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for 15/11/19  
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REPORT



ON THE

ADMINISTRATION

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OF THE

METEOROLOGICAL DEPARTMENT

OF THE

GOVERNMENT OF INDIA

IN

1918-19.

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## REPORT ON THE ADMINISTRATION OF THE METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA IN 1918-19.

### CHANGES IN THE STAFF DURING THE YEAR 1918-19.

The services of Dr. G. C. Simpson were placed at the disposal of the Indian Munitions Board from the 25th April 1917 to the 31st March 1919.

Mr. C. W. B. Normand was appointed to the Indian Army Reserve of Officers from the 29th February 1916, and was sent by the Army Department on the 18th June 1916 to Mesopotamia to work there as Meteorologist. Mr. M. G. Subrahman-yam, Head Clerk, Bombay Meteorological Office, acted for him from the 1st February 1918 to the 30th September 1918, and was appointed sub. *pro tempore* Imperial Meteorologist from the 1st October 1918.

Mr. J. H. Field has been on combined leave since the 17th May 1918. Mr. W. A. Harwood, who was appointed to the I. A. R. O. from the 10th February 1916, rejoined the Meteorological Department on the 18th March 1919, and has been acting as Director, Aerological Observatory, Agra, from that date.

Mr. C. W. Peake, Meteorologist, Calcutta, who was on combined leave from the 9th May 1917, retired from service from the 25th October 1918. Dr. E. P. Harrison who is appointed as Meteorologist, Calcutta, is at present employed in the Army as A. C. R. E. and Mr. D. B. Meek, Professor at the Presidency College, Calcutta, is acting in his place.

Mr. R. Ll. Jones, Meteorologist, Madras and Deputy Director, Madras Observ-atory, was on privilege leave from the 1st May to the 16th June 1918. Mr. James Angus, Professor at the Madras Christian College, acted for him.

Mr. H. M. Ffinch was appointed Meteorologist at Bombay from the 17th May 1918, *vice* Mr. C. D. deV. Babington transferred.

The services of Dr. T. Royds were placed at the disposal of the Army Depart-ment for employment in the office of the Director of Ordnance Factories, Calcutta, from the 24th October 1917. Mr. S. Sitaramayya was appointed sub. *pro tempore* Assistant Director of the Kodaikanal Observatory.

### OBSERVATORIES.

2. The observatories maintained by the Government of India are classified as follows :—

*First Class.*—Observatories which are furnished with autographic instruments for con- tinuously recording pressure, temperature, humidity, and wind direction and velocity, in addition to instruments read by eye.

*Second Class.*—Observatories at which readings are taken daily at 8 hrs., 10 hrs., and 16 hrs. ; those at 8 hrs., are (with a few exceptions) transmitted by telegram to one or more of the offices at Simla, Calcutta, Bombay, and Madras for inclusion in India or Provincial Daily Weather Reports.

*Third Class.*—Observatories—

(a) where readings are taken daily at 8 hrs. only ; at those stations where there are telegraph offices, the observations are transmitted by telegram for inclusion in the Simla, Calcutta, Bombay or Madras Daily Weather Reports ;

(b) at stations where there are no telegraph offices, and observations are recorded at 10 hrs. and 16 hrs. only ; these are included in the Monthly Weather Reviews, and furnish a series of observations for the determination of monthly and daily means which should be com- parable with the means already obtained for second class observa- tories.

*Fourth Class.*—Observatories at which observations of temperature, wind and rainfall only, or of temperature and rainfall only are recorded.

*Fifth Class.*—Observatories which telegraph rainfall only.

3. At the end of the year the total number of observatories was 274, of which 41 were non-departmental and 233 were maintained by the Government of India. Of the 233 departmental observatories, 5 were first class, 181 third class, 23 fourth class, and 24 fifth class.

4. The only change in the observatories during the year was the following :—  
a fifth class observatory was opened at Car Nicobar on 1st July 1918.

#### FIRST CLASS OBSERVATORIES.

5. The Directors of the observatories of Kodaikanal, Madras and Bombay publish separate annual reports which are forwarded for the information of Government. It has accordingly been ruled as unnecessary to include information relating to the working of these observatories in this Administration Report.

6. *Alipore Observatory.*—This observatory is under the charge of the Meteorologist, Calcutta. The following special instruments were in use during the year :—

A Bergholz barograph, a Dines' microbarograph, a Kew thermograph, a Beckley anemograph, a Dines' pressure tube anemometer, Beckley, Hellman-Fuess and monthly rain-gauges, two Omori-Ewing seismographs, grass and ground thermometers, and a nephoscope.

All instruments issued by the Meteorological Department are tested at this observatory and their corrections ascertained before they are sent out for use. The number of instruments tested and verified during the year was 491 as compared with 1,470 last year: 10 instruments were condemned as unfit for issue, or were sent to the India Office for repair and 17 instruments were kept in store for future treatment. In addition to the above, 162 instruments were examined and issued to other observatories.

The observatory gives mean Calcutta time to the port and shipping. Three time-balls are dropped daily at 1 p.m., local mean time, throughout the year, one on the Semaphore Tower at Fort William, the second at the Port Commissioners' office and the third at the Kidderpore Docks. This work was carried out quite satisfactorily as far as this department is concerned. There were 50 failures, as compared with 17·9, the average number of the past 30 years; all these were due to defects in the electric or mechanical arrangements outside the observatory, for which this department is not responsible.

Year.	Number of days on which one or other ball failed to drop properly.	Number of failures due to telegraphic defects.
1918-19 .. .. .	50	50
1917-18 .. .. .	34	34
1916-17 .. .. .	56	41
1915-16 .. .. .	17	17
1914-15 .. .. .	24	24
1913-14 .. .. .	36	36
1912-13 .. .. .	50	50

7. *Lahore Observatory.*—The following special instruments were in use during the year :—

A Draper barograph, a Casella rain-gauge, a Beckley anemograph, a sunshine recorder, grass and ground thermometers, and a nephoscope.

Eye observations of the ordinary meteorological instruments were taken seven times daily at this observatory as in past years at 6, 8, 10, 14, 16, 18, and 22 hours. Ground surface temperature was recorded four times daily at 6, 10, 16 and 22 hours. Cloud observations were taken daily by nephoscope at 8, 12 and 16 hours for use at the Aerological Observatory, Agra.

CHARACTER OF THE WORK OF OBSERVATION AT SECOND AND THIRD CLASS OBSERVATORIES.

8. The general character of the work of the observatories, as judged by the number of mistakes made by observers, was satisfactory.

The number of stations of great reliability in which either no mistake or only one mistake has been detected in the data for the Indian Daily Weather Report, was 22 as against 33 in 1917-18; while the number of stations at which more than 50 mistakes were made was 6 as against 3 last year.

The usual list showing the number of mistakes in observation and in the preparation of telegrams for all the observatories which send weather telegrams to the Simla office was prepared and circulated to the observatories on the 16th September 1919.

INSPECTION OF OBSERVATORIES.

9. The number of visits paid to observatories during the year under review was 36 as compared with 44 in the previous year and an average of 51 during the past 10 years.

The Director-General inspected the observatories at Calcutta, Madras, Bombay and Agra. Rai Bahadur Hem Raj inspected 2, Mr. P. K. Ghose 26, Mr. V. Doraiswamy 1, and Mr. Budha Mall 1.

Of the 30 third class observatories that were visited, 16 were reported as good, 9 as tolerable and 5 as bad.

Condition.	SECOND OR THIRD CLASS OBSERVATORIES INSPECTED IN —					
	1918-19.	1917-18.	1916-17.	1915-16.	1914-15.	1913-14.
Good or satisfactory .. ..	16	27	33	24	52	34
Tolerable .. ..	9	11	7	10	14	23
Bad .. ..	5	4	..	..	3	6
Total .. ..	30	42	40	34	69	63

In estimating the general character of the observatories from the above table it must be remembered that it is, as a rule, on account of something unsatisfactory that a visit of inspection is made. The general level of the stations is thus decidedly better than might otherwise appear. The most frequent cause of bad work is the changing of observers at short intervals necessitated by acting and other arrangements in the Medical, Telegraphic and Postal Departments.

SPECIAL OBSERVATIONS.

10. Observations other than those recorded at regular intervals are made as follows:—

- (a) In accordance with orders issued from the Simla or Calcutta Office, when weather is disturbed and storm warnings may have to be issued: such observations are reported by telegraph. Certain observers at coast observatories are in receipt of a regular monthly allowance of Rs. 5 for sending special storm warning telegrams, while other observers receive an allowance of Re. 1 for each set of special observations sent under instructions from either Simla or Calcutta. The total number of telegrams forwarded during the year under review was 1,033 compared with 1,878 during the previous year.
- (b) Certain observers, when they consider that conditions at sea are sufficiently threatening, send of their own initiative to Simla or Calcutta a telegram containing special observations. Three such telegrams were received.
- (c) In connection with flood warning a number of observers have been instructed to send telegrams announcing the occurrence of heavy rainfall to Government officers and certain railway engineers who desire early information. The number of telegrams so sent was 131 as compared with 275 last year.

- (d) Observers are instructed to send detailed information of earthquakes to the Simla Meteorological Office and to the Director, Geological Survey, Calcutta; for this work they are paid awards from this department. Of such reports, 100 were received during this year.

#### OBSERVATIONS WITH SPECIAL METEOROLOGICAL INSTRUMENTS.

11. The following special observations were carried out during the past year at certain selected stations:—

- 1st*—Wind observations recorded by Beckley anemographs at 6 stations, and by Dines' pressure tube anemometers at 4 stations.  
*2nd*—Solar and terrestrial radiation observations at 1 and 8 stations, respectively.  
*3rd*—Underground temperature observations at 2 stations.  
*4th*—Sunshine observations at 6 stations.  
*5th*—Barometric observations recorded by self-registering instruments, chiefly Richard barographs, at 12 stations.  
*6th*—Temperature observations recorded by self-registering instruments, chiefly Richard thermographs, at 6 stations.

#### OBSERVATIONS OF SOLAR ENERGY IN ABSOLUTE UNITS.

12. Observations at Simla by means of Angstrom's electric pyrheliometer continued in abeyance owing to shortness of staff.

#### AEROLOGICAL WORK.

13. In the absence from the Aerological Observatory of both the Director and his Assistant, no examination or publication of the data already collected was possible. Pilot balloon work at three stations in north India and one in the south was continued on the same scale as during 1917 to 1918, and a survey of the winds along the flying route to Rangoon was started by the institution of a flying station at Akyab in February 1919. The preparation of the data for publication was continued. The Observatory provided assistance in connection with the military pilot balloon work of Mesopotamia by supplying hydrogen and apparatus.

#### RESEARCHES BY THE SIMLA STAFF.

14. Owing to the absence on war work of Simla gazetted officers, the only researches found possible have been statistical examinations of various types.

#### SEISMOGRAPH OBSERVATIONS.

15. Seismological observations were recorded throughout the year by two Omori-Ewing seismographs at Simla and at Calcutta and one at Bombay; by Milne seismographs at Kodaikanal and Colaba (Bombay); and by means of other self-registering instruments at the last named station. All the instruments worked satisfactorily throughout the year, and data were transmitted to the Seismological Committee of the British Association.

#### MARINE METEOROLOGY.

16. No change was made during the year in the method of collecting marine information.

At Calcutta and Bombay a clerk at each port spends his whole time in visiting ships, making in each case a copy of the log and a comparison of the ship's barometer with a secondary standard, for the purpose of applying the necessary corrections to the readings in the logs; and, after the barometer comparisons have been made, a statement of the error of the ship's barometer is given to the captain, in case he should desire to make use of it. The number of ships visited is materially less than that of the vessels which come into port, but it is ample for the purposes of the department.

The data thus obtained are utilised in the preparation of charts of disturbances in the Bay of Bengal and the Arabian Sea for future reference in connection with the storm warning work of the department, and in drawing up an account of the storms of the year for publication in the Annual Summary.

The arrangement made with Royal Alfred Observatory at Mauritius, for collecting marine data from the Indian Ocean, has been continued, and the thanks of this department are again due to that office for thus supplying a large amount of useful data. No such data were received from the London Meteorological Office during the year.

SNOWFALL REGISTRATION IN THE MOUNTAIN DISTRICTS TO THE NORTH AND WEST OF INDIA.

17. The information as to the amount, distribution and time of occurrence of the snowfall in the Himalayan and Afghan mountain areas was on the whole tolerably complete, and the thanks of the department are again due to the various officers who have collected and forwarded it. Unfortunately the series of large-scale photographs of the snows, as seen from Simla, which was started in 1905, has had to be discontinued during the war.

RAINFALL REGISTRATION.

18. The registration of rainfall in India has invariably been carried out by the provincial authorities. In 1889 a uniform system was introduced by the Government of India, and the Director-General of Observatories was made consulting officer in connection with this work. His advice is sought regarding the starting of new rain-gauge stations, and he receives annual reports from the local officers responsible for the registration of rainfall upon the efficiency of the work. A general account of the system, which came into operation in the year 1891-92, will be found on pages 5-8 of the Administration Report of the year 1889-90, and on pages 6 and 7 of the Administration Report for the year 1890-91.

The following is a statement of the number of rain-gauge stations from which data were received for publication in the Rainfall data of India at the end of the year :—

Province or Division.	Number of rain-gauges supplying returns for publication on 31st March 1919.	Province or Division.	Number of rain-gauges supplying returns for publication on 31st March 1919.
Burma .. .. .	210	Baluchistan .. .. .	89
Assam .. .. .	125	Rajputana .. .. .	186
Bengal .. .. .	241	Bombay and Sind .. .. .	289
Bihar and Orissa .. .. .	302	Central India .. .. .	126
United Provinces .. .. .	274	Central Provinces and Berar .. .. .	189
Punjab .. .. .	190	Hyderabad .. .. .	19
Kashmir .. .. .	39	Mysore .. .. .	77
North-West Frontier Province .. .. .	35	Madras (including Pudukkottai, Coorg, Travancore and Cochin).	525

The following paragraphs give a brief summary of the reports of the officers in charge of rainfall registration for the year 1918-19 :—

*Assam.*—The number of gauges inspected was 88, and the total number of inspections was 142 against 82 the previous year. Forty-one rain-gauges were inspected more than once. There was thus a distinct improvement in the matter of inspections compared with the previous year:

*Baluchistan.*—The number of stations that were inspected is not stated in the report.

*Bihar and Orissa.*—Out of 305 stations, 181 stations were inspected and 224 inspection cards were received against 219 last year. The rainfall registration work was generally done satisfactorily.

*Bengal.*—Of the 241 rain-recording stations in the Province, only 41 stations were inspected.

*Bombay and Sind.*—Out of 278 rain-gauges in British districts, 178 were inspected, 48 being inspected more than once. The total number of inspections was 232 against 304 in the previous year. In Native States, 44 gauges were inspected out of 61 : the total number of inspections amounted to 50.

*Burma.*—Of 213 rain stations, 18 were meteorological observatories, 25 were in charge of the Public Works Department, 2 in charge of the Agricultural Department, and the rest were under District officers. Of the rain-gauges, 149 were inspected : 122 were in good order, 21 were in fair condition, and 6 were unsatisfactory.

*Central Provinces.*—There were 146 inspections against 175 the previous year. The results attained during the year are fairly satisfactory and the registration continues to be efficiently done.

*Berar.*—The number of inspections of the 43 rain-gauges was 127 against 103 in the previous year.

*Hyderabad.*—The rainfall registering stations of Hyderabad are in charge of the Nizam's Public Works Department. There are 17 stations, of which only 2 were inspected during the year. In addition there is a rain-gauge in charge of the Residency Surgeon and one at Bolaram in charge of the Senior Medical Officer.

*Kashmir.*—There were 38 rain-gauges in this State, of which 8 are meteorological observatories and the remainder are in charge of the Revenue Department. Ten rain-gauges were inspected as against fourteen last year.

*Madras.*—Out of 495 rain-recording stations, 395 were in the Madras Presidency, and of these the number inspected was 383. As a result of the systematic inspection in this presidency of late years, defects are rarely noted now in the inspection reports, which means that the rain-gauges are being maintained in good order and that the rain registration is accurate.

*Mysore.*—At the close of the calendar year 1918, the number of rain-recording stations was 225 : of these, 203 were inspected against 201 inspected last year.

The gauges appeared to be maintained on the whole in a satisfactory condition.

*North-West Frontier Province.*—The report on rainfall registration contained in the current administration report of land revenue, land records and agriculture of this province, refers to the year 1917-18 and states that there was no change in the number or the situation of the rain-gauges except that a new gauge was sanctioned for Kaghan. These and the rainfall registers are generally reported to be in good order and properly maintained.

*Punjab.*—The number of rain-gauges in the Punjab was 244, of which 150, are in charge of district officers and 97 in charge of irrigation officers. There were 21 inspections of the district rain-gauges. The process of replacing the old self acting gauges by Symons' gauges continued during the year under report.

*Rajputana and Ajmer-Merwara.*—During the triennial period ending the 31st March 1919, there were 420 rain-gauges, of which most were inspected during the period under review.

*United Provinces.*—Out of 270 stations under district and canal officers, 45 per cent. were inspected as compared with 51 per cent. last year and 56 per cent. in 1916-17.

*Summary.*—In Rajputana, the Central Provinces, Berar, Madras, and Mysore, the proportion of the rainfall stations inspected was over 75 per cent., which is satisfactory. In Assam, Bihar and Orissa, Burma and Bombay, where between 50 and 75 per cent. of gauges were inspected, the efficiency of the system must suffer before long. But the proportions in the remaining provinces—Kashmir 33 per cent., Hyderabad 23 per cent., Bengal 17 per cent. and the Punjab 14 per cent.—are such as to call for serious attention.

#### THE SYSTEM FOR STORM WARNING.

19. The work of warning Indian ports of the approach of cyclonic storms or of bad weather is performed from the Simla Office by the Director-General of Observatories, and from the Calcutta Office by the Meteorologist, Calcutta.

The following ports are warned from Simla for storms in the Arabian Sea :—

Aden, Karachi, Cutch Mandvi, Jamnagar, Dwarka, Porbandar, Veraval, Jafarabad, Bhavanagar, Daman, Bombay, Alibagh, Murud Janjira, Harnai, Ratnagiri, Malvan, Vengurla, Nova Gova, Marmagao, Karwar, Kumta, Honavar, Mangalore, Tellicherry, Calicut, Cochin, Alleppy, Quilon, Trivandrum, Colachel, Busra and Colombo.

The Meteorologist, Calcutta, warns the following ports for storms in the Bay of Bengal :—

Colombo, Tuticorin, Pamban, Negapatam, Porto Novo, Cuddalore, Madras, Masulipatam, Cocanada, Vizagapatam, Calingapatam, Gopalpur, Puri, Hukitala (False Point), Chandbali, Sandheads, Saugor Island, Diamond Harbour, Mud Point, Budge Budge, Calcutta, Khulna, Barisal, Goalundo, Narayanganj, Chandpur, Noakhali, Chittagong, Cox's Bazar, Akyab, Kyaukpyu, Diamond Island, Bassein, Rangoon, Elephant Point, Moulmein, Tavoy, Mergui, Table Island and Port Blair



The following River Police stations in Eastern Bengal and Sunderbans are also warned :—

Nikli, Bhairab, Chandpur, Mirzaganj, Narayanganj, Madaripur, Gopalganj, Gournadi, Goalundo, Aralia, Sirajgang, Lohajang, Sara, Godagari, Rampur Boalia, Khoksa Kakchira and Tushkhali.

*Note.*—No signals are hoisted at Tavoy, Noakhali, Calingapatam, Porto Novo or at any of the River Police stations; but the information contained in special telegrams is generally conveyed either to the shipping agents or to vessels lying in the ports.

20. In addition to special messages sent during stormy weather the Meteorologist, Calcutta, provides shipping with daily information regarding the weather over the Bay. The following ports receive daily telegrams under the "General system with additional signals":—

- |                     |                     |
|---------------------|---------------------|
| (1) Table Island.   | (8) Madras.         |
| (2) Elephant Point. | (9) Cuddalore.      |
| (3) Diamond Island. | (10) Porto Novo.    |
| (4) Akyab.          | (11) Bassein.       |
| (5) Chittagong.     | (12) Rangoon.       |
| (6) Negapatam.      | (13) Saugor Island. |
| (7) Cocanada.       | (14) Sandheads.     |

*Note.*—Ports (1) to (12) however receive no telegrams during the period 15th January to 31st March. On the 15th January a telegram is sent to these ports saying the Ball indicating fine weather should remain suspended until further orders. At the Sandheads signals are not exhibited, but information is available for passing vessels.

21. In accordance with resolutions passed at the International Radio-Telegraph Conference held in London in June and July 1912, the Indian Radio-Telegraph coast stations are now supplied with telegrams containing meteorological information with regard to the Arabian Sea and the Bay of Bengal. The messages are sent to the radio stations at Bombay, Karachi, Calcutta, Rangoon, Madras and Port Blair for broadcast transmission by wireless to the shipping in the Arabian Sea and the Bay of Bengal.

Arrangements made for the receipt by wireless telegraphy of meteorological observations from ships at sea worked satisfactorily up to August 1914, when owing to the outbreak of the war these wireless telegrams had to be discontinued.

#### WARNINGS FOR STORMS IN THE BAY OF BENGAL.

22. During the year warnings were issued for eleven disturbances. Two of these were of sufficient intensity to be classed as storms. Below is given a statement of their course and of the action taken.

##### *Storm of 22nd-25th May 1918.*

This developed slowly over the Sandheads during the 22nd and 23rd. It began moving almost due east on the 24th and by the morning of the 25th had struck the coast between Cox's Bazar and Akyab. It was of small extent but of moderate intensity.

The action taken with regard to Chittagong, Cox's Bazar and Akyab is shown by the following telegrams :—

##### *Chittagong.*

24th May at 11 hrs. 15 mins. Hoist danger signal number seven. Feeble storm one hundred miles south-west Cox's Bazar moving north-east.

24th May at 16 hrs. 9 mins. Storm small but of moderate intensity approaching now sixty miles west-south-west Cox's Bazar moving north-east.

25th May at 11 hrs. 9 mins. Hoist Ball. Storm crossed coast near Cox's Bazar. Fairly strong monsoon over Bay.

##### *Cox's Bazar.*

24th May at 11 hrs. 15 mins. Hoist danger signal number seven. Feeble storm one hundred miles south-west Cox's Bazar moving north-east.

24th May at 16 hrs. 6 mins. Lower danger signal number seven and hoist danger signal number six. Small storm of moderate intensity now sixty miles west south west Cox's Bazar.

25th May at 11 hrs. 29 mins. Lower storm signal. Storm crossed coast near Cox's Bazar.

### *Akyab.*

24th May at 11 hrs. 21 mins. Hoist local cautionary. Feeble storm one hundred miles south west Cox's Bazar moving north east.

25th May at 11 hrs. 9 mins. Hoist Ball. Storm crossed coast near Cox's Bazar. Fairly strong monsoon over Bay.

Although the coast observations on the morning of the 23rd showed clearly the existence of the disturbance, no warnings were issued till the morning of the next day: the notice given was thus rather short.

### *Storm of 16th-21st November 1918.*

Unsettled weather appeared over the south of the Bay on the 13th and gradually concentrated into a storm of slight or moderate intensity by the 16th. On the 17th the centre was probably about 200 miles east south east of Negapatam. Thence it travelled roughly in a north north easterly direction and disappeared on the 21st over the north of the Bay. The ports which were likely to be affected or from which vessels might run into the storm were informed daily from the 13th of its progress and signals were hoisted. The action taken with regard to Negapatam, Madras and Diamond Harbour is shown by the following telegrams.

### *Negapatam.*

13th November at 10 hrs. 31 mins. Hoist distant cautionary section five. Depression probably forming one hundred miles west Andamans.

14th November at 10 hrs. 17 mins. Hoist distant cautionary section four. Conditions slightly unsettled two hundred fifty miles off Negapatam.

15th November at 10 hrs. 32 mins. Hoist distant cautionary section four. Weather disturbed south west Bay three hundred miles east Negapatam.

15th November at 22 hrs. 57 mins. Hoist local warning. Slight storm formed off Negapatam moving westwards.

16th November at 11 hrs. Hoist danger signal number five. Storm moderate intensity two hundred fifty miles east Pamban moving west south west; weather stormy whole south west Bay south latitude Madras.

17th November at 11 hrs. 42 mins. Hoist danger signal number seven. Storm moderate intensity two hundred miles east Pamban moving slowly westwards; weather stormy south Madras west Port Blair.

17th November at 18 hrs. 48 mins. Storm seems severe is still east of north end Ceylon and moving slowly westwards.

17th November at 22 hrs. 50 mins. Storm moderate to severe approaching coast near Negapatam likely cross it to-night.

18th November at 10 hrs. 37 mins. Hoist danger signal number six. Storm moderate to severe one hundred miles east Cuddalore this morning, moving in north westerly direction towards Madras.

19th November at 11 hrs. 20 mins. Hoist distant warning sections two four. Moderate storm over two hundred miles east Madras moving north north easterly direction; weather stormy off north Madras and Orissa coasts.

20th November at 11 hrs. 8 mins. Hoist distant warning sections two three. Storm now feeble; centre Bay; latitude Vizagapatam; moving north east; weather squally northern half Bay.

21st November at 11 hrs. 17 mins. Hoist distant warning section one. Storm feeble now; centre Bay; latitude Puri; moving north east; weather squally head Bay.

22nd November at 10 hrs. 24 mins. Hoist Ball. Depression practically disappeared. Weather almost normal again.

*Madras.*

13th November at 10 hrs. 31 mins. Hoist distant cautionary section five. Depression probably forming one hundred miles west Andamans.

14th November at 10 hrs. 17 mins. Hoist distant cautionary section four. Conditions slightly unsettled two hundred fifty miles off Negapatam.

15th November at 10 hrs. 32 mins. Hoist distant cautionary section four. Weather disturbed southwest Bay three hundred miles east Negapatam.

15th November at 22 hrs. 59 mins. Hoist local cautionary. Slight storm formed off Negapatam moving westwards.

16th November at 11 hrs. 4 mins. Hoist local warning. Storm moderate intensity two hundred fifty miles east Pamban moving westsouthwest; weather stormy whole southwest Bay south latitude Madras.

17th November at 11 hrs. 55 mins. Hoist danger signal number five. Storm moderate intensity two hundred miles east Pamban moving slowly westwards; weather stormy south Madras west Port Blair.

17th November at 18 hrs. 48 mins. Storm seems severe, is still east of north end Ceylon and moving slowly westwards.

17th November at 22 hrs. 50 mins. Storm moderate to severe approaching coast near Negapatam likely cross it to-night.

18th November at 10 hrs. 26 mins. Hoist danger signal number seven. Storm moderate to severe one hundred miles east Cuddalore this morning moving in northwesterly direction towards Madras.

19th November at 11 hrs. 20 mins. Hoist distant warning sections two four. Moderate storm over two hundred miles east Madras moving northnortheasterly direction; weather stormy off north Madras and Orissa coasts.

20th November at 11 hrs. 8 mins. Hoist distant warning sections two three. Storm now feeble; centre Bay; latitude Vizagapatam; moving northeast; weather squally northern half Bay.

21st November at 11 hrs. 17 mins. Hoist distant warning section one. Storm feeble now. Centre Bay; latitude Puri; moving northeast; weather squally head Bay.

22nd November at 10 hrs. 24 mins. Hoist Ball. Depression practically disappeared. Weather almost normal again.

*Diamond Harbour.*

13th November at 10 hrs. 34 mins. Hoist distant cautionary. Depression probably forming one hundred miles west Andamans.

14th November at 10 hrs. 32 mins. Conditions slightly unsettled two hundred fifty miles off Negapatam.

15th November at 10 hrs. 42 mins. Weather disturbed southwest Bay three hundred miles east Negapatam.

16th November at 11 hrs. 56 mins. Lower distant cautionary. Hoist distant warning. Storm moderate intensity two hundred fifty miles east Pamban moving westsouthwest; weather stormy whole southwest Bay south latitude Madras.

17th November at 12 hrs. 43 mins. Storm moderate intensity two hundred miles east Pamban moving slowly westwards; weather stormy south Madras west Port Blair.

18th November at 11 hrs. 11 mins. Storm moderate to severe one hundred miles east Cuddalore this morning moving in northwesterly direction towards Madras.

19th November at 11 hrs. 50 mins. Moderate storm over two hundred miles east Madras moving northnortheasterly direction. Weather stormy off north Madras and Orissa coasts.

20th November at 11 hrs. 40 mins. Storm now feeble; centre Bay latitude Vizagapatam; moving northeast; weather squally northern half Bay.

21st November at 11 hrs. 45 mins. Storm feeble now. Centre Bay; latitude Puri; moving northeast; weather squally head Bay.

22nd November at 10 hrs. 47 mins. Lower signal. Depression practically disappeared; weather almost normal again.

The warnings were on the whole fairly successful, although from the 15th to the 18th, the Meteorologist, Calcutta, was under the impression that the storm was

going to cross the Coromandel Coast and hoisted signals accordingly: thus the danger signal No. 7 was flying at Madras on the 18th to show that the port was directly threatened and was only lowered on the 19th.

#### WARNING FOR STORMS IN THE ARABIAN SEA DURING THE YEAR.

23. The Simla Office warns the west coast ports, not only for storms, but also for squally weather, especially at the beginning of the monsoon. There were ten periods of disturbed weather in the Arabian Sea for which warnings were issued, but only one of these disturbances developed into a storm.

This was the development of a depression which had its origin in the Bay of Bengal and was thence transmitted westwards into the southeast of the Arabian Sea on the 1st November. According to the limited marine information available it travelled in a westnorthwesterly direction and passed into Arabia near the Kuria Muria Islands before the morning of the 12th. It would appear to have developed into a storm of considerable severity during its passages over the Arabian Sea.

The ports which were likely to be affected or from which ships might run into the storm were informed daily from the 1st to the 7th and the appropriate signals were hoisted. The signals were lowered everywhere on the 8th, that is, three days before the storm had actually disappeared. The premature lowering of the signals was, however, due solely to the fact that the coast stations failed to show any signs of the continued existence of the storm, which was then far away in the west of the Arabian Sea.

The action taken with regard to Bombay and Aden is shown by the following telegrams:—

#### *Bombay.*

1st November at 12 hrs. 20 mins. Approaching unsettled weather, may cause squalls Malabar Coast. Hoist signal number one distant cautionary.

1st November at 22 hrs. 9 mins. Depression from Madras coast slowly approaching.

2nd November at 11 hrs. 56 mins. Weather disturbed Malabar coast but no storm.

3rd November at 12 hrs. Depression from Madras coast passed out into southeast Arabian Sea: at present feeble but may develop.

4th November at 12 hrs. 8 mins. Depression moved west.

5th November at 11 hrs. 58 mins. Depression giving disturbed weather southern half Arabian Sea.

6th November at 11 hrs. 57 mins. Storm probably formed about four hundred miles west of Ratnagiri. Replace distant cautionary by distant warning signal.

6th November at 22 hrs. 30 mins. Storm probably now moving slowly northwest.

7th November at 12 hrs. 5 mins. Depression probably still going slowly northwest.

7th November at 23 hrs. 3 mins. Depression scarcely influencing observatories: so either weakening or travelling away westwards.

8th November at 11 hrs. 48 mins. The depression has ceased affect observatories. Lower signal.

#### *Aden.*

3rd November at 12 hrs. 8 mins. Depression southeast Arabian Sea may develop and move west or north. Hoist distant cautionary signal.

4th November at 12 hrs. 5 mins. Depression moved west.

5th November at 12 hrs. 5 mins. Depression giving disturbed weather southern half Arabian Sea.

6th November at 12 hrs. 3 mins. Storm probably formed about four hundred miles west of Ratnagiri. Replace distant cautionary by distant warning signal.

7th November at 12 hrs. 8 mins. Depression about sixtyseven east eighteen north. Probably moving northwest.

8th November at 11 hrs. 50 mins. Depression ceased affect observatories. Lower signal.

## INFORMATION IN CONNECTION WITH THE SENDING OF VESSELS TO MESOPOTAMIA.

24. Information regarding weather in the Bay was sent by the Meteorologist, Calcutta, to the Captain Superintendent, Royal Indian Marine Dockyard, Calcutta, in connection with the towage of vessels intended for Mesopotamia. A number of warnings regarding cyclonic weather in the north of the Arabian sea or squally weather in the Persian Gulf were sent from Simla to the Port Officer, Busrah.

## FLOOD WARNING AND WEATHER FORECASTS TO DISTRICT, IRRIGATION, RAILWAY AND OTHER OFFICERS.

25. This work is carried out chiefly by the Simla Meteorological Office, and partly by that of Calcutta. The arrangements have been made at various times and differ considerably in character, according to the nature and extent of the flood or weather warnings required by the officers concerned. In most cases these officers require telegrams either warning them of advancing storms likely to give heavy rain, or informing them of the actual occurrence of heavy rainfall likely to give rise to severe floods which might injure railways or canal works; and in other cases, they require warnings or forecasts of the weather for as long a period beforehand as possible.

The number of district officers and officers in the irrigation, telegraph, railway and other departments requiring flood warnings from Simla amounted at the end of the year to 210, as compared with 206 in the previous year. There were also 5 officers of the Telegraph Department who required warnings for strong winds.

This number does not include captains of mail steamers and other vessels who occasionally telegraph from Karachi, Aden and other ports for the latest intelligence respecting the position and movement of cyclonic storms, nor does it include the names of other individuals or firms who ask for special forecasts.

The number of warning messages sent from Simla during the year 1918-19 was 3,605 as compared with 5,789 in 1917-18, 4,879 in 1916-17 and 2,838 in 1915-16.

The number of warnings for heavy rainfall and strong winds sent from Calcutta during the year 1918-19 was 630 and for only strong winds 236, thus making a total of 866, as compared with 1,355 in 1917-18.

26. Instructions were issued by the Government of India in 1898 that every officer to whom storm or flood warnings are issued should, in the month of January of each year or, in the case of military expeditions, at the close of the campaign, forward to the head of this department a brief return of the warnings received and should also report—

- (1) whether the warning telegrams were rapidly transmitted and delivered by the Telegraph Department;
- (2) whether the warnings were timely and satisfactory in every respect and, if not, in what points they were defective;
- (3) whether any changes might be made in the system which would make the warnings more useful.

Reports on the ordinary storm and flood warnings for the calendar year 1918 were received from 45 officers. Of these, 32 stated that the warnings were satisfactory, and the remaining 13 offered no remarks.

A comparison of the reports of floods and of heavy rain with information supplied to the various officers would appear to show that the system is working satisfactorily, and that most of the warnings issued were of value to the recipients. As an illustration, the following note may be of interest. It formed part of the report submitted by the Executive Engineer, Rupar Division, Sirhind Canal :—

“ It was a particularly dry season and there were no large floods. The telegrams however were generally useful when sent and on several occasions there was heavy rain over the catchment area, in the hills when we had only light rain near Rupar and the telegrams gave us timely warning that a rise in the river could be expected.”

## SEASONAL FORECASTS.

27. The forecast for the monsoon period of 1918, dated the 8th June, was sent to Local Governments and Administrations, communicated to the press, and printed

in the Gazette. A statement of the rainfall of June and July with a forecast for August and September was drawn up on the 7th August 1918 and published in a similar manner.

A statement of the actual rainfall during the monsoon period and a comparison of the two forecasts with actual rainfall was drawn up on the 4th January 1919 and sent to Local Governments and Administrations.

The following are summaries of these two forecasts and comparison of them with the actual rainfall :—

Forecast, dated the 8th June 1918.	REMARKS.																												
(a) The monsoon rainfall of Upper Burma and northeast India is likely to be in excess.	The percentage departures of monsoon rainfall were—9 in Upper Burma, +29 in Assam, +17 in Bengal, —13 in Orissa, —6 in Chota Nagpur and + 16 in Bihar. The average of these is + 6.																												
(b) In the remainder of India, excluding Lower Burma and the south of the Peninsula, the outlook is roughly normal though slightly perhaps on the unfavourable side.	Apart from the east of the Central Provinces, where the total rainfall was normal, it was everywhere in moderate or large defect; the worst cases were Punjab 51%, Sind 81%, Rajputana 59% and Bombay 53 %.																												
(c) The rainfall of northwest India is not likely to be affected prejudicially by accumulations of snow in the Himalayas.	The rains in northwest India extended early to the frontier and there was no evidence of local snowfall effect.																												
Forecast, dated the 7th August 1918.	REMARKS.																												
(a) Prediction is unusually difficult in a season in which the strongest monsoon on record in May has been followed by the weakest monsoon on record in July; but although the outlook is not favourable there are grounds for expecting an improvement in the general rainfall of India.	After a percentage defect over India of 24 % in the first half of the monsoon period, the rainfall of August was in defect by only 3%, that of September being in defect by 27%. For the second half of the period the defect was 13% and there was a decided improvement.																												
(b) Apart from northeast India and Burma the area most likely to get a good percentage of its usual rainfall in August and September is the Central Provinces; and the prospects are least good in northwest India, including the greater part of the United Provinces, the west coast regions and Madras.	<p>The total rainfall of August and September was in excess in Burma, Assam, Bengal and Bihar and Orissa. In other provinces there was a defect of the following percentage amounts :—</p> <table data-bbox="680 1715 1206 1962"> <tbody> <tr> <td>United Provinces</td> <td>39</td> <td>Central India</td> <td>27</td> </tr> <tr> <td>Punjab</td> <td>.. 39</td> <td>Central Provinces</td> <td>29</td> </tr> <tr> <td></td> <td></td> <td>Hyderabad</td> <td>36</td> </tr> <tr> <td>North-West Frontier Province</td> <td>30</td> <td>Mysore</td> <td>.. 26</td> </tr> <tr> <td>Sind</td> <td>.. 55</td> <td>Madras</td> <td>.. 30</td> </tr> <tr> <td>Rajputana</td> <td>.. 45</td> <td></td> <td></td> </tr> <tr> <td>Bombay</td> <td>.. 37</td> <td></td> <td></td> </tr> </tbody> </table> <p>Thus apart from northeast India and Burma the percentage was least bad in Central India, the Central Provinces, Mysore and Madras. It was worst in northwest India and the west coast.</p>	United Provinces	39	Central India	27	Punjab	.. 39	Central Provinces	29			Hyderabad	36	North-West Frontier Province	30	Mysore	.. 26	Sind	.. 55	Madras	.. 30	Rajputana	.. 45			Bombay	.. 37		
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It will be seen that in June the forecasts (a) and (c) proved correct, but (b), which was by far the most important of all, was wrong. In August both (a) and (b) proved on the whole correct. The failure of the monsoon was associated with low pressure in the Argentine and Chile, and high pressure in the Indian Ocean; but though it was apparently produced in the usual way it did not give the usual indications in advance. In these respects as in some others it resembled the monsoon of 1907.

28. A forecast of the probable character of the rains during January and February 1919 was prepared on the 4th January 1919 and issued in the same manner as the forecast of the previous June. On the 10th July 1919 a comparison of the actual precipitation with the above forecast was issued. The summary of the forecast issued was :—

“ The indications suggest that the total rainfall of northwest India in January and February and the snowfall on the neighbouring hills will be roughly normal.”

The forecast was not correct, as the rainfall of the period in the plains was in large excess, and the snowfall in the hills was also above normal.

#### DAILY TELEGRAPHIC WEATHER SUMMARY.

29. The summary was despatched daily at about noon. It was exhibited at certain telegraph offices and sent to 85 officers of Government. The subscribers for longer or shorter periods were 10 newspapers and 90 private individuals. To officers in Simla, sheets containing the summary with a chart showing the rainfall of the day are distributed by hand.

#### PUBLICATIONS.

30. There were no changes made during the year in the form of the routine publications of the department, of which a description will be found in the departmental administration reports of 1907-08 and 1910-11. Publication of the Monthly Weather Review and of the Annual Summary, which had been stopped during the war on account of the shortage of paper, was resumed towards the end of the year.

The monthly and annual supplements to the Indian Daily Weather Report have been printed as usual, and supply the general need for prompt information.

#### SUPPLY OF METEOROLOGICAL INFORMATION.

31. In addition to the meteorological information published by the department, special information was supplied to the Meteorological Departments of England, Australia and Egypt.

Climatological information, at times involving special calculation, is also provided for sanitary and other officers of Government, as well as for private firms who are willing to pay the expense necessarily incurred. The extent to which the department is utilised in this manner will be seen from the chart appended.

#### MEDICAL DEPARTMENT.

The department has also supplied information in connection with cases of heat-stroke among British soldiers. The highest wet bulb temperatures of the days were required, but as most of the departmental observatories recorded readings at 8 hrs. only, these maximum temperatures had to be deduced approximately from other readings by applying corrections. During July wet maximum thermometers were started at six cantonments in northwest India and information was furnished to the local military authorities whenever the maximum wet bulb temperature reached the danger limit (80°).

#### MISCELLANEOUS.

32. Three hundred and fiftyone books and pamphlets, either purchased or presented by scientific bodies, were added to the library during the year, as against four hundred and eleven in the year 1917-18.

Six libraries, observatories or societies were added during the year to the list of institutions to which the publications of the Indian Meteorological Department are supplied, and one was removed; the number on the list is now 376.

## CHIEF FEATURES OF THE YEAR.

33. The activities of the department were very much curtailed throughout the year owing to the absence on war duty of a large number of the senior officers. Dr. Simpson and Mr. Normand of the Simla office were absent on war work throughout the year. Both Mr. Field, the Director, and Mr. Harwood, the Assistant Director of the Agra Aerological Observatory, were absent for the same reason for the greater part of the year. Dr. Royds, the Assistant Director of the Kodaikanal Observatory, was employed under the Director of Ordnance Factories throughout the year. Thus, of the seven members of the European staff of the department, five were absent for the whole or the greater part of the period under review. To meet this reduction, the scientific work of the department had to be reduced to a minimum but the routine work was continued with but little change.

The publication of the Monthly Weather Reviews which had been discontinued owing to the war was resumed near the end of March.

Arrangements were made for the military authorities at six cantonments in northwest India to be informed when the wet bulb temperature reached 80°; it having been found that when the wet bulb temperature is above this value the danger of heatstrokes is very great.

The department has also had under consideration two schemes which will have an important bearing on its working in the near future. Firstly, it has been found necessary to consider the removal of the Colaba Observatory from its present site owing to the expansion of the Bombay Harbour Defence Works. The necessity for the removal and possible sites to which the observatory can be transferred have received careful consideration and it has been recommended to Government that the observatory should be removed to a new site. Secondly, the needs of the military air service in India and the international convention regarding aviation have necessitated the department taking into consideration the inauguration of a special meteorological service for aviators. The upper air observations already taken in connection with the aerological work of the Agra Observatory have been found of considerable use; but observations over a much expanded area will be required in the future. Methods of undertaking this new work were being discussed at the end of the year under review.

## CONCLUDING REMARKS.

34. The Meteorological Department owes a large part of its usefulness to the sympathetic assistance it receives from outside departments. Civil Surgeons and other officers of Government departments, as unpaid superintendents of observatories and in other capacities, help in the meteorological work; the Telegraph and Postal Departments assist in every way in the rapid transmission of meteorological information, at the same time that they allow their employees to act as observers. The Indo-European Telegraph Department, also, by giving free transit to the daily records of the Persian observatories, places a large amount of most useful information at the disposal of the Meteorological Department. Weekly telegrams were received from May to September from the Director of the Royal Alfred Observatory, Mauritius, as well as from the departmental observatories at Zanzibar and Seychelles. These telegrams gave valuable information of the weather conditions in the Indian Ocean and the department is indebted to the officers indicated for the punctual transmission of the information. Thanks are more specially due to the Director of the Royal Alfred Observatory for his courtesy in placing the meteorological data of that observatory at the disposal of the Indian Meteorological Department.

The department is greatly indebted for important information as to meteorological conditions prevailing antecedent to and during the southwest monsoon to the Director, Physical Service, Survey Department, Cairo; the Directors of the Observatories at Buenos Ayres and Santiago; and to the various officers around the Indian frontiers who have collected and supplied valuable snowfall information.

SIMLA;

G. C. SIMPSON,

*The 19th September 1919.**Officiating Director General of Observatories.*



# GROWTH IN DEPARTMENTAL ACTIVITY AND CHANGES IN TOTAL COST



