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GOVERNMENT OF TAMIL NADU

Rule DEPARTMENT

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REPORT
ON THE
ADMINISTRATION OF THE METEOROLOGICAL DEPARTMENT
OF WESTERN INDIA
FOR THE YEAR 1880-81.

Up to the end of the year 1879-80 the operations of the Meteorological Department of Western India were almost exclusively confined to the climatological branch of the science of meteorology, but during the past year an important step has been taken towards utilizing the observations for the more immediate practical purpose of giving warning to the various ports of the approach of cyclonic storms. This step consists in the establishment of a system of daily telegraphic weather reports from seven stations on the west coast of India, and from three on the Coromandel coast, viz:—

- | | |
|---------------|------------------|
| 1. Karachi. | 6. Calicut. |
| 2. Surat. | 7. Cochin. |
| 3. Ratnagiri. | 8. Negapatam. |
| 4. Karwar. | 9. Madras. |
| 5. Mangalore. | 10. Masulipatam. |

The observations telegraphed are those recorded daily at the observatories at 10 A.M. The telegrams begin to arrive about 12-30 P.M., and as fast as they come in, the telegraphic code words are translated into the corresponding instrumental readings. These are corrected and reduced, and entered on a chart and also in the daily telegraphic weather report, a specimen copy of which is appended. The last telegrams usually arrive about 3 P.M., and in about an hour afterwards a copy of the daily report is ready for despatch to the Port Officer, who posts it up at his office for inspection, and gives the information to the *Times of India* for publication in the next morning's paper. A form, giving the principal items of information, is also filled up at the Meteorological Office for daily publication in the *Bombay Gazette*.

In the event of threatening weather being reported from any of the coast stations, special telegraphic reports are called for from all the Government Observatories in the neighbourhood of the disturbance, and a special telegram is despatched to the Port Officer at Bombay describing the observed indications. If the disturbance should threaten any of the Bombay ports, warning telegrams are at once sent to them. The following are the ports which have been selected by the Bombay Government to receive these warning telegrams, and to exhibit the storm warning signals:—

- | | |
|-------------------|-----------------------------|
| 1. Karachi. | 4. Vengurla. |
| 2. Bombay Castle. | A. Vengurla Rocks. |
| A. Prince's Dock. | (a) Malvan. |
| B. Colaba Point. | 5. Karwar. |
| (a) Kenneri. | A. Oyster Rock Light House. |
| 3. Ratnagiri. | 6. Kumta. |

A description of the storm signals, and the significations attached to them, will be found in Appendix II, entitled "Telegraphic Weather Intelligence." The object aimed at in this appendix is, as far as present circumstances will permit, to secure conformity with the storm warning system in use at home. During the past year special telegraphic reports have been called for on two occasions, but it has been necessary to issue warning telegrams only once, to the ports southward of Bombay on the 21st November 1880, when a cyclone was crossing the southern portion of the Indian Peninsula.

It will be noticed that the chief defects of this storm warning system (which, however, is avowedly only in its initiatory stage) are—1st, the paucity of the regular reporting stations, the data from which are, by themselves, insufficient to

determine the general character of a disturbance, owing to the fact that it is impossible to draw isobaric and other lines from the observations of stations situated along a straight coast line like the west coast of India; and 2nd, the delay which arises in calling for additional information from other stations after the detection of some suspicious feature in one or more of the regular reports, and which must frequently result in the special telegraphic information arriving too late to be of much use.

There is also a somewhat serious defect in the character of the daily reports, viz., the absence of any information as to the *velocity* of the wind at the time of observation. This arises from there being no provision in the meteorological telegraph code for the transmission of this important piece of information. The total movement of the wind during the preceding twenty-four hours is transmitted, but this is of much less use for storm warning purposes. It is hoped that a revision of the code will shortly remove this defect.

It now seems quite possible to make use of meteorological observations, not merely for storm warning purposes, but also for the more important object of forecasting, in a general way, the character of a coming monsoon season. In my last report I pointed out that there is on the average in the Bombay Presidency a definite relation between the height of the barometer and the quantity of the rainfall, the latter being above the average when the former is below it, and *vice versa*. It also appears from the report of the Indian Famine Commission that all the great scarcities and famines in India have been caused by deficient rainfall. If therefore the above relation between the height of the barometer and the quantity of the rainfall holds good generally in India, it would follow that all the past great scarcities and famines should have occurred at or soon after a period of excessively high barometric pressure, and such, as far back as meteorological observation goes, really appears to have been the case. The great famine of 1876-1878 was accompanied by the highest mean barometric pressure on record. The Rājputāna famine of 1868-69 occurred soon after a wave of very high pressure. The Orissa famine of 1865-66 was also immediately preceded by a similar wave of high pressure, and, speaking generally, past famines have occurred during or soon after periods when the barometer was unusually high. There is good reason, therefore, for believing that if these waves of high or low pressure could by any means be anticipated, the corresponding character of the accompanying rainfall might be foreseen. Now I have recently found that the abnormal barometric movements of long period are similar in character at widely separated stations, but with this important difference, the movements occur at the more westerly stations much earlier than at the more easterly ones; for instance, between Bombay and Calcutta, there is an average difference in time of more than two and a half months, Bombay being first affected. It follows therefore that the observed barometric movements at westerly stations might be utilized to forecast the general character of the impending changes at the more easterly ones, much in the same manner as the knowledge of the existence of a cyclonic disturbance at one part of the earth's surface can be utilized for forecasting the character of impending changes at those places towards which the vortex is advancing. From this point of view the observations recorded at Zanzibar during the past year by Dr. O. T. Peters become especially interesting. Comparing them with the observations of previous years, recorded by Dr. Robb, and with those recorded in Western India, it would appear that a wave of moderately high pressure has been slowly passing over the Arabian Sea, between April 1880 and June of the present year. The highest point of the wave appears to have passed over Zanzibar in October 1880, since which time the abnormal pressure has, on the whole, been falling, at least up to May last, when the pressure was slightly below the average. At Bombay, however, the pressure did not rise above the average till June 1880, two months later than at Zanzibar, and the highest point of the wave was not reached till January of the present year, about three months later than at Zanzibar. The general course of the Bombay curve has since been downwards, following the Zanzibar curve at an interval of two or three months. As far therefore as a judgment can be formed from these results, it would seem probable that the pressure at Bombay will fall to, or below, the average in July or August next, and if so, at least an average rainfall during one, if not both, of those months may be anticipated.

OBSERVATORIES.

The number of observatories which sent in complete registers remained the same as in the previous year, viz., twenty-two; but a set of instruments has been supplied to the Port Officer at Calcutta to enable him to forward daily reports to this office, in connection with the new storm warning system. If this be included there are now twenty-three observatories working under the supervision of this office. The old observatories at Belgaum and Poona were closed during the year, after having worked for a year along with the new ones at the same stations, so as to provide the means of connecting the old series of observations with the new. The height above sea-level of the Bickaneer Observatory has been determined during the year, and that of Ratnagiri has been verified. The list of observatories and the names of the supervising officers and of the observers are given in Appendix III.

INSPECTION OF OBSERVATORIES.

During the past year I have inspected the observatories at Poona, Surat, Rājkot, Deesa, Mount Abu, Karāchi, Hyderabad (Sind), and Jacobabad.

Poona.

The old Observatory at Wankwrie.

The chief object of my visit to this observatory was to compare the barometer with the travelling standards before finally removing it and the rest of the instruments to Bombay, and closing the observatory. The index error was found to be the same as by the previous comparison in 1879. It was anticipated that this instrument, after having been in use probably for upwards of 25 years, might, when inverted for removal, be found in a leaky condition, and such was the case; but by the adoption of suitable precautions it was safely carried to Bombay, and on arrival there, found to be uninjured, the index error being unaltered. The thermometers and other instruments were also carefully packed and taken to Bombay, where they were compared with the standards throughout the whole range of their variation when under observation.

The new Observatory at Yaravla:—Everything at this observatory, except the embossing anemograph, was found in good order. In my last report, I mentioned the defects of this instrument, one of which was that the apparatus which records the wind direction was very liable to get out of order. This defect has now been overcome by adding two new collars and a new brass piece, which together prevent the connecting endless chain from slipping, while leaving it free to move without any increase of friction. The remaining great defect, viz., the failure of the instrument to record calms, and the consequent loss of the time record on all such occasions, cannot be overcome in any similar manner.

Surat.

All the instruments at this observatory were found in good order. The comparisons with the standards gave the results shown in Appendix IV. The small anemometer, which at this station is erected on a post at the Castle two miles from the observatory, was in good order, but the flag used for finding the wind direction was too small and not well fixed—defects which I rectified. Instead of relying upon any makeshift arrangement for finding the wind direction, or of using vanes of the common kind, all of which give the very roughest approximations to the truth, it would, I think, be a great improvement if the small Robinson's anemometers were fitted with windmill vanes of the Beckley pattern of a suitable size, but without any of the self-recording attachments. The instrument-makers do not include such instruments in their catalogues, but there could be no difficulty in constructing them.

Rājkot.

At this station the instruments were found in good order, but the thatch of the meteorological shed was growing thin, and the fence round the radiation thermometers needed some repairs which have since been executed. The instruments were as usual compared with the standards, and the observer's methods of observation were carefully checked and found to be correct in every particular.

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Deesa.

Everything was in good order at this station. The usual comparisons of the instruments with the standards were made, and the large anemograph was taken to pieces and cleaned, evidently not before it was needed, although the anemograms had shown no signs of a lack of freedom in the movement of the instrument.

Mount Abu.

All was in good condition except the nocturnal radiation thermometer, which had been reported broken. It was replaced by a new instrument which I had taken with me for that purpose. I noticed that the inner surface of the glass jacket of the solar thermometer was becoming slightly dimmed, particularly near the two bits of packing which support the thermometer at the upper and lower extremities of the tube. It is not improbable that this cause alone will produce a gradual change in the readings of this instrument, and thus prevent any reliable conclusions with regard to the secular variations of the intensity of the solar rays being drawn from its indications.

Karachi.

On arrival at this station, I found the observer had died a few days before, and that the man who was taking the observations had but partially learned how to perform the meteorological duties. I put him through a course of instruction, and he has since carried on the work satisfactorily. The instruments were all in good order, as will be seen from the results of the comparisons with the standards given in Appendix IV.

Hyderabad (Sind).

This observatory was closed at the time of my visit, and all the instruments, except the rain gauge, had been sent to the Karachi Observatory, for safe keeping, where I compared them with the standards and found them in good order. The Hyderabad Observatory had been closed, on the departure of the troops (and with them the Hospital Assistant who was also observer) to the frontier, and such was the demand for Hospital subordinates caused by the war, that it was impossible for several months to re-open the observatory. The influence of the war has also been felt at several other observatories, as will be seen by the frequent changes of Superintendents and observers shown in the list which forms Appendix III. These changes are, under ordinary circumstances, much more frequent than is desirable, and when they take place, as they often must, at very short notice, it is impracticable for the new observer to be put through a proper training by his predecessor before the latter leaves the station, much more to find time for the deputation of the new man to the Bombay Office for a course of instruction. The work done under such circumstances is consequently not unfrequently of an inferior character for a time.

Jacobabad.

All was in fairly good order except the radiation thermometers, one of which had apparently burst, a day or two before my arrival. The other, the nocturnal radiation thermometer, had $4\frac{1}{4}$ degrees of condensed spirit at the upper end of the tube. The observer himself put this instrument into proper order on the defect being pointed out to him, but he said he had not noticed it, and it certainly would not have been seen without careful scrutiny; nevertheless, as the liability of these instruments to become deranged in this manner is so distinctly pointed out both in the instruction book and in a special set of memoranda pasted on a board for guidance, and as the defect is so easily rectified, there is very little excuse for having the instrument out of order.

METEOROLOGICAL ERECTIONS.

The thermometer shed at Kairwar having been blown down (fortunately without injury to more than one of the thermometers) a new one of a more substantial character has been erected. Sanction was also given during the year for the erection of the anemograph tower at Belgaum, and it has since been completed, and the anemograph set to work. Various needful petty repairs at other stations have also been executed.

INSTRUMENTS AND THEIR VERIFICATION.

The instruments issued during the year, and the observatories to which they have been sent, are shown in the following table:—

Instruments issued between the 1st April 1880 and the 31st March 1881.

Stations.	Barometer.	Dry Bulb of Hygrometer.	Wet Bulb of Hygrometer.	Dry Maximum.	Dry Minimum.	Wet Minimum.	Solar Thermometer.	Grass Thermometer.	Anemometer.	Rain Gauge.	Rain Glass.	Total.
Jacobabad	...	...	...	...	...	...	1	1	...	...	...	2
Bickanuer	...	1	...	...	...	...	2	3	...	...	1	7
Hyderabad	...	...	...	...	...	...	...	...	...	...	...	...
Karachi	...	...	...	...	...	...	...	...	1	...	...	5
Bhuj	...	...	...	...	...	...	...	...	...	...	...	...
Deesa	...	1	...	1	...	...	...	...	...	...	...	2
Mount Abu	...	...	...	1	...	...	...	2	...	...	...	3
Neemuch	...	1	...	...	...	...	...	1	1	...	...	3
Indore	...	3	...	...	...	...	...	...	...	...	...	3
Rajkot	...	...	...	...	...	...	...	1	...	...	...	1
Surat	...	...	...	...	...	...	...	...	1	...	...	1
Akola	...	1	1	...	...	...	...	1	...	...	...	3
Amraoti	...	...	...	...	...	...	...	...	...	...	...	...
Chikalda	...	...	...	1	...	...	...	...	...	...	...	1
Buldana	...	...	...	...	...	...	...	...	...	...	...	...
Malegaon	...	...	...	...	...	...	...	1	...	...	...	1
Poona	...	...	...	...	...	...	...	2	...	...	...	2
Sholapur	...	...	...	...	...	...	1	2	...	...	...	3
Ratnagiri	...	...	...	...	...	...	...	...	...	...	...	...
Belgaum	...	...	...	...	...	...	...	2	...	...	...	2
Kairwar	...	...	...	1	...	...	...	1	...	...	...	2
Cahent	...	1	1	1	...	...	...	...	1	1	2	7
Zanzibar	...	...	...	...	...	...	...	...	...	...	...	...
Total	7	2	2	6	...	...	6	17	4	1	3	48

With the exception of one solar thermometer and two nocturnal radiation thermometers, which were furnished with correction tables when received from Calcutta, all these instruments were verified, as in previous years, at this office.

TRAINING OF OBSERVERS.

No observers have been trained at this office during the year, but it was necessary to send a clerk from Bombay to the Malegaon Observatory to teach the observer how to perform his duties, and an observer for the Hyderabad Observatory was trained at Karachi by the observer at that station who had been taught by myself during my tour of inspection. However desirable it may be that each observer, before being entrusted with meteorological work, should be put through a course of training at this office; the fact that most of the observers hold their observerships merely as adjuncts to other offices, renders it impracticable, in the majority of cases, for them to undergo this preliminary course of instruction, and it becomes necessary to rely upon such information as they are able to obtain from their predecessors and from the instruction book, supplemented by correspondence between this office and the officers in charge of the observatories, pointing out defects as they arise, and the proper modes of correcting them. In some instances the supervising officers have taken much interest in the work, and have afforded me very material assistance, for which my special acknowledgments are due.

METHODS OF OBSERVATION AND REDUCTION.

The only change during the year in the methods of reducing the observations was the introduction of a method of correcting the indications of the

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anemometers for stoppages during the short intervals when they are out of action for cleaning or slight repairs. Formerly, it was the practice to reject a day's record whenever it was incomplete, but now the velocity of the wind before the stoppage, the interval of the stoppage, and the velocity after restarting the instrument, are all noted down, and it thus becomes possible to apply a suitable correction for the loss of the record during the interval of inaction.

The traces of the new Robinson-Beckley anemograph at the inland station, Deesa, have brought to light a remarkable phenomenon, which will render it necessary to modify or extend the usual methods of tabulating and reducing the records of these instruments. I allude to the very great variability of the wind direction during the day-time, and the very evident diurnal period which this variability undergoes. It is of such magnitude, and changes so rapidly, that it becomes no longer allowable, even as an approximation, to assume that the wind, for so short an interval as an hour, may, without sensible error, be regarded as blowing from a constant direction, and the task of resolving the wind into its mechanical components thus becomes exceedingly complicated, if not altogether impracticable; and the only true solution of the problem would require the use of some mechanism which would act the part played by the wind component integrator of Dr. Oettingen. Possibly some less accurate, but more convenient, method of correcting the results might be devised, but this would at least involve the tabulation of the amount of variation which the wind direction undergoes during each hour. In fact the hourly tabulations of the velocity and the *mean* direction give but a very rough idea of the wind's behaviour at an inland station. This matter is of great importance with regard to the explanation of the diurnal hot winds, or "winds of elastic expansion" as Mr. Blanford has called them, and I am by no means sure that the whole theory will not be found to lie in the fact of the great variability of the wind direction; for it is quite certain that if this element of the wind's behaviour be disregarded, the results would exhibit peculiarities such as have been pointed out by Mr. Blanford in his paper on the "Winds of Calcutta," and by myself in my paper on the "Winds of Karachi". The great definiteness of the phenomenon above mentioned, will be seen from the following statement of the mean hourly range of the variability of the wind direction at Deesa during the month of March 1881.

Hour ...	1	2	3	4	5	6	7	8	9	10	11	Noon.
Points ...	1.8	1.4	0.9	2.0	0.8	1.6	2.6	2.0	3.6	7.0	7.7	10.2
Hour ...	13	14	15	16	17	18	19	20	21	22	23	Mid-night.
Points ...	8.0	8.1	5.6	5.0	1.8	1.4	2.3	1.8	2.1	2.1	2.0	2.5

In considering the significance of these figures, it must be borne in mind that there is nothing of the nature of pendulous oscillation about the wind vane of the Deesa anemograph, as it is a windmill vane of the Beckley pattern.

The method at present adopted of correcting the readings of solar thermometers might, I think, be improved, if it is at all worth while to apply corrections to such results as these instruments are capable of affording. The method at present in use is to apply a constant correction to each reading, the constant being the average difference of not less than thirty simultaneous readings of the instrument and an arbitrary standard; but theory and observation seem to imply that it would be more correct to multiply the excess of the reading of the solar thermometer over that of the air thermometer (both instruments being first corrected for error of graduation), by a constant factor, in order to obtain a result approximately comparable with that derived from the standard instrument. Even in this case, however, there would still remain differences due to differ-

ences of sensitiveness of the instruments, and gradual dimming of the inner surfaces of the glass jackets, and other causes, which could hardly be allowed for, and I think it is very doubtful whether it is worth while to incur the labour of elaborate correction, with so little prospect of arriving in the end at definite comparable results.

CHARACTER OF THE METEOROLOGICAL REGISTERS FOR THE YEAR 1880.

With the exceptions noted below, all the meteorological registers for the year 1880 bear a high character for accuracy, and even with regard to these exceptions it is satisfactory to be able to report that the defects are in no case due to deliberate dishonesty, but in all, as already mentioned, to lack of experience on the part of the observers when first taking up the work of meteorological registration. The exceptions are, inaccuracy of the barometric observations at Sholapur during the latter half of the month of October 1880, and erroneous readings of the barometer and anemometer during the months of August and September 1880, at Malegaon. These untrustworthy observations have been rejected.

LIBRARY.

Appendix V. gives the list of books and pamphlets added to the library during the past year, and another list is appended giving the titles of the publications previously received. The lists together form a complete catalogue of the works in the library, almost all of which have been presented to the office. The books have been carefully compared with the catalogue, and there are none missing.

OFFICE ESTABLISHMENT.

During the past year I applied for privilege leave of absence from the 1st April to the 9th June 1880, but as arrangements for my relief were not completed until the 26th April, the period of my leave extended from that date to the 9th June, during which time Mr. A. N. Pearson acted for me. The office establishment at the end of the year stood as follows:—

Name.	Monthly Pay.
FOR LAND METEOROLOGY.	
Ganesh Sadashiv ...	48
Vajaram Ishharan ...	38
Mahadev Ramchandra ...	34
Krishnaji Ramchandra ...	30
Ramchandra Sadashiv ...	30
FOR THE STORM WARNING SERVICE.	
Ramchandra Govind ...	30
Anant Vishvamber ...	30

There is also one menial whose pay is Rs. 10 per month.

WORK OF THE OFFICE.

This has mainly consisted, as in previous years, in the regular reduction and tabulation of the meteorological observations from the various observatories, for incorporation in the general annual reports of the Indian Meteorological Department. The complete monthly returns have been regularly forwarded to the Meteorological Reporter to the Government of India, and abstracts of them have been published every month in the *Bombay Government Gazette*.

A sketch of the meteorology of the Bombay Presidency in the previous year was, as usual, prepared for the General Administration Report of the Presidency.

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and published therein, a few spare copies being struck off for distribution to scientific men in Europe and elsewhere. In this sketch I attempted to lay down, with some approach to mathematical exactness, the very definite relation which exists between the variations of the rain-fall and those of the barometric pressure, and to show how this relation would, under certain stated conditions, render it possible to forecast the general character of the rain-fall of a coming monsoon season. In a special preliminary report on "Abnormal Variations of Barometric Pressure in the Tropics and their relation to Sun-spots, Rain-fall, and Famines", which was submitted to the Bombay Government on the 4th September 1880, and published in *Nature* on the 25th November 1880, and the 2nd December 1880, I showed how these conditions might be realized by obtaining meteorological observations from stations differing widely in longitude. This paper was forwarded to the Government of India, and I was much gratified to find, from the *Gazette of India* of the 26th February 1881, that it has led to steps being taken to establish observatories possibly at Socotra, Seychelles and the Chagos Islands.

The introduction of the new system of daily telegraphic weather reports for storm warning purposes has involved much work of a special character. All the arrangements connected therewith have now been made, with the exception of the establishment of direct telegraphic communication between the Meteorological Office and the Telegraph Office, and it is hoped that this will shortly be arranged in a satisfactory manner.

Copies of all the rain registers (upwards of 400 in number), showing the daily rain-fall during the year 1880 at each of the rain gauge stations in the Bombay Presidency, have been collected; and similar registers for the two preceding years have also been obtained.

F. CHAMBERS,
Meteorological Reporter for Western India.

Meteorological Office, Bombay,
Dated the 24th June 1881.

[Statement.]

APPENDIX I.

DAILY TELEGRAPHIC WEATHER REPORT.

Thursday, the 31st March 1881.

STATIONS.	BAROMETER.		THERMOMETER IN SHADE.		HEGHT.		WIND.		Rain from 10 A. M. yesterday to 10 A. M. to-day.	Sea & disturbances at 10 A. M. at 10 A. M.	Weather at 10 A. M.	Weather from 10 A. M. yesterday to 10 A. M. to-day.
	At 10 A. M. reduced to sea-level.	Rise (+) or fall (-) from 10 A. M. yesterday to 10 A. M. to-day.	Reading at 10 A. M.	Rise (+) or fall (-) from 10 A. M. yesterday to 10 A. M. to-day.	Saturation indicated by 100.	Rise (+) or fall (-) from 10 A. M. yesterday to 10 A. M. to-day.	Direction and Force at 10 A. M.	Mean Velocity from 10 A. M. yesterday to 10 A. M. to-day.				
	Inches.	Inches.	Degrees.	Degrees.	Per Cent.	Per Cent.		Miles per hour.	Inches.			
Karachi	29.923	-.036	84.9	0.9	74	+12	S. W.	11	0.00	...	...	...
Surat	30.002	-.011	84.6	0.0	78	+9	W.	12	0.00	...	...	...
Bombay	30.018	-.010	83.6	+0.7	70	0	E. S. E.	6	0.00	Slight	...	Fine clear weather.
*Panaji	...	...	...	...	...	...	...	...	...	...	...	Fine weather with passing clouds.
Karwar	...	-.032	80.1	0.0	60	+7	N. W. mode rate.	...	0.00	Very smooth	...	...
Mangalore	...	-.027	85.4	+0.5	61	0	S. W.	4	0.00	...	...	...
Calicut	...	-.024	88.6	0.0	74	+11	S. S. W.	8	0.00	Slight	...	...
Cochin	...	-.012	86.5	-1.0	70	+1	N. N. W.	2	0.00	...	Overcast.	Sultry.
Malapattam	...	+0.01	89.0	+1.0	63	-3	S. S. E.	...	0.00	...	...	Sultry.
Madras	...	-.010	86.0	+2.0	55	-1	S. E.	7	0.00	...	...	Fine weather with passing clouds.
Nagapatnam	...	-.008	89.0	0.0	63	-3	E. N. E.	4	0.00	...	...	Sultry.
Cochin	29.927	+0.014	87.0	+0.5	69	+2	N. W.	3	0.00	...	Overcast.	Sultry.

* Telegraph line to Rangoon not opened till 27th May 1881.

(Signed) F. CHAMBERS.

Meteorological Reporter for Western India.

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APPENDIX II.

Telegraphic Weather Intelligence.

The Meteorological Office, Bombay, issues (free of charge) to ports and fishing stations approved of by the Government of Bombay, telegraphic notices of atmospheric disturbances on or near the coasts of the Bombay Presidency.

Signals.

The fact that such a notice has been received at any station is made known by a signal which is hoisted on the receipt of the telegram.

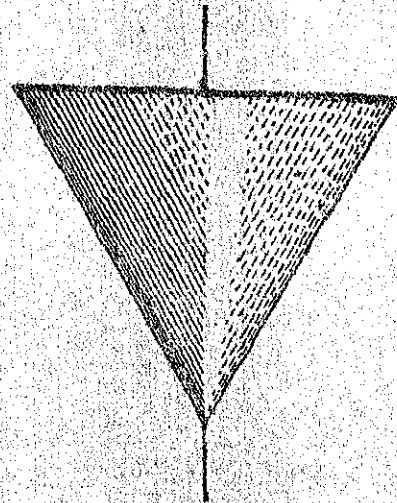
The signals are made by means of a canvas shape, a *Cone* during the day time, and by means of three lanterns during the night.

The *Cone* is not less than three feet high and three feet wide at the base, and when hoisted, appears as a triangle *with the point downwards*.

The lanterns are arranged in a triangle *with the point downwards*.

CAUTIONARY SIGNALS.

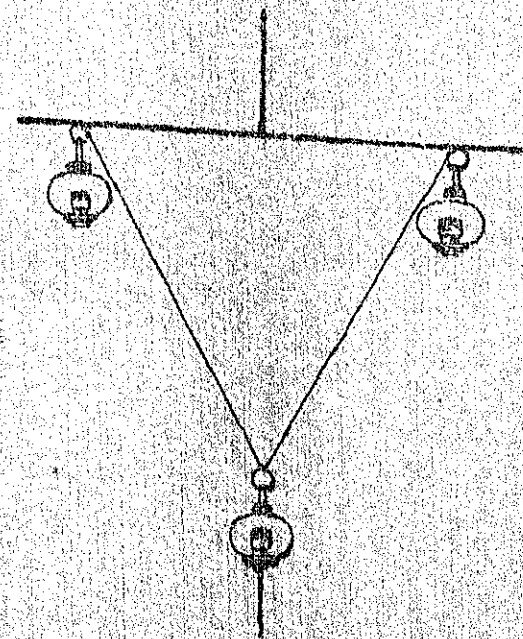
DAY SIGNAL.

Cone.

NIGHT SIGNAL.

Lights in Triangle instead of the Cone.

Three lanterns and one yard four feet long will be sufficient.



This signal should be made with lanterns showing a red light. The haul yards should be good rope, and protected from chafing, and the lanterns should hang at least three feet apart.

ON HOISTING THE SIGNALS.

The day signal is kept up till dusk, when the night signal is substituted. The day signal is again hoisted next morning, and so on until 48 hours have elapsed from the time the telegram was despatched. The signal is then lowered, unless a second telegram orders it to be kept up for more than 48 hours. In every case when it is thought at the Meteorological Office that the weather has ceased to be of a threatening character before the 48 hours are over, orders are issued to lower the signal at once. The time at which the warning telegram is despatched is always marked upon it.

MEANING OF SIGNALS.

The hoisting of one of these signals is intended as a sign that there is an atmospheric disturbance in existence which threatens to cause bad weather in the neighbourhood of the place where the signal is hoisted, and the knowledge of which is likely to be of use to the sailors and fishermen on that part of the coast. In every case some of the principal reasons which have led to the hoisting of the signal are explained in the telegram, which should always be kept posted up for public inspection while the signal is flying. It must be remembered that only the greater and more general disturbances of the atmosphere can be made known by this method. Local squalls of less extent, such as the "Elephantes", may be indicated to observers by their own instruments, and by local signs of weather, &c.

[Statement.]

Bombay (contd.)	Government of Bombay-- (continued.)	Preliminary Report by the Committee on Solar Physics appointed by the Lords of the Committee of Council on Education. Meteorological Observations made at Simla, 1841--1845.
Calcutta	Meteorological Reporter to the Government of India.	Zeitschrift der Österreichischen Gesellschaft für Meteorologie, No. 21 of 1875; No. 5 of 1876; Nos. 16, 17, 18, and 20 of 1877; Nos. 7 and 27 of 1878, with title page and index; and XIV Band, August and October 1879. Deutsche Rundschau für Geographie und Statistik, Nos. 1 and 2. Results of Meteorological Observations at Vizagapatam, 1872, 1873, 1874, 1875, 1876, 1877, and 1878--By A. V. Nursingrow, Esq., F.R.A.S., F.R.G.S. Meteorological Reports of the Hyderabad Assigned Districts for 1875 and 1874. General Report on the operations of the Survey of India during 1876-77 and 1877-78--By Colonel J. T. Walker, C.B., R.E., F.R.S., &c. Copies of Despatches on the Organization of the Indian Meteorological Department. Annual Report on the Observations registered in the Punjab for 1867--By A. Neil, M.R.C.S.I. Report on the Internal Trade of Bengal, 1877-78. Report on Meteorology, Museum and Horticultural Gardens in Oudh, 1872-73, 1874-75, and 1876-77. Madras Observatory Rain Register, 1813--1873. A Memoir on the Indian Surveys--By C. R. Markham, Esq., C.B., F.R.S. Monatliche Übersicht der Witterung, Deutsche Seewarte, January to July 1876; January to March 1877, and January to July 1878. Note on the Correction of the Calcutta Standard Barometer to the Kew and Greenwich Standards--By H. F. Blanford, Esq. On the Origin of a Cyclone--By Henry, F. Blanford, F.G.S. A Brief Resume of the Meteorology of Bengal for 1875. Administration Report of the Government of Bengal for 1873-74. Meteorology Summary of Bengal for 1878. Report of the Meteorological Committee of the Royal Society, 1869. Report on the use of Isobaric Curves--By Captain Henry Tynbee, F.R.A.S. Report of the Treasury Committee appointed to enquire into the conditions and mode of administration of the annual grant-in-aid of Meteorological Observations. Contributions to our knowledge of the Meteorology of the Arctic Regions, Part I. Report on the Meteorology of the North Atlantic between the parallels of 40° and 50° North--By Captain Henry Tynbee, F.R.A.S.

Calcutta--(contd.)	Meteorological Reporter to the Government of India-- (continued.)	Report of an enquiry into the connection between strong winds and barometrical differences--By Robert H. Scott, Esq. Bombay Places and Common Official Words. The Madras Cyclone of May 1872. Indian Meteorological Memoirs, Vol. I, Part IV. Telegraphic Code with Instructions. Report on the Meteorology of India in 1878--By Henry F. Blanford, F.R.S. Administration Report of the Meteorological Department of the Government of India for 1879-80. Registers of Original Observations in 1879, reduced and corrected, in monthly series from January to December. Administration Report for the year 1879-80.
Ditto	Meteorological Reporter to the Government of Bengal.	Return of Wrecks and Casualties in Indian Waters for the years 1876, 1877, 1878 and 1879--By Robert O. Carrington, F.R.A.S., A.I.C.E., &c. List of Light Houses and Light Vessels in British India--By Robert O. Carrington, F.R.A.S. Catalogue of Charts, &c., issued by the Marine Survey Department. Indian Wreck and Casualty Statements for the year 1874. Wreck Charts for years 1865 to 1875. Curves of equal Magnetic Variation for 1877. Charts Nos. 15a, 15, 15b, 15a and 15c. Preliminary Chart of the Jodhpur Meridional Series, season 1874-75.
Ditto	Surveyor General of India.	Jaypore Meteorological Report for the year 1879. Report of the Meteorological Council to the Royal Society for the year ending 31st March 1879. Ditto ditto for the year ending 31st March 1880. Contributions to our knowledge of the Meteorology of the Arctic Regions, Part II. Meteorological Observations at Stations of the Second Order for the year 1878. Aids to the Study and Forecast of Weather--By W. Clement Ley, M.A.
Mauritius	Meteorological Society Observatory	Monthly Notices, New Series, Nos. 9, 10 and 11. Royal Alfred Observatory of Mauritius, Cyclone of 20th--21st March 1879. Storm Warnings.
New South Wales	Government Astronomer.	Results of Rain and River Observations made in New South Wales during 1879--By H. O. Russell, B.A., F.R.A.S.
Paris	Bureau Centrale Meteorologique de France.	Annales du Bureau Centrale Meteorologique de France, année 1878, Vols. I and III. Atlas des Mouvements Généraux de l'Atmosphère, June to December, 1864; January to March, April to June, July to September, and October to December, 1865. Atlas des Orages, 1865.

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(Paris—continued.)	Bureau Centrale Meteorologique de France—(contd.)	Atlas Meteorologique de L'Observatoire Imperial, 1866; 1867; 1868; 1869-70; 1871; 1872; 1873; 1874; 1875; 1876 charts, and 1876 Text.
Poona	... Photozincographic Office ...	Deccan Topographical Survey Maps, District Násik, Sheets Nos. 1, 3, 3a, 5 and 6.
Rome	... Observatorio del Collegio Romano.	Annali dell Ufficio Centrale Di Meteorologia Italiana, Serie II, Vol. I, 1879.
Zánzibár	... John Robb, M.D., F.M.S.	Notes on the Meteorology of Zánzibár, East Africa.
Washington	... War Office ...	Daily Bulletin of the Signal Service, U.S.A., from the 1st June 1879 to the 3rd May 1880. Monthly Weather Review of the Signal Service, U. S. A., from January to December 1880.
Bombay	... Government of Bombay ... Telegraph Office.	Regulations and Orders for the Army of the Bombay Presidency. Indian Telegraph Guide, Parts I and II.

APPENDIX VI.

List of Books in the Library of the Meteorological Office, Bombay, on the 31st March 1880.

- Meteorological Observations made at the Adelaide Observatory during the years 1876-77 and 1878.—By *O. Todd, O.M.G., F.R.A.S.*
- Singapore Meteorological Observations, 1841—1845.—By *Captain C. M. Elliott.*
- Meteorological Observations made at Simla, 1841—1845.
- Annual Reports of the Sanitary Commissioner for the Government of Bombay for the years 1875, 1876, 1877 and 1878.
- Report on the Military Cantonments and Civil Stations in the Presidency of Bombay inspected by the Sanitary Commissioner in the years 1875 and 1876.
- Report on the Meteorology and Horticultural Gardens in Oudh, 1875-76.
- Abstract of the Reports of the Surveys and other Geographical Operations in India for 1874-75.
- Papers on the subject of the Bengal Cyclone and Storm Wave of the 31st October—1st November, 1876.
- Report of a Committee appointed to consider certain questions relating to the Meteorological Department of the Board of Trade.
- Tables, Meteorological and Physical, prepared for the Smithsonian Institution.—By *Arnold Gayot, P.D., LL.D.*
- Codes of the Financial Department, 1879.
- Civil Account Code, Part I, 1878.
- Tide Tables of the Port of Bombay, 1878.
- Postal Directory of the Bombay Circle, 1879.—By *H. E. M. James, Esq., C.S.*
- Copies of Despatches on the Organization of the Meteorological Department in India, 1871—1873.
- Papers relating to Solar Physics, &c.
- Spellings of the Names of the more important Places in Rájputána.
- Diurnal Variations of the Wind and Barometric Pressure.—By *F. Chambers, Esq.*
- Bombay Meteorological and Magnetical Observations, 1865—1870.
- Meteorology of the Bombay Presidency with Diagrams and Map.—By *C. Chambers, F.R.S.*
- The Absolute Direction and Intensity of the Earth's Magnetic Force at Bombay and its Secular and Annual Variations.—By *C. Chambers, F.R.S.*

- On the Mathematical Expression of Observations of Complex Periodical Phenomena, and on Planetary Influence on the Earth's Magnetism.—By *C. Chambers, F.R.S., and F. Chambers, Esq.*
- Magnetical and Meteorological Observations at Batavia; Vols. II. and III.—By *Dr. P. A. Bergsma.*
- A Manual of the Geology of India, Parts I. and II., with Map.—By *H. B. Medlicott, M.A., and W. T. Blanford, F.R.S.*
- Rules for indenting for Stores, Maps, Books, &c.—By *George Easton, Esq.*
- On the Rain-fall at Calcutta.—By *R. Strachan, F.M.S.*
- Casella's Illustrated List of Standard Meteorological Instruments.—By *L. Casella, Esq.*
- Dent on the Aneroid Barometer.
- Instructions for using Newman's Portable Mountain Barometer.—By *J. Newman, Esq.*
- Instructions to the Meteorological Observers in Bengal.—By *H. F. Blanford, A.R.S.M., F.G.S.*
- Tables to accompany Instructions to the Meteorological Observers in Bengal.—By *H. F. Blanford, F.G.S.*
- Indian Meteorologist's Vade Mecum, Part I.—By *H. F. Blanford, Esq.*
- Tables for the Reduction of the Meteorological Observations in India.—By *H. F. Blanford Esq.*
- A. L. Crelle's. Rechentafeln Ne'ue Ausgabe.
- Chambers' Mathematical Tables.
- Reduction of Barometric Readings at High Stations to Sea-level.—By *Cap. Allen —Cunningham, R.E.*
- Meteorological Researches for the use of the Coast Pilot, Part I.
- Report on the Meteorology of India in the years 1875, 1876 and 1877.—By *H. F. Blanford, F.R.S.*
- Indian Meteorological Memoirs, Vol I, Parts I., II. and III.
- Report of the Vizagapatam and Backergunge Cyclones of October 1876.—By *J. Elliott, M.A.*
- Report on the Administration of the Meteorological Department of the Government of India in 1875-76, 1877-78, and 1878-79.
- Meteorological Abstracts of the Meteorological Reporter to the Government of Bengal, for the years 1871, 1872 and 1874.—By *H. F. Blanford, Esq., and W. G. Wilson, M.A.*
- Report on the Administration of the Meteorological Department of the Government of Bengal, in 1871-72, 1872-73, and 1878-79.
- Administration Report of the Meteorological Reporter to Government, North-Western Provinces and Oudh, for the years 1877-78 and 1878-79.
- Report on the Madras Cyclone of May 1877.—By *J. Elliot, M.A.*
- Report on the Rain-fall of the North-Western Provinces and Oudh, 1879.—By *S. A. Hill, B. Sc., F.C.S.*
- Report on Meteorological Observations in North-Western Provinces for 1873.—By *Murray Thomson, M.D.F.R.S.*
- Annual Report on the Meteorology of the Punjab for the years 1868, 1871, 1872, and 1873.—By *A. Neil, M.R.C.S.L.*
- Zeitschrift der Österreichischen Gesellschaft für Meteorologie. Band VII., No. 9; Band VIII., Nos. 6 and 9; Band IX., Nos. 6, 7, 8, 9, 10, 11, 12, 18 and 23; Band XII., Nos. 18 and 14.
- Magnetical and Meteorological Observations at Cape of Good Hope, Vol II., 1841—1846.—By *Lieutenant-Colonel Edward Sabine.*
- Spirit Levelled Heights, No. 1, Bombay Presidency, and No. 2, Southern India.
- Remarks to accompany Monthly Charts of Meteorological Data for Nine Tea—Degree Squares.
- Remarks to accompany Monthly Charts of Meteorological Data for Square 3.
- Charts of Meteorological Data for Square 3, Lat. 10° N., Long. 20°—30° W.
- Charts showing the Surface Temperature of the South Atlantic Ocean in each month of the year.
- Meteorology of the North Atlantic during August 1873.
- Synchronous Charts of the North Atlantic during August 1873.
- Discussion of the Meteorology of the part of the Atlantic lying north of 30° N. for the eleven days ending 8th February 1879, with Charts and Diagrams.

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- Charts of the Meteorological Data for Nine Ten--Degree Squares, Lat. 20° N. to 10° S., Long. 10° to 40° W.
- Currents and Surface Temperature of the North Atlantic Ocean from the Equator to Lat. 40° N., for each month of the year.
- Quarterly Weather Report of the Meteorological Office, from January 1869 to December 1875.
- Quarterly Journal of the Meteorological Society, of April 1878.
- Contributions to our knowledge of the Meteorology of the Arctic Regions, Part I.
- Contributions to our knowledge of the Meteorology of Cape Horn and the West Coast of South America.
- Contributions to our knowledge of the Meteorology of Japan.--By Staff Commander Thomas H. Tizard, H.M.S.
- List of the Fellows of the Meteorological Society.
- Report of the Meteorological Council to the Royal Society for the years 1870, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1877-78 and 1878-79.
- First, Second and Third Reports of the Liverpool Compass Committee to the Board of Trade, in 1855, 1856 and 1857--1860, with letters from the Astronomer Royal thereupon.
- Report on the Proceedings of the Meteorological Conference at Leipzig.
- Instructions in the use of Meteorological Instruments.--By R. H. Scott, M.A., F.R.S.
- Report on Weather Telegraphy and Storm Warnings presented to the Meteorological Congress at Vienna in 1874.
- Report on the Proceedings of the Conference on Maritime Meteorology held in London, 1874.
- Report of the Permanent Committee of the First International Meteorological Congress at Vienna, for 1874.
- Report of the Permanent Committee of the First International Congress at Vienna, in 1876, with a supplement, and in 1878.
- Report of the Proceedings of the Meteorological Congress at Vienna.
- On the Physical Geography of the part of the Atlantic which lies between 20° N. and 10° S., and extends from 10° to 40° W.--By Captain Tynbee, F.R.A.S., F.R.G.S., &c.
- Report on the Meteorology of Kerguelen Island.--By Rev. S. J. Perry, S.J., F.R.S.
- Report of the Proceedings of the Second International Meteorological Congress at Rome, 1879.
- Notes on the Form of Cyclones in the Southern Indian Ocean.--By O. Meldrum, Esq., M.A., F.R.A.S.
- Daily Bulletin of the Signal Service, U. S. A., from December 1872 to March 1874, except those for January and November 1873, and from the 12th February 1877 to the 31st May 1879, with the exception of the 10th June and 31st July 1877.
- Monthly Weather Reviews of the Signal Service, U. S. A., from August 1877 to December 1879.

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