0	0	0	9	0	0	0	12	9	0	0	16	9	5	0	5	2	0	0	5	58
10,000 ..	5	0	0	0	15	17	0	0	10	5	0	0	8	5	0	0	5	0	0	0	2	5	0	0	13	8	0	0	0	2	0	0	0	40
Low cloud ..		1				2				1				3				10				53				43				5			0	303
Medium cloud		7				6				15				41				12				10				6				0			3	27
High cloud ..		0				12				57				11				0				7				7				0			7	11

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

4 73

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.)

Ahmedabad.—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	14	0	0	0	59	0	0	0	3	0	0	0	0	0	0	0	24	63
1,800 ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	10	21	0	0	19	36	3	0	7	0	2	0	0	58
3,300 ..	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	16	0	0	16	45	4	0	8	0	2	0	0	49
6,500 ..	7	0	0	0	0	0	0	0	11	0	0	0	4	0	0	0	7	7	0	0	14	25	0	0	7	14	0	0	0	0	0	0	4	28
10,000 ..	7	0	0	0	13	0	0	0	20	0	0	0	20	0	0	0	13	0	0	0	7	0	0	0	13	7	0	0	0	0	0	0	0	15
Low cloud ..	0					0					1					3					8					43					3	0	394	
Medium cloud	3					14					22					4					1					29					6	3	62	
High cloud ..	4					10					60					10					1					1					1	8	17	
AUGUST																																		
Surface ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	56	0	0	0	6	0	0	0	0	0	0	0	23	79
1,800 ..	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	32	1	0	13	38	3	0	4	5	0	0	0	79
3,300 ..	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	14	1	0	14	49	8	1	4	3	0	0	0	76
6,500 ..	0	0	0	0	2	0	0	0	0	0	0	0	5	0	0	0	19	0	0	0	19	41	2	0	2	5	5	0	0	0	0	0	0	42
10,000 ..	6	0	0	0	18	0	0	0	6	0	0	0	6	6	0	0	18	0	0	0	6	12	0	0	18	0	0	0	6	0	0	0	0	17
Low cloud ..	1					1					0					0					2					31					60	0	330	
Medium cloud	6					14					14					4					6					28					23	3	47	
High cloud ..	0					25					47					3					8					6					0	5	19	
SEPTEMBER																																		
Surface ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	16	0	0	0	12	0	0	0	5	0	0	0	65	75
1,800 ..	7	4	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	4	0	0	19	21	1	0	18	15	0	0	3	72
3,300 ..	11	0	0	0	6	2	0	0	9	0	0	0	5	0	0	0	2	0	0	0	9	2	0	0	30	12	0	0	9	0	0	0	5	66
6,500 ..	2	0	0	0	5	2	0	0	7	5	0	0	31	4	0	0	16	2	0	0	9	5	0	0	7	0	0	0	0	0	0	0	4	55
10,000 ..	4	0	0	0	10	2	2	0	23	12	0	0	29	2	0	0	8	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	2	48
Low cloud ..	2					3					4					3					3					24					53	0	224	
Medium cloud	1					16					17					19					7					18					9	7	82	
High cloud ..	1					12					27					20					10					8					17	2	75	

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.

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Mahran coast

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.)

Ahmedabad—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 ..	0	0	0	0	6	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	0	0	1	0	0	0	85	84
1,800 ..	19	5	0	0	15	4	0	0	7	2	0	0	5	1	0	0	2	0	0	0	4	0	0	0	11	1	0	0	12	12	0	0	0	84
3,300 ..	14	1	0	0	18	4	0	0	13	0	0	0	5	1	0	0	4	1	0	0	6	0	0	0	10	1	0	0	19	1	0	0	4	84
6,500 ..	5	1	0	0	15	5	2	0	17	0	0	0	17	0	0	0	2	2	0	0	2	4	0	0	12	2	0	0	6	1	0	0	5	82
10,000 ..	12	6	0	0	9	11	0	0	15	4	0	0	7	0	0	0	6	0	0	0	1	4	0	0	4	3	0	0	16	1	0	0	0	80
Low cloud ..	3				17				10				7				7				22				25				9				0	113
Medium cloud	1				3				16				7				12				28				29				4				0	71
High cloud ..	0				2				2				8				7				57				25				0				0	43
NOVEMBER																																		
Surface ..	1	0	0	0	8	0	0	0	18	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72	85
1,800 ..	11	1	0	0	18	2	0	0	25	16	1	0	11	1	0	0	1	0	0	0	0	1	0	0	4	0	0	0	7	0	0	0	1	84
3,300 ..	12	1	0	0	21	2	0	0	21	2	0	0	8	2	0	0	6	0	0	0	2	1	0	0	5	1	0	0	7	0	0	0	7	85
6,500 ..	12	0	0	0	8	0	0	0	11	0	0	0	8	0	0	0	16	0	0	0	19	5	0	0	8	1	0	0	8	0	0	0	4	85
10,000 ..	13	1	0	0	7	2	0	0	6	0	0	0	1	0	0	0	5	2	0	0	13	12	1	0	11	4	0	0	15	1	0	0	4	82
Low cloud ..	4				20				5				0				20				26				19				6				0	40
Medium cloud	0				0				0				2				4				71				23				0				0	29
High cloud ..	0				0				0				0				5				44				43				7				0	80
DECEMBER																																		
Surface ..	0	0	0	0	17	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	72	86
1,800 ..	14	2	0	0	12	7	0	0	9	22	2	0	8	0	0	0	1	1	0	0	4	0	0	0	4	0	0	0	7	2	0	0	4	85
3,300 ..	11	0	0	0	12	5	0	0	16	1	0	0	5	0	0	0	5	0	0	0	9	5	0	0	12	0	0	0	15	0	0	0	5	85
6,500 ..	13	2	0	0	5	0	0	0	4	0	0	0	4	0	0	0	7	4	0	0	8	12	2	0	12	8	0	0	13	2	0	0	4	84
10,000 ..	10	4	0	0	4	0	0	0	2	0	0	0	0	0	0	0	4	0	0	0	7	20	4	0	13	8	4	0	11	7	1	0	1	83
Low cloud ..	1				1				3				0				14				44				27				10				0	29
Medium cloud	0				1				1				1				5				35				45				13				0	35
High cloud ..	0				0				0				0				0				16				72				12				0	71

Authorities.—Bibliography Nos. 32, 35, 51.

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 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	
	PASNI†					KARACHI (Manora)					DWARKA					VERAVAL					
January	0	6	5	14	75	0	3	41	37	19	0	0	1	99	0	0	0	6	99	0	
February	3	4	15	12	66	5	7	26	39	23	.7	2	3	94	0	.7	1	7	98	0	
March	2	5	15	24	54	0	5	30	41	24	0	0	5	95	0	0	0	3	97	0	
April	0	6	7	18	69	0	3	22	53	22	.7	2	17	80	0	0	.7	8	91	0	
May	0	7	14	38	41	0	3	28	63	6	0	.6	51	48	0	0	.6	16	83	0	
June	0	7	29	53	11	0	19	52	26	3	0	8	63	29	0	0	11	23	66	0	
July	0	10	41	45	4	0	25	60	14	.6	0	23	70	7	0	3	20	19	58	0	
August	0	2	21	53	24	0	8	52	35	5	0	10	68	22	0	0	10	25	65	0	
September .. .. .	.7	2	13	35	49	0	2	20	61	17	0	3	30	66	.7	.7	5	17	77	0
October	3	4	3	14	76	0	3	23	33	41	.6	.6	5	91	3	0	0	0	100	0	
November	0	.7	1	9	89	.7	7	38	35	19	0	2	0	88	10	0	0	0	100	0	
December .. .. .	.6	1	6	9	83	0	3	31	52	14	0	0	0	97	3	0	0	.6	99	0
Year .. .. .	.9	5	14	27	53	.5	7	35	41	16	.2	4	26	.68	1	.4	4	9	86	0
1600 (Z-4 $\frac{1}{2}$)*																					
January .. .. .	.6	5	8	13	73	0	3	2	10	85	0	.6	4	95	0	0	0	0	100	0
February	0	7	15	11	67	0	.7	2	37	60	0	4	0	96	0	0	.7	.7	99	0	
March	0	8	13	27	52	0	2	7	35	56	0	1	9	90	0	0	0	0	100	0	
April	0	15	11	25	49	0	0	11	65	24	0	2	19	79	0	0	.7	.7	99	0	
May	0	17	16	41	26	0	.6	21	73	5	0	1	56	43	0	0	0	.6	99	0	
June	0	17	25	49	9	0	6	60	31	3	0	7	63	30	0	0	9	6	85	0	
July	0	6	35	53	6	0	11	70	15	4	0	19	71	10	0	.6	10	12	77	0	
August	0	0	18	50	32	0	3	46	44	7	0	6	68	25	1	.6	4	10	79	6	
September	0	3	20	30	47	0	.7	10	65	24	0	4	29	67	0	0	6	3	85	6	
October	0	3	8	13	76	0	1	7	22	70	0	0	4	93	3	0	0	0	100	0	
November	0	1	3	13	83	0	1	.7	13	85	0	.7	3	85	11	0	0	0	100	0	
December	0	3	4	11	82	0	0	1	12	87	0	.6	1	98	.6	0	0	0	100	0	
Year	<.1	7	15	28	50	0	2	20	35	43	0	4	27	68	1	.1	2	3	94	1	

Authority.—Bibliography No. 52.

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

* Zone time (Z-4 $\frac{1}{2}$) differs from local time by less than 20 min.

† At Pasni observations up to June 1934 were at 0830 and 1830 (Z-4 $\frac{1}{2}$) and from July 1934 onwards at 0830 and 1830 (Z-4 $\frac{1}{2}$).

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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					0 Tr.-3 4-6 7-9 10				
	PASNI†					KARACHI (Manora)					DWARKA					VERAVAL				
January	39	21	13	10	17	34	29	10	17	10	47	27	9	6	11	52	29	11	8	0
February	44	21	4	9	22	23	36	13	13	15	32	36	7	9	16	45	31	13	11	0
March	50	21	9	10	10	36	35	10	12	7	48	22	8	12	10	57	25	7	11	0
April	54	21	7	11	7	33	40	13	10	4	41	29	11	10	9	36	42	13	8	.7
May	58	16	10	12	4	21	44	17	13	5	20	35	21	20	4	17	44	25	10	4
June	27	15	21	21	16	8	28	20	25	19	.7	33	18	15	33	.7	19	27	36	17
July	5	7	10	21	57	0	8	13	21	58	0	4	6	23	67	0	2	13	44	41
August	8	9	8	17	58	0	12	10	16	62	0	1	7	12	80	0	3	8	44	45
September	24	18	17	12	29	4	30	16	23	27	1	26	17	23	33	.7	21	17	38	23
October	60	17	4	4	15	38	47	6	5	4	37	39	10	6	8	27	43	14	9	7
November	48	28	11	9	4	33	42	9	11	5	39	34	10	7	10	32	41	11	13	3
December	33	27	16	8	16	25	43	11	14	7	42	27	10	10	11	41	40	8	6	5
1600 (Z-4½)*																				
January	38	29	10	14	9	35	32	12	14	7	48	30	5	7	10	48	33	12	6	.6
February	42	28	12	6	12	31	35	8	16	10	41	33	7	8	11	54	28	8	10	0
March	49	26	9	9	7	36	37	8	13	6	59	22	5	8	6	66	17	11	6	0
April	43	25	12	13	7	25	54	9	9	3	53	33	7	6	1	51	37	8	4	0
May	62	23	5	8	2	30	41	21	7	.6	26	35	23	12	4	30	42	17	8	3
June	66	18	7	5	4	9	40	21	23	7	4	25	24	21	26	3	23	23	29	22
July	28	33	17	10	12	.6	13	24	32	30	0	4	12	21	63	0	5	19	35	41
August	30	26	16	14	14	3	20	12	28	37	0	7	8	18	67	0	8	15	38	39
September	64	24	6	5	.7	8	49	15	17	11	3	34	20	16	27	0	30	17	34	19
October	85	11	3	0	.6	48	42	7	2	.6	40	42	6	7	5	25	42	15	15	3
November	42	29	15	9	5	37	41	10	8	4	43	33	8	5	11	38	36	12	11	3
December	32	32	14	10	12	23	41	15	14	7	47	36	3	6	8	49	32	7	8	4

Table VI—Cloud amount at coastal stations

Authority.—Bibliography No. 52.

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

* Zone time (Z-4½) differs from local time by less than 20 min.

† At Pasni observations up to June, 1934 were at 0830 and 1830 (Z-4½) and from July 1934 onwards at 0830 and 1630 (Z-4½).

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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
	PASNI†						KARACHI (MANORA)						DWARKA						VERAVAL					
January	89	0	11	0	0	0	98	2	0	0	0	0	99	0	.6	0	0	0	100	0	0	0	0	0
February	97	0	3	0	0	0	98	1	.7	0	0	0	99	.7	.7	0	0	0	99	0	0	0	.7	0
March	99	0	0	.6	0	0	98	2	0	0	0	0	99	0	.6	0	0	0	100	0	0	0	0	0
April	99	.7	0	0	0	0	93	5	2	0	0	0	94	5	.7	0	0	0	100	0	0	0	0	0
May	87	10	3	0	0	0	80	19	.6	0	0	0	50	20	29	.6	0	0	97	3	0	0	0	0
June	58	33	9	0	0	0	27	51	19	3	0	0	19	17	51	13	0	0	51	21	21	7	0	0
July	31	29	38	2	0	0	17	40	41	2	0	0	3	16	48	33	0	0	16	29	41	14	0	0
August	56	28	16	0	0	0	37	39	24	0	0	0	25	17	50	8	0	0	30	44	25	1	0	0
September	100	0	0	0	0	0	96	3	1	0	0	0	70	18	12	0	0	0	83	12	4	.7	0	0
October	99	.7	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0	99	.6	0	0	0	0
November	100	0	0	0	0	0	99	.7	0	0	0	0	99	0	.7	0	0	0	99	0	.7	0	0	0
December	97	0	3	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0
1600 (Z-4½)*																								
January	91	0	9	0	0	0	96	3	.6	0	0	0	99	0	1	0	0	0	99	.6	0	0	0	0
February	92	.7	7	0	0	0	99	.7	.7	0	0	0	97	2	.7	0	0	0	100	0	0	0	0	0
March	95	0	5	0	0	0	97	3	0	0	0	0	99	.6	0	0	0	0	100	0	0	0	0	0
April	88	.7	11	0	0	0	84	14	2	0	0	0	82	15	3	0	0	0	100	0	0	0	0	0
May	67	18	15	0	0	0	79	20	1	0	0	0	35	17	44	4	0	0	96	3	.6	0	0	0
June	45	31	24	0	0	0	14	57	27	2	0	0	9	12	58	21	0	0	42	27	22	9	0	0
July	25	30	42	3	0	0	12	45	38	5	0	0	3	10	56	31	0	0	19	30	35	11	5	0
August	58	29	13	0	0	0	30	42	27	1	0	0	25	17	52	6	0	0	30	48	21	.6	0	0
September	95	0	5	0	0	0	93	6	.7	0	0	0	72	13	15	0	0	0	85	12	2	.7	0	0
October	98	.6	1	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0	95	5	0	0	0	0
November	100	0	0	0	0	0	99	0	.7	0	0	0	99	0	.7	0	0	0	95	4	.7	0	0	0
December	97	0	3	0	0	0	99	.6	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0

Authority.—Bibliography No. 52.

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

* Zone time (Z-4½) differs from local time by less than 20 min.

† At Pasni observations up to June 1934 were at 0830 and 1830 (Z-4½) and from July 1934 onwards at 0830 and 1630 (Z-4½).

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