KODAIKÁNAL AND MADRAS OBSERVATORIES.

REPORT FOR THE YEAR 1902.

CONTENTS.

KODAIKANAL AND MADRAS OBSERVATORIES.

I.—ANNUAL REPORT OF THE KODAIKÁNAL OBSERVATORY FOR THE YEAR 1902.

(*a*) **Staff.**—The personal establishment of the observatory was as follows :—

Title.	Name.
Director	C. Michie Smith, B.Sc., F.R.A.S., F.R.S.E.
First Assistant	K. V. Sivarama Aiyar, M.A.
Second ,, ...	S. Sitarama Aiyar, B A.
Third ,, ...	G. Nagaraja Aiyar.
Fourth ,, ...	M. G. Subrahmanya Aiyar, B.A.
Writer	L. N. Krishnaswami Aiyar.
Magnetic Observer	C. Theodore, B.A.

Owing to the absence of the first assistant, who went on privilege leave on July 21 and on sick leave on August 10, Mr. S. Balasundaram Aiyar was temporarily engaged on August 1 to assist in the observations and reductions. Mr. Krishnaswami Aiyar has been removed from the observatory and placed in charge of the base meteorological station at the foot of the Palni Hills, near Periyakulam. He has been there since June 8, so that the numerous clerical duties here have been thrown on the general members of the staff.

On October 31 the Director went on leave to England, the observatory meanwhile being left in charge of Mr. Sitarama Aiyar until the arrival of Mr. Charles P. Butler, who had been appointed Acting Director during the absence of the Director.

A first-class book-binder from the Government Press, Madras, is attached to the establishment.

The subordinate staff consists of a mechanic, a book-binder's boy, five peons and two lascars.

(*b*) **Buildings and grounds**—*Main observatory.*—The porches built for the protection of the east and west doors have been of great value, and similar provision is being made for the south door. There is still considerable trouble, however, caused by the moisture being driven through the walls, and in continuous misty weather the whole of the inner walls of all the rooms are exceedingly damp. The effect of this is rendered more unfortunate as there is no provision whatever for adequate artificial heating, and it is impossible to overestimate the probable damage to the many delicate and costly instruments which are erected or stored in the various structures. The addition of a verandah to the wall of the north room has been sanctioned, and some method of treating the outer wall surfaces is under consideration by the engineer.

Photoheliograph.—This is a corrugated iron structure brought from Madras. The sliding semi-circular roof is very heavy and moreover the level of the slide is below the telescope so that great care has to be exercised when opening the roof or the instrument would be overturned. A small section of the end of the roof has been cut out and hinged to allow the roof to pass the telescope so that the instrument may be got partly into working order pending the construction of a more suitable cover which is under consideration.

Transit.—The transit building is now complete with the exception of a few minor details connected with the shutters and opening gear, but there is as yet no provision for keeping the place and instruments dry in wet weather.

Magnetic observatory.—The underground magnetic record vault was completed about the end of July and the two photographic recorders for Horizontal Force and Declination were installed by Captain Fraser on August 5. Considerable trouble has been occasioned by the presence of springs, causing the walls to be very damp

and various preventive devices have been and are being tried in hopes of finally overcoming this difficulty. The absolute comparison room above was completed about the beginning of August and with the exception of slight leakage in the roof, gives every satisfaction.

Anemometer tower.—The anemometer tower was completed about the beginning of April and the instruments were at once installed and got into working order. A second room below the present one is about to be constructed to contain the Dine's pressure tube anemometer (recording form).

Quarters are nearly completed for the accommodation of the book-binder and the mechanic, one peon and two lascars. At present they have to go backwards and forwards between the observatory and the settlement some miles down the hill.

(*c*) **Instruments.**—The following instruments are available for use in the observatory :—

Instrument.	Employed for
6″ Cooke Refractor. 7′ focus, Equatorially mounted.	Visual examination of sun and other celestial objects.
6″ Lerebour and Secretan Refractor 8′ focus. Equatorially mounted. Remodelled by Grubb.	Visual examination of spectrum of sunspots and chromosphere.
5″ Grubb portrait lens, 36″ focus. Mounted on Lerebour Equatorial.	Photographs of comets, meteors, variable or new stars, etc., for magnitude determination.
11″ polar siderostat in conjunction with 6″ Grubb lens, 40′ focus.	Feeds the concave grating spectrograph, and can also be used for direct photographs of the sun.
Altazimuth	Dismounted at present.
4″ Rowland concave grating, 10′ focus. 14,439 lines to the inch.	Spectra of sun, chromosphere, etc., and laboratory investigation.
Revolving plate-holder with clockwork.	Compensating rotation of field of Siderostat.
6″ Transit instrument from G.T. Survey of India.	For determination of standard time and general rating of chronometer.
Prism Spectroscope. Six prisms with automatic deviation (With photographic attachment and two dark slides).	For eye observations of solar and terrestrial spectra.
Small grating spectroscope	Examination of sunspot and chromospheric spectra with the Lerebour equatorial.
Photoheliograph by Dallmeyer ..	Arranged to give 8″ photographs of sun similar to others at Dehra, Mauritius and Greenwich.
Mean time clock. Kullberg No. 6326.	....
Mean time chronometer. Kullberg No. 6299.	....
Sidereal time chronometer. Kullberg No. 6134.	With electrical seconds contacts for chronographic registration.
Chronograph (old)	General recording purposes.
Drum Chronograph sidereal Clock. Shelton.	....
Chronograph new ; by Fuess	For use with transit and magnetic work.
Stage micrometer. Hilger	For measurement of photographic spectra
Theodolite 6″; Cooke	General adjustment of instruments, positions of special objects and laying out new buildings.
Unifilar Magnetometer. Elliott No. 16.	For absolute comparisons of magnetic elements.
Dip Circle. Barrow No. 46	
Declination and Horizontal Force Magnetograph. Watson No. 2.	Automatic recording of magnetic elements.
2 Phototheodolites. Steinheil	Cloud photography.
Sextant	Time determination.
Seismometer. Milne's horizontal pendulum.	Continuous photographic registration of seismic disturbances.
2 Actinometers. Balfour Stewart ..	For series of comparisons of value of sun's heat.
Solar Calorimeter. Buchanan	
Induction coil giving 4″ spark with 2 quart Leyden jars and vacuum tubes.	For comparison with spectra obtained from celestial sources.
Small polar heliostat	Adjustment of spectroscopes. Experimental work.
Complete set of meteorological instruments.	....

(*d*) **Astronomical observations.**—In this branch work has been chiefly directed to the examination of sunspots; drawing them and examining their spectra; a considerable time has also been devoted to the mapping of prominences with the spectroscope and the general spectrum of the chromosphere. The following table gives a resumé of the state of sun's surface during the year :—

Month.	Number of days on which sun was visible.	Number of days on which spots were seen.	Number of days on which there were no spots.	Number of days on which spots were extremely small.	Number of days on which no observation was possible.	Number of days on which widened lines were observed.
January	25	8	17	6	6	..
February	28	2	26	2	..	..
March	31	12	19	1	..	5
April	30	2	28	2	..	..
May	31	12	19	4	..	6
June	30	6	24	4	..	2
July	28	3	25	3	3	..
August	29	7	22	5	2	2
September	30	14	16	2	..	10
October	30	25	5	2	1	8
November	27	12	15	1	3	..
December	27	7	20	3	4	..
Total ..	346	110	236	35	19	33

Whenever there are spots the sun's image is projected on a graduated disc 8″ in diameter rigidly attached to the eye end of the 6″ cooke equatorial and the position of the spot marked on it, taking care that the east to west line marked on the disc is parallel to the diurnal motion. The heliographic latitudes and longitudes of the spots are subsequently derived from these positions (1) by applying L. Niesten's formula and (2) by superposing over the discs certain charts, also 8″ in diameter, prepared by the Rev. Father Beauripaire Louvagny giving the heliographic co-ordinates of every point on the charts for different heliographic latitudes of the centre of the sun's disc, and then by taking the means of the values derived by the two methods.

(*e*) **Meteorological observations.**—These include determinations of (1) temperature, (2) rainfall, (3) barometric pressure, (4) humidity, (5) wind direction and velocity, (6) actinometry for measurement of sun's heat, (7) cloud phenomena, (8) duration of sunshine, and (9) earthquake measurements. All the instruments have been in working order for most of the year and the tabulated results are given in the appendices.

Eye observations of temperature (wet and dry bulb, maximum and minimum), pressure, wind direction and velocity, cloud and rainfall are made daily at 8*h*., 10*h*. and 16*h*. local mean time at both Kodaikánal and the base station at Periyakulam. Continuous records of temperature and pressure are also taken at both stations with Richard's recorders. The records are reduced immediately and supply scale corrections. The anemometer (Dine's pressure tube) and the Beckley anemograph were installed in the new tower on April 1.

Seismometer.—The seismometer has been in continuous action throughout the year. A list of the principal shocks recorded during the year is given in Appendix I.

(*f*) **Terrestrial magnetism.**—The magnetographs were installed in the new vault in August and were in constant action up to the end of the year.

The atmosphere of the chamber has been very damp, notwithstanding the ventilation provided, and it has therefore been impossible to keep the optical system from becoming overrun by fungoid growths which considerably diminish the intensity of the photographic traces and at times occasion disturbances on the traces.

Deflection observations were taken every morning at 10 A.M. Madras mean time for determination of the scale co-efficient of horizontal force magnetograph. Six of these deflections are visually read. Once every week the deflection is photographically recorded on the sheet carrying the traces.

The recording cylinders are so arranged that two days' photographic traces are obtained on the same sheet of paper one above the other.

The sheets are developed every second day and are written up and read.

Monthly tabulation and reduction of results are also being done.

Disturbances.—No disturbance of a violent nature has been recorded since the instruments were set up, but moderate magnetic storms were found on the undermentioned dates :—

1902, August 16, 21.	1902, October 11, 31.
„ September 18, 19, 20.	„ November 23, 24.

Notices of these disturbances were sent immediately after their detection to the Director-General of Telegraphs.

No definitive values of the magnetic elements can be given from the records of so short a period, but the values below are the means from the bi-weekly series which have been undertaken :—

Mean westerly Declination	0° 19′
Mean Inclination	3° 2′
Mean Horizontal force	0·3739 C.G.S.

Absolute observations.—These are at present arranged so that a complete set of observations are taken twice a week as follows :—

Horizontal force	Wednesdays and Saturdays.
Inclination	Mondays and Thursdays.
Declination	Tuesdays and Fridays.

The underground vault is supplied with a thermograph and two thermometers which are read thrice a day.

(*g*) **Library.**—One hundred and ten books have been bound during the year and the work will hereafter be facilitated by the extra room provided for the binder. About three hundred books and periodicals have been received during the year.

(*h*) **General**—*Rainfall.*—The rainfall for the year has been much above the normal, as it has also been the case at Periyakulam and Madras; the difference having been caused mainly by the rather excessive fall in October. The rainfall on any one day was not particularly heavy in October, the greatest amount for the year having fallen on the 8th January—an exceptional feature.

Wind.—The maximum daily wind velocity for the year was only 700 miles—much less than in previous years. Another peculiarity about it is that it did not occur during the South-west Monsoon months as it usually does, but in December.

Temperature.—The lowest dry bulb reading during the year was 39°·4 F. on the 26th January, and the lowest reading on the ground was 27°·2 F. on the 25th January.

In other respects the year was more or less normal, judging from the past three years' observations.

KODAIKÁNAL,
5th February 1903.

CHARLES P. BUTLER.

II.—ANNUAL REPORT OF THE MADRAS OBSERVATORY FOR 1902.

The following report has been submitted by Professor R. Ll. Jones, Deputy Director of the Madras Observatory :—

I was away on leave during the greater part of the year—from the 6th of February to the 30th of November. The Rev. A. Moffat, M.A., Professor of Physical Science at the Madras Christian College, officiated as Deputy Director during this period.

The First Assistant also was on leave during the greater part of the year.

At the end of the year the staff consisted of—

Mr. S. Solomon Pillay, Computer and Manager.
Mr. M. B. Subba Rao, B.A., First Assistant.
Mr. E. Ramanujam Pillay, Second Assistant.

Astronomical observations for time determination made during the year involved observations of 334 clock stars, 79 azimuth stars and 86 determinations of level and collimation errors. Nearly the whole of these observations were made by Mr. Solomon Pillay.

Time service.—There was no change made in the time signal distributed from the observatory. A reference has been received as to the possibility of transmitting a time signal to Colombo at 8 A.M. daily and disposed of, as far as the observatory is concerned.

The Fort time signal gun failed on 36 occasions out of 730, thus giving a percentage of successes of 95·1. The firing apparatus was replaced by the other spare one on the 9th October, as it was found to be defective.

The time ball at the Port office failed at 1 P.M. on three occasions, but successfully dropped at 2 P.M. On two other occasions it failed at 1 and 2 P.M.

The following table shows all the failures as far as they could be ascertained :—

Month and date.	Signal.	Fault.	Cause.
1902.			
8th January	Noon gun	Failed	Not known.
21st ,, ...	Time ball	Failed at 1 P.M., dropped at 2 P.M.	Do.
5th to 8th February ..	Gun	Failed	Instrument out of adjustment.
6th March	8 P.M. gun	Do.	Not known.
11th April	Noon gun	Do.	Bad tube.
14th May	Do.	Do.	Weight did not drop.
15th ,, ...	8 P.M. gun	Do.	Do.
16th ,, ...	Noon gun	Do.	Gunner disconnected instrument before time.
19th ,, ...	Do.	Do.	Weight did not drop.
29th ,, ...	Time ball	Failed both at 1 and 2 P.M.	Not known.
6th June	8 P.M. gun	Do. do.	Copper was bad.
7th ,, ...	Noon ,, ...	Do. do.	Do.
13th ,, ...	Time ball	Do. do.	Not known.
16th ,, ...	Noon gun	Do. do.	Do.
16th ,, ...	Time ball	Failed at 1 P.M., dropped at 2 P.M.	Do.

Month and date.	Signal.	Fault.	Cause.
1902.			
17th June	4 P.M. roll	Not received at T.O. ..	Not known.
18th ,, ...	Noon gun	Failed	Tube failed.
18th ,, ...	4 P.M. roll	Not received at T.O. ..	Not known.
19th ,, ...	Time ball	Failed at 1 P.M., dropped at 2 P.M.	Do.
24th ,, ...	Noon gun	Failed	Bad tube.
2nd July	Do.	Do.	Gunner late.
12th ,, ...	Do.	Do.	Do. absent.
18th ,, ...	Do.	Do.	Do. late.
19th ,, ...	Do.	Do.	Weight did not drop.
26th ,, ...	Do.	Do.	Gunner late.
31st ,, ...	Do.	Do.	Not known.
5th August	Do.	Do.	Gunner absent.
6th ,, ...	Do.	Do.	Do.
1st, 2nd, 12th, 15th, 18th, 20th and 27th September.	Do.	Do.	Weight did not drop.
26th September ..	8 P.M. gun	Do.	Do.
6th October	Noon gun	Do.	Do.
28th ,, ...	Do.	Do.	Tube failed.
16th November	Do.	Do.	Weight did not drop.
3rd December	4 P.M. roll	Not received	Fault at Telegraph office.

In all the cases marked "Not known," it was ascertained that the fault was not at the Observatory.

Meteorological observations.—Meteorological observations were carried on as in former years, and the registers are kept posted up to date. Mean meteorological results for the years 1891—1900, and a table of maximum and minimum temperatures observed at Madras from 1813 to 1900 were prepared. The observations at 10 hours and 16 hours were reduced and sent to the Imperial Reporter's Calcutta office at the end of every month. In addition to the weather messages sent daily to Simla, Bombay and Calcutta, special storm signal observations were called for and sent to the Bengal Reporter on the following dates: June 6 and 7; July 5 and 6; October 20—22, 29 and 30; November 10—13, 16 and 17; December 15.

Instruments.—The transit instrument was overhauled in January when the Director inspected the Observatory, and is, I believe, in excellent order.

The Sidereal clock by Dent is also in good order.

The mean time clock by Shepherd is in good order, and performing very satisfactorily. The hourly signals, the firing of the gun, and the working of the time ball at the Port office are all automatically controlled by this clock. None of the time signals, except the 4 P.M. roll, are sent by hand.

The mean time chronometer by Kullberg is also working very satisfactorily.

The 8-inch equatoreal is in good order. No systematic work is being done with it.

The Haswall clock in the dome is kept going, but is not satisfactory. This is of less consequence considering that no extra meridian work is being done here.

All the meteorological instruments are in good order, except the thermograph, which will shortly be replaced by a new one.

Buildings.—A new press room is being built for the lithographic presses by means of which the weather reports are printed. Considerable repairs to the buildings have been effected during the year, and others are in contemplation. When these are finished, I think it will be right to describe the condition of the whole property as "first rate".

The following is the weather summary of Madras for the year 1902:—

Pressure was above normal for February, May, June, September, October and November, and was below normal for the other months. The mean pressure for the day was lowest on the 25th of May, 29·532 inches, and highest on the 17th February, 30·186 inches.

Temperature.—The mean temperature was above the average for all months except October when it was slightly below normal, and September when it was normal. The highest temperature recorded during the year was 180° F. on the 8th May and the lowest was 62° ·2 F. on the 6th of February.

Humidity was slightly below normal for May, normal for April and above normal for all other months. Humidity was lowest for the 18th May, the 9th and 15th June, for which days it averaged 32.

Rainfall was below the average for February, March, April, May, June, August, September and November, and above the average for the remaining months. The deficiency was greatest for September, 5·47 inches, and the excess was greatest for December, 5·42 inches. The rainfall for the year was above the average by 5·42 inches, the total fall being 54·44 inches.

Winds were stronger than usual in April: velocities were below the average for all other months, the deficiencies being greatest for September and December.

Sunshine was below normal for all months.

Storms.—A storm formed in the south of the Bay towards the end of October, moved towards the Coromandel Coast and passed inland a little to the south of Madras. It is noteworthy on account of the heavy rain it gave at Madras, 9·16 inches falling between 8 A.M. on the 27th and 8 A.M. on the 28th of October. At Masulipatam on the following day, the rainfall, due to the storm, was 9·50 inches.

R. LL. JONES,
Deputy Director.

KODAIKANAL,
5th February 1903.

CHARLES P. BUTLER,
Ag. Director, Kodaikánal and Madras Observatories.

Appendix I.

KODAIKÁNAL Observatory seismological records.

No.	Date.	Commencement, G.M.T.		Maxima, G.M.T.		Amplitude.		Duration.		Remarks.
	1902.	H.	M.	H.	M.	MM.	SECONDS.	H.	M.	
1	January 1 ..	5	43·7	6	18·1	1·0	0·5	2	31	P. Ts. 29m.
				23	2·2	1·3	0·7			
2	,, 4 ..	3	44·5	3	45·0	..	..		02	Slight.
3	,, 11 ..	5	06·7	5	06·9	..	..		04	Do.
4	,, 12 ..	22	14·5	22	34·9	0·5	0·2	1	10	
					49·4	0·7	0·3			
5	,, 24–25 ..	23	37·9	23	48·9	1·0	0·7	1	40 (?)	P. Ts. 10m.
6	,, 29 ..	1	43·9	1	58·3	0·8	0·4	0	57	
				2	06·2	0·8	0·4			
7	,, 30 ..	14	10·6	14	19·9	1·0	0·5	1	20	P. Ts. 8m.
					47·0	2·0	1·0			
8	,, 31 ..	1	59·5	2	01·0	0·5	0·2	0	50	
					26·7	0·5	0·2			
					28·8	0·5	0·2			
9	February 5 ..	5	57·5	6	00·5	0·8	0·4	0	08	
10	,, 9 ..	7	57·5	8	00·5	0·5	0·3	1	12	
					32·3	1·2	0·8			
11	,, 9 ..	10	24·7	10	31·8	0·3	0·2	1	05	
				11	09·3	0·4	0·3			
12	,, 13 ..	9	47·6	10	02·6	0·5	0·3	0	55	Slight.
13	,, 15 ..	21	39·0	21	45·1	0·3	0·2	0	16	Do.
14	,, 17 ..	1	07·7	....		..	..	1	20	Do.
15	,, 25 ..	15	43·6	....		..	..	0	25	Widening of line.
16	March 6 ..	19	43·0	....		..	..	0	55	Slight.
17	,, 12 ..	15	28·4	....		..	..	0	10	Widening of line.
18	,, 22 ..	23	92·4	....		..	..	0	30	Slight.
19	,, 28 ..	6	16·3	....		..	..	0	20	Widening of line.
20	,, 28 ..	9	40·5	9	59·5	0·5	0·3	0	40	
21	,, 28 ..	13	54·9	....		..	..	..		Single marks.
		14	13·9							
22	,, 28 ..	14	53·4	15	20·0	1·5	0·8	3	00	P. Ts. 7½m.
					23·1	1·3	0·7			
					26·2	1·3	0·7			
23	April 7 ..	13	19·3	13	20·0	0·6	0·3	0	15	
24	,, 12 ..	18	53·5	....		2·0	1·5	..		Dislocation to W. Earthquake felt and heard.
25	,, 17 ..	20	19·0	....		..	..	0	18	Widening of line. Earthquake felt at Simla and strongly at Srinagar.
26	,, 19 ..	2	39·0	3	00·4	0·8	0·6	1	50	Guatemala earthquake.
					06·7	0·5	0·4			
					10·8	0·5	0·4			
					47·2	0·4	0·3			
					52·3	0·5	0·4			
27	,, 21 ..	17	40·2	17	57·4	1·0	0·7	1	30	P. Ts. 10m.
28	,, 23 ..	5	34·0	....		..	..	..		Slight.
29	,, 29 ..	3	46·6	....		..	..	..		? Single marks.
		3	49·7							
		6	06·2							
		6	13·4							
30	,, 30 ..	14	16·6	....		..	..	..		? Do.
			18·6							

Kodaikánal Observatory seismological records—*cont.*

No.	Date.	Commencement, G.M.T.	Maxima, G.M.T.	Amplitude.		Duration.	Remarks.
	No record May 7d. 9h. 30m. to May 9d. 9h. 25m.						
	1902.	H. M.	H. M.	MM.	SECONDS.	H. M.	
31	May 12 ..	14 12·1	14 13·9	0·5	0·3	0 05	
34	,, 25 ..	17 30·8	...	..	..	0 20	Slight.
35	,, 26 ..	8 56·4	9 01·7	0·8	0·3	0 12	
36	,, 31 ..	4 54·4	4 54·4	1·0	0·4	0 05	Single.
37	June 4 ..	12 41·0	....	..	.	..	Slight.
38	,, 6 ..	18 47·2	18 47·8 49·4	1·0 0·6	0·5 0·3	} 0 08	
39	,, 11 ..	6 42·1	6 47·3 51·4	1·0 0·6	0·5 0·3	} 0 40	P. Ts. 4m.
40	,, 16 ..	1 46·2	1 47·2	0·8	0·4	0 15	Felt at Naini-Tal.
42	,, 16 ..	22 52·4	23 02·6	0·5	0·2	0 12	
46	,, 28 ..	14 29·8	(—)	(—)	(—)	0 20	Slight.

No.	Date.	Earthquake records.			Kodaikánal.			Remarks.
		P.T. commencement G.M.T.	L.W. Commencement G.M.T.	Maxima G.M.T.	End, G.M.T.	Maxima, Amplitude.	Duration.	
	1902.	H. M.	H. M.	H. M.	H. M.	MM. SEC.	H. M.	
49	July 5 ..	15 31·3	15 35·4	15 37·0	15 46·0	0·4 0·3	0 15	
50	,, 6 ..	13 27·7	14 08·7	14 11·8	15 34·0	0·6 0·3	2 06	
51	,, 9 ..	3 48·3	3 55·6	3 56·7	4 14·2	1·2 0·6	0 26	Bunder Abbas earthquake.
52	,, 19 ..	..	13 23·1	..	..	..	0 06	Slight.
53	,, 19 ..	..	17 25·7	17 27·2	..	0·5 0·2	0 06	
54	Aug. 2 ..	..	23 41·0	..	..	..	0 03	Very slight.
54A	,, 3 ..	..	2 00·5	..	..	..	0 03	Do.
55	,, 3 ..	17 07·7	17 11·8	17 12·0	?	0·3 0·2	?	
56	,, 7 ..	12 00·7	12 07·0	12 07·9	..	0·7 0·3	..	
				11·1	12 19·9	1·0 0 5	0 19	
57	,, 12 ..	..	4 05·8		..	..	..	Slight.
58	,, 21 ..	11 30·7	11 34·6	11 35·0	12 09·0	0·6 0·3	0 38	Many small maxima.
59	,, 22 ..	3 04 8	3 09·9	3 14·0	..	11·0 4·9	..	
				16·6	to 3 25·4 off the scale at intervals.			
				39·5	6 45·0	8·0 3·9	3 40	Kashgar earthquake.
60	,, 23 ..	..	..	13 13·1	..	..	..	Widening of line.
				14 05·8	..	..	0 03	
61	,, 24 ..	1 41·1	2 03·7	2 04·8	2 21·2	2·6 1·1	0 40	
62	,, 29 ..	..	15 20·2	15 21·2	15 27·4	0·5 0·2	0 07	

Kodaikánal Observatory seismological records—*cont.*

No.	Date.	Earthquake records.			Kodaikánal.			Remarks.
		P.T. commencement G.M.T.	L.W. commencement G.M.T.	Maxima G.M.T.	End, G.M.T.	Maxima Amplitude.	Duration.	
	1902.	H. M.	H. M.	H. M.	H. M.	MM. SEC.	H. M.	
63	Aug. 30 ..	21 59·5	22 03·2	22 05·7	22 59·5	8·0 3·8	1 00	
64	Sept. 6 ..	4 44·1		4 54·9	5 06·7	0·5 0·2	0 23	Earthquake ?
65	„ 16 ..	..	11 21·4	11 22·5	11 34·9	0·3 0·2	0 13	
66	„ 18 ..	..	19 06·9	19 08·0	19 11·0	0·3 0·2	0 04	
67	„ 19 ..	..	5 01·2	5 02·8	..	11·2 5·6	..	
				29·7	5 48·0	9·5 5·1	0 47	
68	„ 20 ..	6 40·5	6 43·1	6 48·1	6 58·5	0·4 0·2	0 18	Felt in Srinagar.
69	„ 22 ..	1 57·5	2 0·68	2 22·8	3 56·5	1·0 0·6	1 59	Many small maxima.
70	„ 22 ..	10 17·1		10 19·2	..	0·2	0 10	
71	„ 23 ..	20 39·0	21 38·0 ?	21 46·2	22 47·0	1·1 0·7	2 08	
72	Oct. 6 ..	?	?	8 48·0 ?	10 00·2	2·0 ?	?	New sheet started 9 hours 26 minutes. This earthquake damaged the Chitral fort.
73	Nov. 1 ..	..	..	9 41·0	..	..	..	Widening of line.
74	„ 4 ..	..	11 44·0	11 45·5	..	1·5 0·8	..	
				47·5	..	4·5 2·4	..	Sudden disturbance.. No P. T. S.
				49 2	12 23·5	2·0 1·1	0 39·5	
75	„ 11 ..	..		18 46·2	..	..	..	Widening of line.
76	„ 13 ..	..		8 05·4	..	0·5 0·3	..	Do. (elongated).
77	„ 15 ..	..		9 59·8	..	..	..	
				10 10·2	..	..	0 10·4	
78	„ 20 ..	..	20 50·9	20 50·9	..	..	..	
				59·5	21 40·5	0·5 0·2	0 49·6	
79	„ 21 ..	7 10·0	7 17·8	7 33·3	8 01·8	0·75 0·4	0 51·8	
80	Dec. 13 ..	..		9 19·5	..	..	..	Widening of line.
81	„ 13 ..	17 11·7	17 16·8	17 16·8	..	1·2 0·6	..	
				20·4	17 52·1	2·0 1·1	0 40·4	
82	„ 16 ..	5 18·8	5 23·5	5 23·5	..	2·5 1·1	..	Andijan destroyed by this earthquake.
				26·0	6 11·7	1·0 0·5	0 52·9	
83	„ 18 ..			17 20·8	..	..	..	
				20 12·7	..	..	..	
	„ 19 ..	..	..	0 45·1 1 59·4 2 16·3 3 35 7	..	..	..	Marks exactly similar to hour marks.
84	„ 21 ..	..	..	0 32·1	..	..	..	Widening of line.
85	„ 28 ..	2 01·0	2 04·6	2 06·6	..	0·75 0·4	..	Continuous undulating upheaval of earth in Andijan and adjoining districts.
				10·8	2 17·2	1·75 0·9	0 16·2	

Appendix II.

MEAN monthly and annual meteorological results at the Kodaikánal Observatory in 1902.

—	Barometer.		Dry bulb thermometer.				Wet bulb.		Tension of vapour.	Relative humidity.	Sun Max. in vac	Min. on grass.	Wind.			Rain.		Clear sky.	Bright sunshine.
	Reduced to 32°.	Daily range.	Mean.	Max.	Min.	Range.	Mean.	Min.	By Blanford's tables.				Daily velocity.	Mean direction.		Amount.	Days.		
	Inches.	Inches.	°	°	°	°	°	°	Inches.	Cents.	°	°	Miles.	Points.	Points.	Inches.	No.	Cents.	Hours.
January	22·828	0·071	51·6	60·3	45·6	14·7	45·1	39·9	0 241	63	112·6	36·5	402	5	NE by E	8·61	6	84	230·9
February	·901	·071	54·0	65·0	46·9	18·1	46·0	39·3	·234	56	122·9	39·2	327	7	E by N	1·66	3	69	228·6
March	·850	·069	57·7	68·3	50·9	17·5	48·8	42·3	·260	55	130·5	43·0	317	7	E by N	3·43	5	70	245·7
April	·835	·074	59·6	70·0	52·9	17·1	53·8	47·4	·361	70	137·5	45·0	240	7	E by N	4·33	8	48	201·1
May	·825	·071	61·1	70·4	55·5	14·9	55·9	51·0	·397	74	136·4	51·3	218	2	NNE	3·95	14	43	185·7
June	·790	·056	58·4	66·2	53·9	12·3	53·9	49·5	374	76	133·3	48·3	313	30	NNW	3·67	8	35	185·2
July	·761	·055	56·7	62·8	53·1	9·7	53·6	49·8	·381	83	121·0	49·8	427	26	WNW	3·73	14	19	86·2
August	·771	·064	57·2	64·2	53·4	10·8	54·4	50·6	·398	85	126·7	48·2	260	30	NNW	4·01	6	23	112·3
September	·796	·068	56·9	64·0	52·8	11·2	53·7	49·3	·383	82	127·6	48·9	342	28	NW	3·07	9	28	106·1
October	·844	·074	55·3	62·4	51·1	11·3	53·4	49·4	·392	89	123·3	47·5	317	8	E	16·85	21	32	106·6
November	·849	·069	54·6	61·5	50·5	11·0	52·7	48·0	·391	90	123·4	46·1	311	3	NE by N	9·38	16	35	73·9
December	·833	·078	54·1	60·8	49·4	11·5	50·9	46·8	·345	82	111·3	43·8	317	2	NNE	9·84	13	45	124·9
Annual ..	22·824	0·068	56·4	64·7	51·3	13·3	51·8	46 9	0·346	75	125·5	45·6	~~361~~ 311	2	NNE	72·53	123	44	153·1

EXTREME monthly meteorological records at the Kodaikánal Observatory in 1902.

—	Barometer.					Dry bulb thermometer.				Wet bulb.		Humidity.		Sun. Th. in vacuo.		Grass therm.		Wind.				Rain.	
	Highest.		Lowest.		Range.	Highest.		Lowest.		Lowest.		Lowest.		Highest.		Lowest.		Highest.		Lowest.		Greatest fall.	
	Inches	Day.	Inches.	Day.	Inches.	°	Day.	°	Day.	°	Day.	Cents.	Day.	°	Day.	°	Day.	Miles.	Day.	Miles.	Day.	Inches.	Day.
January	22·918	9	22·751	4	0·167	68·5	28	**39·4**	**26**	**30·2**	**26**	**7**	**17**	128·4	19	**27·2**	**25**	539	6	207	9	**4·08**	**8**
February	**·989**	**17**	·786	1	·203	71·1	2	43·5	10	34·5	5, 6	**7**	**5**	134·6	19	29·3	1	544	4	168	22	0·74	14
March	·923	16	·782	6	·141	~~75·2~~	**23**	45·3	6	36·0	5	15	5	143·8	23	32·1	5	562	7	169	10	1·17	28
April	·916	2	·753	22	·163	74·1	28	49·0	2	40·5	1	21	27	145·2	17	37·4	2	472	1	164	3	1·59	5
May	·896	11	·756	25	·140	75·2	7	52·7	17	48·2	2	38	7	144·5	7	45·9	13	316	22	157	16	0·42	15
June	·869	3	·705	10	·164	70·3	2	51·0	21	44·0	15	50	15	**145·3**	**2**	42·8	6	604	11	124	5	1·10	29
July	·886	22	**·660**	**11**	·226	67·8	27	51·2	22	43·1	28	49	28	144·4	23	42·2	21	681	12	161	19	0·46	19
August	·850	28	·702	19, 23	·148	67·5	11	50·9	29	44·1	29	53	29	142·7	3	43·8	29	467	6	145	13	2·16	24
September	·884	30	·710	13	·174	67·2	4	51·1	7	42·0	22	38	21	141·9	4	42·3	25	662	7	153	27	0·98	17
October	·960	12	·708	28	·252	67·5	1	46·7	21	37·3	21	37	21	145·0	14	37·2	21	626	28	152	12	1·61	27
November	·945	21	·745	1	·200	67·1	24	47·2	30	39·4	14	28	16	135·2	15	36·4	14	534	18	170	14	1·49	21
December	·944	18	·730	5	·214	67·1	30	42·2	29	38·9	30	11	30	129·2	18	30·1	31	**700**	**2**	**94**	**8**	3·21	4

Appendix III.

KODAIKÁNAL.—Mean hourly wind velocity for the year 1902.

—	Hours.																								Total.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
January	19	19	18	18	18	18	18	18	18	19	18	17	17	16	13	12	12	12	13	14	15	15	17	19	393
February	14	14	14	14	14	15	16	16	15	17	17	16	15	14	13	12	11	10	10	11	11	12	13	14	328
March	13	14	15	15	14	15	15	15	16	17	16	17	15	13	12	11	10	9	9	11	11	10	12	13	318
April	11	11	16	11	10	10	10	10	11	12	12	12	10	10	9	9	8	8	9	10	10	9	9	9	246
May	10	10	10	9	9	9	9	9	10	10	10	10	10	9	10	11	9	7	7	7	8	8	8	9	218
June	13	14	13	13	14	14	13	13	15	15	14	13	12	12	11	11	11	12	14	14	13	13	13	13	313
July	20	20	21	20	19	17	17	15	15	17	17	15	16	16	16	16	16	18	18	19	20	19	20	20	427
August	10	11	11	12	11	11	11	10	11	11	11	10	12	12	12	11	9	11	11	10	11	10	9	10	260
September	15	16	17	17	18	17	14	15	14	15	15	14	14	13	13	13	12	12	12	12	13	13	14	14	342
October	13	14	15	15	15	14	14	14	15	15	13	13	13	13	12	12	12	11	12	13	12	13	12	13	317
November	13	13	13	13	13	14	15	15	14	15	15	13	13	13	11	12	11	10	11	12	14	14	14	14	311
December	14	13	13	13	13	13	14	13	13	14	15	15	14	14	13	13	12	12	12	12	12	13	13	13	317
Means ..	14	14	14	14	14	14	14	14	14	15	14	14	14	13	12	12	11	11	12	12	12	12	13	13	316

Appendix IV.

KŏDAIKÁNAL.—Mean hourly bright sunshine for 1902.

—	Hours.													Total.
	5-6.	6-7.	7-8.	8-9.	9-10.	10-11.	11-12.	12-13.	13-14.	14-15.	15-16.	16-17.	17-18.	18-19.	
January	..	0·05	0·75	0·81	0·77	0·76	0·76	0·75	0·72	0·69	0·68	0·63	0·05	..	7·4
February	..	·06	·71	·80	·87	·91	·85	·85	·85	·76	·68	·63	·20	..	8·2
March	..	·15	·75	·87	·88	·90	·86	·87	·75	·62	·55	·55	·19	..	7·9
April	..	·10	·72	·83	·92	·94	·93	·76	·55	·37	·31	·23	·06	..	6·7
May	..	·08	·62	·87	·94	·93	·84	·59	·50	·31	·19	·09	·02	..	6·0
June	..	·01	·52	·69	·64	·62	·48	·47	·43	·25	·19	·16	·03	..	4·5
July	..	·05	·31	·44	·39	·39	·33	·28	·19	·15	·16	·07	·02	..	2·8
August	..	·16	·41	·56	·51	·51	·46	·36	·30	·19	·09	·07	·01	..	3·6
September	..	·06	·40	·52	·56	·54	·49	·41	·20	·13	·12	·09	·03	..	3·6
October	..	·02	·37	·48	·55	·54	·45	·30	·25	·20	·15	·12	·03	..	3·5
November	..	·00	·20	·38	·31	·28	·30	·31	·28	·15	·11	·06	·00	..	2·3
December	..	·00	·27	·36	·51	·52	·48	·48	·40	·41	·32	·19	·00	..	3·9
Sums ..	..	0·74	6·03	7·61	7·85	7·84	7·23	6·43	5·37	4·23	3·55	2·89	0·64	..	60·4
Means ..	..	0·06	0·50	0·63	0·65	0·65	0·60	0·54	0·45	0·35	0·30	0·24	0·05	..	5·0

Appendix V.

KODAIKÁNAL OBSERVATORY.—Number of days in each month on which the Nilgiris were visible.

Month.	Very clear.	Visible.	Just visible.	Tops only visible.	Total.
January	2	12	6	1	21
February	..	4	3	3	10
March	2	4	3	2	11
April	..	1	4	..	5
May	3	1	4	1	9
June	4	10	5	2	21
July	5	6	4	3	18
August	6	10	7	1	24
September	3	13	7	1	24
October	10	3	2	2	17
November	8	3	..	4	15
December	4	12	3	..	19
Total ..	46	79	48	20	193

14

Appendix VI.

MEAN monthly and annual meteorological results at the Periyakulam Observatory in 1902.

—	Barometer.		Dry bulb thermometer.				Wet bulb.		Tension of vapour.	Relative humidity.	Sun Max. in vac.	Min. on grass.	Wind.			Rain.		Clear sky.
	Reduced to 32°.	Daily range.	Mean.	Max.	Min.	Range.	Mean.	Min.	By Blanford's tables.				Daily velocity.	Mean direction.		Amount.	Days.	
	Inches.	Inches.	°	°	°	°	°	°	Inches.	Cents.	°	°	Miles.	Points.	Points.	Inches.	No.	Cents.
January	29·013	0·137	73·1	85·3	62·2	23·1	65·4	60·2	0·527	64	133·2	54·4	43·2	2	NNE	2·63	6	65
February	·071	·148	76·3	90·5	62·7	27·8	66·1	59·5	·508	55	144·9	54·1	60·3	6	ENE	0·12	1	63
March	28·945	·156	81·6	95·8	68·2	27·6	71·2	64·9	·630	56	151·4	60·4	67·2	4	NE	1·40	4	75
April	·896	·152	85·3	98·2	74·0	24·2	75·4	70·8	·750	62	156·3	68·2	59·2	1	N by E	1·34	2	51
May	·861	·130	84·4	99·4	74·0	25·4	75·0	70·9	·747	63	157·5	70 0	66·5	31	N by W	3·61	9	49
June	·855	·112	82·7	96·5	72·4	24·1	72·8	69·2	·672	60	155·6	68·0	92·1	15	S by E	1 51	4	50
July	·847	·104	80·7	92·3	72·1	20·2	72·0	69·0	·668	64	150·7	68·2	87·6	16	S	1·31	4	30
August	·853	·122	82·3	95·5	72·7	22·8	72 5	69·1	·668	60	157·1	68·2	85·0	17	S by W	1·57	2	46
September	·894	·121	81·8	94·9	72·2	22·7	72·1	68·7	·660	61	157·5	67·6	78·4	11	S E by E	0·90	2	38
October	·978	·129	78·2	88·1	71·5	16·6	72·5	69·6	·725	75	144·4	69·2	47·4	11	S E by E	8·92	15	36
November	·995	·118	76·7	84·8	70·5	14·3	71·7	68·7	·711	77	139·8	68·1	44·7	15	S by E	7·09	9	31
December	·994	·125	75·6	84.1	69·4	14·7	70·9	67·4	·696	78	135·6	67·2	32·7	12	SE	6·85	6	34
Annual ..	28·934	0·130	79·9	92·1	70·1	22·0	71·5	67·4	0·664	65	148·8	65·3	63·7	9	E by S	37·25	14	4·7

EXTREME monthly meteorological records at the Periyakulam Observatory in 1902.

—	Barometer.					Dry bulb thermometer.				Wet bulb.		Humidity.		Sun Th. in vacuo.		Grass therm.		Wind.				Rain.	
	Highest.		Lowest.		Range.	Highest.		Lowest.		Lowest.		Lowest.		Highest.		Lowest.		Highest.		Lowest.		Greatest Fall.	
	Inches.	Day.	Inches.	Day.	Inches.	°	Day.	°	Day.	°	Day.	Cents.	Day.	°	Day.	°	Day.	Miles.	Day.	Miles.	Day.	Inches	Day.
January ..	29·143	9	28·893	22	0·250	91·1	23	**55·1**	**30**	**50·4**	**25**	**22**	**25**	151·8	19	**42·3**	**25,26**	97·6	26	16·8	7	1·24	8
February ..	**·205**	**7**	·896	27	·310	95·5	27	57·5	1	54·3	4	24	1	156·9	15	46 4	1	109·0	5	31·6	2	0 12	15
March ..	·072	16	·756	21	·316	100·9	22	57·2	3	53·6	3	24	20	164·8	28	44·1	3	107·5	4	42·6	28	0·61	10
April ..	·037	2	·734	21,22	·303	**102·3**	**21**	68 5	3	66·6	1, 3	28	1	164 8	28,29	62·5	1	111·2	3	28·6	4	0·77	23
May ..	28·964	3	·707	25	·257	101·8	9, 10	71 1	13	67·9	13	27	1	**168·8**	**9**	66·2	27	118·5	17	41·3	5	0·92	22
June ..	·993	20	·722	11	·271	100·7	1, 2	69·5	21	66·4	15	37	1, 7, 19	165·0	24	63·7	25	170 5	14	31·8	21	0·53	27
July ..	29·012	22	**·695**	**11**	·317	98·7	26	67·0	28	62·9	28	35	8, 26,27	164·9	6	59·7	28	**172·7**	**5**	12 9	13	0·39	24
August ..	28·978	27	·708	19	·270	99·8	12	68·5	29	64·5	29	34	12	166·8	26	61·5	29	136·3	29	31·8	17	1·09	15
September ..	29·009	30	·777	22	·232	99·1	21	68·5	22	64·4	4	35	21, 22	166·1	11	62 1	22	143·8	12	39·2	19	0·46	30
October ..	·117	6	·785	30	·332	96·7	2	65·5	21	62·5	21	33	20	164·7	5	60·4	21	128·6	24	**9·0**	**29**	1·07	28
November ..	·149	21	·817	1	·332	87·7	4, 14	64·9	24	63·5	24	56	16, 23	151 3	11	59·3	24	84·6	29	15·3	18	**2·43**	**2**
December ..	·165	28	·830	5	·335	87·2	18	57·2	30	55 4	30	47	29	146·8	11	50·5	30	63·1	1	13·2	12	1·51	**5**

Appendix VII.

ABSTRACT of the mean meteorological condition of Madras in 1902 compared with the average of past years.

Mean values of	1902.	Difference from	Average.
Reduced atmospheric pressure	29·875	0·011 above.	29·864
Temperature of air	82·0	0·9 ,,	81·1
Do. of evaporation	76·0	1·5 ,,	74·5
Percentage of humidity	76	4 ,,	72
Greatest solar heat in *vacuo*	135·8	3·9 below.	139·7
Maximum in shade	91·0	0·2 above.	90·8
Minimum in shade	75·4	0·7 ,,	74·7
Do. on grass	73·5	1·6 ,,	71·9
Rainfall since January 1st on 103 days	54·44	5·42 ,,	49·02
General direction of wind	S.E.	Same as	S.E.
Daily velocity in miles	161	10 below.	171
Percentage of clear sky	46	5 ,,	51
Do. of bright sunshine	45·0	13·4 ,,	58·4

DURATION and quantity of the wind from different points.

From	Hours.	Miles.	From	Hours.	Miles.	From	Hours.	Miles.	From	Hours.	Miles.
North ..	144	1,174	East ..	294	1,259	South ..	183	1,371	West. .	140	1,239
N. by E. ..	273	1,682	E. by S. ..	411	1,859	S. by W. ..	280	1,987	W. by N. ..	307	2,306
N.N.E. ..	229	1,727	E.S.E. ..	210	1,214	S.S.W. ..	212	1,583	W.N.W. ..	118	700
N.E. by N. ..	382	2,636	S.E. by E.	481	2,454	S.W. by S.	266	1,897	N.W. by W.	57	338
N.E. ..	376	2,507	S.E. ..	193	1,149	S.W. ..	148	1,007	N.W. ..	7	57
N.E. by E.	446	2,680	S.E. by S.	896	7,334	S.W. by W.	240	1,703	N.W. by N.	26	114
E.N.E. ..	253	1,452	S.S.E. ..	514	4,761	W.S.W. ..	218	1,633	N.N.W. ..	70	336
E. by N. ..	451	2,299	S. by E. ..	426	3,542	W. by S. ..	268	2,212	N. by W. ..	110	748

There were 131 calm hours during the year. The resultant corresponding to the above numbers is represented by a S.E. wind, blowing with a uniform daily velocity of 47 miles.

Appendix VIII.

MADRAS OBSERVATORY.—Number of hours of wind from each point in the year 1902.

Month.	N.	1	2	3	4	5	6	7	E.	9	10	11	12	13	14	15	S.	17	18	19	20	21	22	23	W.	25	26	27	28	29	30	31	Calm.
January	..	35	59	86	72	109	37	117	96	36	24	64	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9
February	..	..	11	19	19	107	94	195	59	84	8	4	21	10	23	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	15
March	..	..	..	13	17	10	1	25	33	105	47	60	48	241	83	14	7	13	10	5	2	..	..	..	..	..	..	..	..	..	..	..	10
April	..	..	..	..	..	..	..	..	..	2	26	72	14	344	147	53	13	17	14	5	1	2	1	..	..	..	..	..	..	..	..	..	9
May	..	..	1	1	..	1	..	1	..	4	20	32	21	167	130	119	24	33	39	35	23	24	18	18	5	13	6	3	..	2	..	..	4
June	10	4	2	2	3	..	1	5	4	39	15	37	9	57	40	56	26	37	36	45	27	18	33	44	24	74	24	23	4	6	7	5	3
July	10	..	1	..	..	..	1	2	1	1	8	16	9	21	47	60	36	69	44	58	41	57	68	85	50	32	17	1	1	1	..	5	2
August	..	..	1	..	1	..	2	3	5	8	23	31	7	21	27	65	31	35	47	68	18	68	58	49	29	119	20	3	..	2	..	..	3
September	1	11	..	..	..	..	..	..	..	11	20	35	14	23	11	44	23	60	14	48	34	69	38	64	32	62	47	23	1	3	12	..	20
October	5	36	13	41	51	61	41	27	51	61	13	104	49	12	5	13	18	6	8	2	2	2	2	8	..	7	4	4	1	12	46	8	31
November	66	114	64	96	98	53	27	53	36	9	2	3	1	..	1	1	3	10	..	..	..	..	..	..	..	..	..	..	..	..	5	69	9
December	52	73	77	124	115	105	49	23	9	51	4	23	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	23	16
Annual ..	144	273	229	382	376	446	253	451	294	411	210	481	193	896	514	426	183	280	212	266	148	240	218	268	140	307	118	57	7	26	70	110	131

Appendix IX.

MADRAS OBSERVATORY.—Number of miles of wind from each point in the year 1902.

Month.	N.	1	2	3	4	5	6	7	E.	9	10	11	12	13	14	15	S.	17	18	19	20	21	22	23	W.	25	26	27	28	29	30	31	Total.
January	..	289	413	501	377	772	339	578	391	150	69	205	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4084
February	..	..	31	169	136	540	544	959	242	357	20	8	82	70	112	9	14	..	..	..	..	..	..	..	..	..	..	..	.	..	..	..	3293
March	..	..	..	39	100	69	9	149	135	493	260	293	303	1602	754	160	72	126	99	47	12	..	..	..	..	..	..	..	..	..	..	..	4722
April	..	..	..	..	..	..	..	..	..	17	164	394	79	3023	1281	541	135	176	132	46	5	15	6	..	..	..	..	..	..	..	..	..	6014
May	..	..	12	9	..	9	..	9	..	39	121	267	215	1641	1422	1118	217	310	319	273	177	217	156	163	41	122	62	22	..	18	..	..	6959
June	36	28	17	17	25	..	10	48	42	259	126	309	76	521	438	475	190	332	275	328	183	159	299	466	250	806	232	168	38	32	60	31	6276
July	36	..	2	..	..	..	4	19	11	9	66	113	56	190	377	501	266	446	296	454	306	449	506	755	507	299	98	2	5	6	..	27	5806
August	..	..	11	..	6	..	19	37	46	43	160	173	51	123	215	383	218	225	304	468	119	432	403	405	212	682	112	28	..	12	..	..	4887
September	4	60	..	..	..	..	..	..	..	41	105	186	81	111	103	254	155	303	94	265	194	423	255	399	229	371	176	110	10	18	41	..	3988
October	40	151	112	226	258	321	194	161	221	207	86	418	199	53	53	96	98	45	64	16	11	8	8	24	..	26	20	8	4	28	187	46	3389
November	593	638	418	829	817	422	139	256	116	48	12	7	7	..	6	5	6	24	..	..	..	..	..	..	..	..	..	..	..	..	48	522	4913
December	465	516	711	846	788	547	194	83	55	196	25	81	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	122	4629
Annual ..	1174	1682	1727	2636	2507	2680	1452	2299	1259	1859	1214	2454	1149	7334	4761	3542	1371	1987	1583	1897	1007	1703	1633	2212	1239	2306	700	338	57	114	336	748	58960

Appendix X.

MADRAS OBSERVATORY.—Number of inches of rain from each point in the year 1902.

Month.	N.	1	2	3	4	5	6	7	E.	9	10	11	12	13	14	15	S.	17	18	19	20	21	22	23	W.	25	26	27	28	29	30	31	Calm.
January	..	..	..	..	..	6·01	0·03	0·74	0·50	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
February	..	..	..	..	..	0·05	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
March	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
April	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·02	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
May	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0 17	..	..	..	..	..	..	..	..	..	..
June	..	0·05	0·01	..	..	..	..	..	..	0 01	..	..	..	..	..	0·01	0·01	0·01	0·02	..	0·01	..	0·11	..	..	0·03	0 06	0·05	..	..		..	0·01
July	..	..	..	..	..	..	..	..	..	..	..	0·02	..	0 03	0·02	0·21	0·06	0·79	0·74	0·65	0·02	0·12	·55	0·38	..	..	0·65	..	..	..	..	..	..
August	..	..	..	..	..	..	..	..	..	..	0·04	0·03	0·01	..	..	0·22	..	0 02	0·01	0·24	0·04	0·10	0·01	1·39	0·11	0·96	0·06	0·02	..	..	..	..	..
September	..	..	..	..	..	..	..	..	..	0 16	0 23	0 68	..	..	..	0 03	..	0·05	..	0·15	0·13	0·09	0·13	0·14	0·20	0·37	1·26	0·09	0·46	..	0·44	0·04	..
October	0·64	0·80	1·87	3·43	1·33	1·21	1·57	0·93	0 04	0·40	0·32	0 63	0·88	0 02	..	0·76	0 03	0·13	0·21	0·97	..	..	..	0 40	..	0·14	..	..	..	1 01	0·56	2·41	..
November	0·60	1·27	0·37	0·47	2·12	0·26	0·33	1·65	1·85	0·36	0·48	0·19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·56	..
December	2·47	0·01	0·11	0·33	0·95	0·04	0·16	0·18	1·28	1·60	1·98	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·07	..
Annual ..	3·71	2·13	2·36	4·23	4·40	1·57	2·09	3·50	3·67	2·53	3·05	1·55	0 89	0·05	0 02	1·25	0 10	1·00	0·98	2·01	0·20	0·31	0·97	2·31	0·31	1·50	2·03	0 16	0·46	1·01	1·00	3·08	0·01

Appendix XI.

MADRAS OBSERVATORY.—Wind, cloud, bright sunshine and evaporation.

Month.	Wind resultant.		Clouds (0—10).					Bright sunshine.		Amount of evaporation.
	Velocity.	Direction.	8 H	10 H	16 H	20 H	Mean.	Average per day.	Greatest number of hours in a day.	Average per day.
1902.										
January	115	N.E. by E.	2·6	3·9	2·6	2·1	2·8	7·7	9·9	0·143
February	104	E. by N.	2·2	3·3	2·6	1·6	2·4	8·6	10·0	0·162
March	129	S.E.	1·8	2·3	1·5	1·0	1·6	7·6	9·6	0·191
April	178	S.S.E.	4·3	4·1	3·1	2·2	3·4	8·2	10·8	0·270
May	177	S. by E.	3·5	3·2	3·3	2·7	3·2	6·5	9·8	0·295
June	69	S.W.	4·8	4·6	6·1	5·0	5·1	4·7	7·3	0·298
July	128	S.W.	6·4	6·8	6·8	6·4	6·6	3·7	7·2	0·249
August	98	S.W.	6·7	6·7	6·8	5·7	6·5	3·4	8·4	0·217
September	79	S.W.	6·5	5·7	6·5	5·8	6·1	3·8	7·6	0·150
October	60	E. by N.	6·0	6·4	5·4	3·5	5·3	4·5	9·1	0·148
November	142	N.E. by N.	5·9	6·6	6·3	5·1	6·0	3·6	8·0	0·153
December	132	N.E. by N.	6·1	6·3	5·7	5·2	5·8	3·2	7·4	0·131
Annual ..	47	S.E.	4·7	5·0	4·7	3·9	4·6	5·5	..	..

Appendix XII.

MEAN monthly and annual meteorological results at the Madras Observatory in 1902.

	Barometer.		Dry bulb thermometer.				Wet bulb.	Tension of vapour.	Relative humidity.	Sun Max. in vac.	Min. on grass.	Wind.			Rain.		Clear sky.	Bright sunshine.	General weather.
	Reduced to 32°.	Daily range.	Mean.	Max.	Min.	Range.	Mean.	By Blandford's tables.				Daily velocity.	Mean direction.		Amount.	Days.			
	Inches.	Inches.	°	°	°	°	°	Inches.	Cents.	°	°	Miles.	Points.	Points.	Inches.	No.	Cents.	Hours.	
January	29·984	·119	75·4	83·9	67·8	16·1	70·6	0·686	78	133·5	64·7	132	6	E N E	1·28	3	72	238·0	..
February	30·048	·119	76·9	86.4	67·3	19·1	71·3	·692	75	136·8	63·9	118	7	E by N	0·05	1	76	242·1	..
March	29·889	·122	81 2	90·3	72·7	17·6	75·6	·813	76	139·3	69·9	152	11	SE by E	..	..	84	234·2	..
April	·824	140	84·9	93·4	78·3	15·1	78·5	·891	74	142·3	76 3	200	13	SE by S	0 02	1	66	246·6	..
May	·736	·118	88 5	100·5	82·2	18·3	79·6	·892	66	143·3	81·0	224	15	S by E	0·17	1	68	202·5	..
June	·727	·116	88·5	99 4	82·5	16·9	78·8	·855	64	139·4	81·2	209	19	SW by S	0 39	6	49	139·8	..
July	·704	·122	85·6	96·9	79·4	17·5	77·7	·842	69	138·5	78·1	187	19	SW by S	4·24	16	34	114·9	..
August	·728	·118	84·6	93·8	77·7	16·1	78·2	891	76	134 5	76·6	157	19	SW by S	3·26	14	35	106 0	..
September	·779	·127	83·0	92·3	76 9	15·4	77·9	·889	79	135·7	75·5	133	20	SW	4·65	16	39	113 6	..
October	·915	·116	80·4	87·9	73·9	14 0	76·3	·851	83	133·2	72·5	109	8	E	20·69	18	47	138·7	..
November	·950	·109	78·5	84·2	74·0	10 2	74·7	·811	83	127 1	72·1	164	3	NE by N	10·51	17	40	107·3	..
December	·956	·114	76·7	82 9	71·9	11·0	72·8	·762	83	125·7	69·6	149	4	NE	9·18	10	42	100 2	..
Annual ..	29·853	·120	82 0	91 0	75·4	15 6	76 0	·823	76	135·8	73·5	161	12	SE	54·44	103	54	165·3	..

EXTREME monthly meteorological records at the Madras Observatory in 1902.

	Barometer.					Dry bulb thermometer.				Humidity.		Sun Th. in vacuo.		Grass therm.		Wind.				Rain.	
	Highest.		Lowest.		Range.	Highest.		Lowest.		Lowest.		Highest.		Lowest.		Highest.		Lowest.		Greatest fall.	
	Inches.	Day.	Inches.	Day.	Inches.	°	Day.	°	Day.	Cents.	Day.	°	Day.	°	Day.	Miles.	Day.	Miles.	Day.	Inches	Day.
January	30·101	26	29 859	22	0·242	85·3	23, 27	63 0	31	50	16	140 3	8	58·9	22	289	7	61	29	1·24	5
February	**·186**	**17**	·890	26	·296	90·2	26	**62·2**	**6**	46	12	141·2	23	**58·2**	**6**	224	13	68	19	0·05	13
March	·012	1	·724	21	·288	94·3	18	65·9	3	49	6	147·9	27	62·2	3	235	12	85	1	..	..
April	29·969	2	·632	22	·337	98·0	22	73·9	4	40	22	148·8	18	70·6	4	292	21	105	6	0·02	22
May	·877	3	**·532**	**25**	·345	**108·0**	**8**	77·7	3	**32**	**18**	150·2	8	75·7	3	281	31	143	4	0·17	13
June	·931	20	·567	11	·364	107·8	5	74·5	20	**32**	**9, 15**	148·2	16	73·9	20	**297**	**3**	154	20	0·25	20
July	·897	22	·541	11	·356	101·9	26	74·5	2	37	8	149 0	5	72·1	2	236	16	134	3, 14	1·70	9
August	·844	28	·611	20	·233	100·3	3	72·9	25	49	18	**153·0**	**13**	72·4	25	224	18	96	4	1·95	4
September	·940	30	·629	1	·311	98·7	3	72·1	18	46	4, 25	151·3	27	70·7	18	204	1	87	27	1·16	18
October	30·077	12	·650	28	·427	92·7	18	68·6	20	36	19	147·7	12	65·2	20	234	29	63	25	**6·70**	**28**
November	·103	21	·769	1	·334	88·9	7	69·6	12	59	24	139·0	7	66·8	24	256	22	**59**	**2**	2·20	26
December	·131	29	·802	5	·329	86·3	11	63·9	29	49	28	140·1	25	59·0	29	265	1	66	18	4·36	3

Appendix XIII.

MADRAS OBSERVATORY.—Abnormals from monthly means for the year 1902.

—	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Reduced atmospheric pressure	— 0·013	+ 0·084	— 0·016	— 0·002	+ 0·001	+ 0·024	— 0·017	— 0·021	+ 0·002	+ 0·074	+ 0·027	— 0·022	+ 0·011
Temperature of air	+ 0·3	+ 0·2	+ 1·2	+ 0·9	+ 1·8	+ 2·1	+ 1·1	+ 0·7	Same as	— 0·2	+ 1·0	+ 1·2	+ 0·9
Do. of evaporation	+ 1·4	+ 0·5	+ 1·7	+ 0·9	+ 1·3	+ 2·2	+ 1·8	+ 2·2	+ 1·6	+ 0·7	+ 1·8	+ 2·2	+ 1·5
Percentage of humidity	+ 5	+ 2	+ 2	Same as	— 1	+ 2	+ 4	+ 6	+ 7	+ 5	+ 4	+ 6	+ 4
Greatest solar heat in vacuo	— 4·9	— 2·9	— 1·2	+ 0·6	+ 0·3	— 1·1	— 0·2	— 5·5	— 5·6	— 5·9	— 10·3	— 10·1	— 3·9
Maximum in shade	— 0·7	— 0·2	+ 1·1	+ 0·5	+ 2·7	+ 1·1	+ 1·3	+ 0·1	— 0·9	— 1·1	— 0·8	— 0·7	+ 0·2
Minimum in shade	+ 0·3	— 0·7	+ 0·6	+ 1·1	+ 1·4	+ 2·2	+ 0·9	+ 0·4	— 0·2	— 1·3	+ 1·7	+ 2·1	+ 0·7
Do. on grass	+ 1·6	+ 0·1	+ 1·3	+ 1·6	+ 2·1	+ 2·6	+ 1·5	+ 1·2	+ 0·5	— 0·3	+ 2·6	+ 3·2	+ 1·6
Rainfall in inches	+ 0·39	— 0·23	— 0·39	— 0·60	— 1·95	— 1·72	+ 0·37	— 1·30	— 0·04	+ 9·69	— 2·70	+ 3·90	..
Do. since January		+ 0·16	— 0·23	— 0 85	— 2·78	— 4·50	— 4·13	— 5·43	— 5·47	+ 4·22	+ 1·52	+ 5·42	+ 5·42
General direction of wind	1 point E.	1 point N.	1 point E.	Same as	Same as	Same as	1 point S.	Same as	2 points W.	1 point E.	1 point E.	2 points E.	Same as
Daily velocity	— 12	— 4	Same as	+ 9	— 3	— 11	— 11	— 17	— 23	— 14	+ 41	— 34	— 10
Percentage of clear sky	+ 9	Same as	+ 8	— 6	+ 6	+ 13	+ 5	+ 2	+ 1	+ 6	— 1	— 6	— 5
Do. of sunshine	— 6·7	— 8·1	— 15·9	— 6·2	— 15 9	— 10 3	— 3·4	— 13·6	— 12·7	— 14·1	— 20·8	— 28·5	— 13·4

+ Means above normal, — below.