KODAIKANAL AND MADRAS OBSERVATORIES.

REPORT FOR THE YEAR 1912.

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KODAIKANAL AND MADRAS OBSERVATORIES.

I.—REPORT OF THE KODAIKANAL OBSERVATORY FOR THE YEAR 1912.

Staff.—The staff of the Observatory on December 31, 1912, was as follows:—

Director	J. Evershed.
Assistant Director	T. Royds, D.Sc.
First Assistant	S. Sitarama Aiyar, B.A.
Second Assistant	G. Nagaraja Aiyar.
Third Assistant	A. Y. Subrahmanya Aiyar, B.A.
Fourth Assistant	S. Balasundaram Aiyar.
Writer	L. N. Krishnaswamy Aiyar.
Photographic Assistant	R. Krishna Aiyar.

The subordinate staff consists of a book-binder, an assistant book-binder, a mechanic, five peons, a boy peon for the dark room, and two lascars.

2. **Distribution of work.**—The Director and the Assistant Director have charge of the two spectroheliographs and of the large grating spectrograph. The First, Second, and Third Assistants are in charge of the work with the Cooke equatorial (spectroscopic), the Lerebour and Secretan equatorial (visual and photographic), and the transit instrument. They have also to do the astronomical computing and the preparation of the observations for the press. The Third Assistant has charge of the seismometer and clock comparisons. The Fourth Assistant, with the help of the Writer, is responsible for the whole of the meteorological work. The Writer is responsible for the accounts, correspondence, and all office records. The Photographic Assistant has charge of most of the photographic developing, printing, etc.

3. **Buildings and grounds.**—The electric installation was completed in February and the storage battery received its first charge on the 25th of the month. With the exception of some initial troubles with the gas engine which were soon remedied by Messrs. Siemens, the electric plant has worked satisfactorily throughout the year. The current is used for research work in which an electric arc is required for direct comparisons of metallic and solar spectra. The electric power is also used for pumping water, for lighting, and other minor purposes.

The new quarters for the photographic assistant were completed and occupied in August.

The Takhtasinghji Observatory at Poona was dismantled in February and the instruments were transferred to this observatory by order of the Government of India. The question of constructing a building for locating the 20-inch reflecting telescope is under correspondence with the Government of India and the Public Works Department. Provisional plans for the new building have been prepared by the Director.

The fire lines in the compound have been kept in good order and there was at no time any risk to the buildings and instruments from forest fires.

4. **Instruments.**—The following are the principal instruments belonging to the Observatory, or in use, at the present time:—

Six-inch Cooke equatorial.

Six-inch Lerebour and Secretan equatorial remounted by Grubb, with a five-inch Grubb portrait lens attached. The Lerebour and Secretan object glass has been replaced by a Cooke photo-visual lens of the same aperture and the instrument has been adapted for direct solar photography in addition to visual work.

Spectrograph I.—consisting of slit, collimator lenses of 4 and 7 feet focus, 2-inch parabolic grating, and camera tube without lens. Used in connection with an 11-inch polar siderostat and 6-inch Grubb lens of 40 feet focus.

Spectrograph II.—consisting of a collimator of 7 feet focus and camera of 14 fee focus placed at an angle of 60° with the former. Plane gratings of $3\frac{1}{4}$ inches or 5 inches ruled surface are used, and the slit is provided with various devices for the direct comparison of spectra from different sources, and for rotating the solar image.
Spectroheliograph—with 18-inch siderostat and 12-inch Cooke photo-visual lens of 20 feet focus, by the Cambridge Scientific Instrument Company.
An auxiliary spectroheliograph attached to the above, made in the Observatory workshop.
Six-inch transit instrument and barrel chronograph, formerly the property of the Survey of India.
Theodolite, six-inch—Cooke.
Sextant.
Evershed spectroscope with three prisms, for prominence and sunspot work, by Hilger.
Mean time clock, Kullberg 6326.
Do. Shelton.
Mean time chronometer, Kullberg 6299.
Sidereal chronometer, Kullberg 6134.
Tape chronograph, Fuess.
Two micrometers for measuring spectrum photographs, Hilger.
Dividing engine, Cambridge Scientific Instrument Company, Limited.
Milne horizontal pendulum seismograph.
Induction coil with necessary adjuncts.
Small polar siderostat.
Universal instrument.
Complete set of meteorological instruments, including Richard barograph and thermograph, and wind recorders.
A high class screw cutting turning lathe by Messrs. Cooke & Sons.
Angström Pyrheliometer.
An 18-inch concave mirror by Henry of Paris belonging to the Director is mounted in the spectroheliograph room for general spectrum work.

The instruments received from the Takhtasinghji Observatory at Poona include the following :—

Twenty-inch reflecting telescope, by Common.
Six-inch Cooke photo-visual telescope with equatorial mounting.
Two prisms of 6 inches aperture for use with the above.
Twelve-inch Cooke siderostat.
Eight-inch horizontal telescope.
Large grating spectroscope, by Hilger.
An ultra-violet spectrograph by Grubb.

OBSERVATIONS.

(a) Solar Physics.

5. The following table shows for each day the solar observations that were made :—

Table A.

Solar Observations in 1912.

A = Spots observed. B = Spot spectrum observed. C = Prominences observed. D = Photoheliograms taken. E = Spectroheliograms taken.

Dates.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ..	A— C D E	A— C D E	A— — D E	— — C D E	— — *C* D E	A— C D E	A— *C* D E	A— *C* D E	A— C D E	A— C D E	A— C D E	A— — — —
2 ..	A— C D E	A— *C* D E	A— C D E	— — *C* D E	— — C D E	A— *C* D E	A— C D E	A— — D *E*	A— C D E	A— *C* D E	A— C D E	A — *C* D E
3 ..	A— *C* D E	A— C D E	A — C D E	— — *C* D E	— — C D E	A— C D E	A— C D E	A— *C* D E	A— C D E	A— *C* D E	A— C D E	— — — — —
4 ..	A— C D E	A— C D E	A — C D E	— — — D *E*	— — C D E	A— *C* D E	A— C D E	A— *C* D E	— — *C* D *E*	A— *C* D E	A— C D E	A— — — *E*
5 ..	A— C D E	A— *C* D E	A — *C* D E	— — C D E	— — C D E	A— *C* D E	A— — D *E*	A— C D E	A— — D E	A— *C* D E	A— C D E	A— C D E
6 ..	A— C D E	A— C D E	A — *C* D E	— — — D *E*	— — C D E	— — — — *E*	A— *C* D *E*	A— C D E	A— *C* D E	A— — D *E*	A— C D E	A— C D E
7 ..	A— C D E	A— C D E	A— — D E	— — C D E	— — *C* D E	A— C D E	— — — — —	A— *C* D E	A— C D E	— — — — —	A— C D E	A— C D E
8 ..	A— C D E	A— C D E	— — C D E	— — C D E	— — C D E	A— C D E	A— — D E	A— — D E	A— *C* D *E*	A— — D E	A— — D *E*	A— C D E
9 ..	A— C D E	A— C D E	— — C D E	— — C D E	— — *C* D E	— — *C* D *E*	A— C D E	— — — — —	A— *C* D E	A— — D E	A— — D *E*	A— C D E
10 ..	A— C D E	A— C D E	— — C D E	— — C D E	— — C D E	— — — — —	A— — D *E*	A— *C* D E	A— *C* D E	A— — D E	A— C D E	A— C D E
11 ..	A— C D E	A— C D E	A— C D E	— — C D E	— — C D E	A— *C* D *E*	A— C D E	A— *C* D E	A— C D E	A— — D E	A— C D E	A— *C* D E
12 ..	A— C D E	A— C D *E*	A— C D E	— B *C* D E	— — C D E	A— — D *E*	A— — D *E*	A— — D *E*	A— C D E	A— — D E	A— C D E	A— *C* D E
13 ..	A— C D E	A— *C* D E	A B C D E	— — C D E	— — *C* D E	— — *C* D *E*	— — — — *E*	A— — D *E*	— — — — *E*	A— — D E	A— C D E	— — — — —
14 ..	A— *C* D E	A— C D E	A B C D E	— — *C* D E	— — C D E	— — — D E	A— *C* D E	A— *C* D *E*	A— C D E	— — — D *E*	A— — D *E*	— — — — —
15 ..	——	A— C D E	A— C D E	— — C D E	— — C D E	— — — D —	A— — D *E*	A— *C* D *E*	A— C D E	A— C D E	A— C D *E*	A— C D E
16 ..	A— *C* D E	A— C D E	A— C D E	— — C D E	A— C D E	— — — D *E*	A— *C* D E	A— C D E	A— — D *E*	A— — D *E*	— — — — —	A— C D E
17 ..	A— C D E	A— C D E	A— C D E	— — C D E	A— *C* D E	— — *C* D E	A— *C* D E	A— *C* D E	— — — — —	A— *C* D E	— — — — —	A— *C* D E
18 ..	A— C D E	A— C D E	A— *C* D E	— — *C* D E	A— *C* D E	— — — D *E*	A— *C* D E	A— C D E	A— C D E	— — — — —	A— — D *E*	— — — — —
19 ..	A— C D E	A— C D E	A— C D E	— — C D E	A— *C* D E	A— *C* D E	A— C D E	A— *C* D E	A— C D E	— — — — —	— — — — —	— — — — —
20 ..	A— C D E	A— C D E	A— *C* D E	— — C D E	A— C D E	— — — D E	A— — — —	A— — D *E*	A— C D *E*	— — — — —	— — — — —	A— C D E
21 ..	A— C D E	A— *C* D E	— — *C* D *E*	— — C D E	A— *C* D E	— — *C* D *E*	— — — — —	— — *C* D *E*	A— *C* D E	A— — D *E*	A— — D —	A— C D E
22 ..	A— C D E	A— C D E	— — C D E	— — *C* D E	A— *C* D E	A— *C* D E	A— — D E	A— *C* D E	A— *C* D E	A— *C* D E	A— C D *E*	A— C D E
23 ..	A— C D E	A— C D E	— — C D E	— — C D E	A— C D E	A— *C* D E	— — — — —	A— C D E	A— C D E	A— — D *E*	A— C D E	A— C D E
24 ..	A— C D E	A— C D E	— — *C* D E	— — C D E	A— C D E	A — — D E	— — — — *E*	— — *C* D *E*	A— C D E	A— — D *E*	A— C D E	A— C D E
25 ..	A— C D E	A— C D E	— — C D E	— — *C* D *E*	A— *C* D E	— — — — —	— — — — —	— — — — —	A— *C* D E	A— C D E	A— — D *E*	A— C D E
26 ..	A— C D E	A— C D E	— — C D E	— — C D E	A— C D E	A— — D E	A— *C* D *E*	A— — D —	A— — D *E*	A— — D E	A— — — *E*	A— *C* D E
27 ..	A— C D E	A— C D E	— — C D E	— — C D E	A— C D E	A— — D —	— — — — —	— — *C* D E	A— C D E	A— *C* D *E*	A— C D E	A— *C* D E
28 ..	A— C D E	A— C D E	— — C D E	— — *C* D E	A— *C* D E	A— *C* D E	A— — — —	A— C D E	A— *C* D E	A— C D E	— — — — —	A— C D E
29 ..	A— C D E	A— C D E	— — C D E	— — C D E	A— C D E	A— *C* D E	A— *C* D E	A— — D *E*	A— *C* D E	— — — — —	— — — — —	A— C D E
30 ..	A— C D E		— — *C* D E	— — C D E	A— *C* D E	A— C D E	A— — D E	A— *C* D E	A— C D E	A— C D E	— — — — —	A— C D E
31 ..	A— C D E		— — C D E		A— C D E		A— C D E	A— C D E		A— C D E		A— C D E

Note.—When a letter is in italics, it means that on that day the observations were not complete.

SOLAR Observations—Abstract.

—	1912.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total
A	30	29	17	..	16	18	24	26	27	25	23	26	261
B	..	..	2	1	..	..	.	..	..	..	..	..	3
C	30	29	29	28	31	18	15	22	25	13	16	24	280
D	30	29	31	30	31	27	22	29	28	26	22	24	329
E	30	29	31	30	31	26	24	28	29	26	22	25	331

The sun's disc was examined visually for spots etc. on 261 days only whilst in 1911 it was examined on 333 days. The reduction in the number of observations was mainly due to an interruption of 66 days whilst the Lerebour and Secretan telescope was being adapted for both visual and photographic work. The observing conditions were perhaps not so good as in 1911 and there were as many as 25 days when there was no sunshine recorded.

6. **Photoheliograph**.—Photographs of the sun were obtained on 329 days as against 324 in 1911. Up to July 31 they were taken with the Dallmeyer photoheliograph, and since that date mostly with the Lerebour and Secretan telescope. Double exposures are taken twice a month for determining the error of orientation of the photographs. Two solar negatives were sent to the Greenwich Observatory out of three asked for to complete the series.

7. **Spectroheliograph**.—Monochromatic photographs of the sun's disc in "K" light were taken on 331 days, and prominence plates on 280 days. With the auto-collimating spectroheliograph H α images were secured on 158 days. The prominence plates are measured as soon as obtained, and the results tabulated. Duplicates of the disc plates have been sent to South Kensington for measurement, as in former years, and in exchange prominence plates have been received from South Kensington.

Mr. Royds has made a special study of the absorption markings shown on the H α plates.

8. **Grating Spectrograph**.—Owing to the paucity of sunspots only a few spectra were obtained for the study of radial movements. The general state of calm in the solar atmosphere was, however, specially favourable for other lines of research and a large number of comparison spectra were obtained of the sun's limb and the centre of the disc. The relative displacements of the lines towards the red at the limb have been measured and compared with the displacements due to pressure. A series of plates has also been obtained of the arc spectrum of iron in air and the centre of the sun's disc. These have been measured to determine the general displacement of the solar lines after correction for the earth's movements. The general result of the whole investigation, although far from being completed, appears to throw great doubt on the usual interpretation of the line displacements, which ascribes the general shift of the solar lines, as well as the relative shift of the lines at the limb, to the effect of pressure. The investigation is being continued with the aid of a special device for the direct photographic comparison of the solar and arc spectra, and a second series of plates has been obtained with the arc under reduced pressure.

9. **6-inch Cooke Equatorial and Spectroscope**.—Visual observations of the prominences and of spot spectra have been continued as in former years but only two spots were studied in detail in this way, Nos. 6977 and 6980 of the Greenwhich numeration. Observation of the behaviour of the C and D_3 lines were recorded in four spots.

In October the telescope and its mounting were removed from the south dome and re-erected in the photoheliograph dome. This involved a break in the prominence observations of one week only. Prominences were recorded visually on 280 days.

10. **Poona 6-inch Equatorial.**—This fine instrument has been erected in the south dome and a powerful grating spectroscope, also from Poona, has been adapted for use with it.

It is intended to make a special study of the metallic prominences and of prominences showing displacements of the hydrogen lines. It has been found from the Kodaikanal records that not only do prominences in general show a numerical preponderance on the east limb, but the preponderance is much greater in the above mentioned special classes of prominence. As the metallic prominences are closely associated with sun-spots, this appears to indicate that both prominences and spots are more active when on the east limb than when on the west. There is also found to be an excess of displacements of the hydrogen lines towards the red end of the spectrum. These facts raise questions which will require the most careful study in the future, and the Poona telescope is well adapted for this work.

11. **Solar Radiation.**—The new photographic telescope for comparing the intensity of moonlight and first type stars was completed during the year, but owing to cloudy skies no opportunity for using it occurred until December when a few plates were secured.

A Hartmann Photometer for measuring the plates has been received from Messrs. Toepfer.

Summary of Sunspot and Prominence Observations.

12. **Sun-spots.**—The following table shows the monthly numbers of new groups observed, the mean daily numbers of spots visible, and the distribution between the northern and southern hemispheres :—

—	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
New groups	..	..	1	2	2	1	3	2	5	1	1	4	22
Daily number	..	..	0·4	0·3	0·4	0·5	0·3	0·1	0·7	0·3	..	0·4	0·3
North	..	..	..	..	..	..	..	..	..	..	..	2	2
South	..	..	1	2	2	1	3	2	5	1	1	1	19
Equator .. .	..	..	..	..	..	..	..	..	..	..	..	1	1

The decline in spot activity noted in the last few years continued in 1912, but the rate of decrease between 1911 and 1912 has lessened very slightly as is shown in the following comparisons for the four years 1909–1912.

Year.	Number of new groups.	Per cent. of previous years number.
1909	220	..
1910	152	68
1911	56	37
1912	22	39

Year.	Mean daily numbers.	Per cent. of previous years number.
1909	3·9	..
1910	1·8	46
1911	0·7	39
1912	0·3	43

Year.	Number of days on which no spot was seen.	Ratio of increase over previous year.
1909	5	..
1910	56	11·2
1911	158	2·8
1912	240	1·5

It seems probable that the minimum of spot activity occurred during the early part of 1912, not a single spot having been recorded in January and February, whilst there was a slight recovery of activity in September and in December. The appearance of a spot in latitude $+27^\circ$ in December may probably be considered as the beginning of a new cycle of activity.

Of the twenty-two groups recorded during the year, nineteen were in the southern hemisphere and were, on the whole, closer to the equator than in 1911. Their mean latitude was—$7^\circ{\cdot}2$ against—$9^\circ{\cdot}8$ in 1911. Of the three remaining spots, one was a small dot on the equator, one was at $+20^\circ$ and the third, the last group of the year was at $+27^\circ$; all three spots were observed in the latter part of December.

Only four groups—No. 2007 (March 7 to 19), No. 2012 (June 17 to 28), No. 2023 (October 4 to 11), and No. 2025 (December 15 to 23)—contained fairly large spots. The spectra of Nos. 2007, 2008 (April), 2021 (September), and 2025 (December) showed disturbances in C and D_3.

13. **Prominences**.—The mean areas of prominences for each hemisphere of the sun are shown in the following table in which the figures for the previous two years are given for comparison :—

Mean daily profile areas of Prominences in square minutes of arc

—	1910.	1911.	1912.
North	2·03	1·27	0 95
South	2·07	1·64	1·51
Total ..	4·10	2·91	2·46

The reduction of prominence area is here shown to be very much less than the reduction of spot numbers or of new groups, also the rate of decrease has lessened considerably between 1911 and 1912.

The area curve underwent a marked change in the second-half of 1911. There were several sharp, though small, maxima and a pronounced maximum near 50° south. These features were maintained in a general way in 1912.

Metallic Prominences.

—	Number observed.	Mean latitude.	Extreme latitudes.
North	3	$14^\circ{\cdot}5$	$1^\circ{\cdot}5$ 35°
South	9	$18^\circ{\cdot}0$	8° $46^\circ{\cdot}5$

The prominence activity in each month may be estimated from the following table :—

Number of Prominences.

Months.	Prominences—one minute or more in height.	Metallic.	Eruptive.
January	84	1	4
February	63	1	3
March	63	3	4
April	39	1	6
May	32	..	1
June	24	2	..
July	16	1	5
August	42	..	2
September	34	1	1
October	31	..	..
November	33	2	3
December	58	..	3

The metallic and eruptive prominences show a decrease corresponding to that of the spot activity. But there is actually an increase in the number of "large" prominences; this is particularly striking in January and February when there was no spot recorded, but the numbers of large prominences are the highest in the year.

The following were the more noteworthy prominences observed during the year:—

June.—A prominence recorded at latitude—25° East on the 22nd reached a height of 200″ at $10^h\ 31^m$ but fell to 130″ at $11^h\ 20^m$.

July.—A metallic prominence was observed at + 78° West on the 31st.

August.—A large prominence covering 30° of the south-west limb was photographed on the 31st and was slowly rising without altering its general shape. The height reached was 170″ at $10^h\ 17^m$.

September.—A prominence photographed at latitude—33° East on the 30th attained a height of 240″.

November.—A prominence photographed at latitude—18° West on the 12th was 240″ in height.

(*b*) Other Observations.

14. **Time.**—The error of the standard clock is usually determined by reference to the 16^h signal from the Madras Observatory. This is rendered possible by the courtesy of the Telegraph department which permits the Madras wire to be joined through to this observatory. The signal is received with accuracy on most days and all failures are at once reported to the officer in charge of the Trichinopoly division. Time determinations are made with the transit instrument, when necessary, as a check.

15. **Meteorology.**—Meteorological observations were carried on as in former years. Eye observations are made at 8^h, 10^h and 16^h local mean time. Temperatures and pressures are recorded continuously by a Richard thermograph (wet and dry bulb) and barograph, and the mean temperatures and pressures are obtained from the traces, corrected by reference to the eye observations. The wind direction and velocity shown in tables II and III of the appendix are obtained from a Beckley anemograph, and the 8^h values for the daily weather reports of Simla and Madras from a Robinson anemometer and a wind vane.

Pressure.—The average pressure for the year was 0·007 inch above the normal. The monthly mean was below normal during four months only—June, July, August and November—and the greatest defect was only 0·009 inch. The greatest excess, on the other hand, was 0·034 inch in April.

Temperature.—The monthly mean temperature was in excess throughout the year, so also were the monthly mean maxima during nine months of the year, the annual excess in the two cases being 0°·9 and 1°·2, respectively. The annual means of the other temperature records, viz., "dry minimum", "wet mean", "wet minimum", "sun maximum", and "grass minimum" were also higher than the normal.

Humidity.—The mean humidity for the year was the same as the normal, viz., 74 per cent. There was a defect of 15 per cent. in January, but the other months did not differ greatly from the normal.

Rainfall.—The rainfall distribution was rather abnormal. There was a deficiency in the months of January, February, March, July, August and October amounting to 7·44 inches, and an excess in the other months amounting to 13·12 inches, the total excess above normal being 5·68 inches. The most striking deviations were a defect of 2·52 inches in January and excesses of 5·77 inches in April and 5·24 inches in November.

Wind.—There was a defect of 95 miles in September and an excess of 92 miles in December in the average daily wind velocity, but there was otherwise no striking difference from the normal. The mean daily velocity was only 3 miles in defect. The mean wind direction for the year was north-north-east, the normal direction being north.

Transparency of the atmosphere.—The transparency of the lower atmosphere as judged by the visibility of the Nilgiris, about 100 miles distant, was much below normal as was the case also in 1911. The atmosphere was clearest in January and December and least clear in April.

Cloud and Sunshine.—The year as a whole was somewhat more cloudy than usual and there were 25 days when no sunshine was recorded. The total number of hours of bright sunshine was 1997, which is 30·8 hours below the average of eleven years.

16. **Seismology.**—The Milne horizontal pendulum recorded 81 earthquakes during the year as against 95 in 1911. The highest records were in May and June, with 13 and 16 respectively. The heaviest shock, as judged by duration and amplitude, was due to the Burma earthquake of the 29th May.

17. **Library.**—One hundred and sixty-four volumes were bound during the year.

18. **Publications.**—Bulletins Nos. XXV. and XXVI. dealing with the prominence observations for 1911 were published during the year and Nos. XXVII., XXVIII. and XXIX. were sent to the press towards the end of the year. The titles of these are "On the presence of Radium and the elements of the inactive group in the chromosphere", "On the relative numbers of prominences observed on the eastern and western limbs" and "Summary of prominence observations for the first-half of 1912".

19. **General.**—The Officiating Director-General of Observatories inspected the Kodaikanal Observatory in February and the Director inspected the Madras Observatory in October.

The staff of the Observatory worked well during the year.

J. EVERSHED,
Director, Kodaikanal and Madras Observatories.

THE OBSERVATORY, KODAIKANAL,
31*st January* 1913.

II.—REPORT OF THE MADRAS OBSERVATORY FOR THE YEAR 1912.

Staff.—The staff at the Observatory on December 31, 1912, was as follows:—

Deputy Director	R. Ll. Jones.
Computer	S. Solomon Pillai.
First assistant	A. A. Narayana Aiyar, B.A.
Second assistant	E. Ramanujam Pillai.

Two peons and two lascars form the subordinate staff. The Computer was on privilege leave from 12th April to 31st May, and the First Assistant from 16th July to 15th August.

2. **Time Service.**—Time determinations have been made systematically on the plan followed in previous years and the time service was efficiently maintained. By the Adjutant-General's order the firing of the 8 P.M. gun at the Fort was discontinued from the 29th January. Towards the end of the year intimation was received that the 8 P.M. firing was to be resumed from the 1st January 1913. No other change was made in the number or manner of the signals distributed from the observatory. The Fort gun failed on five occasions and fired correctly on 386 occasions out of 391, giving 98·7 as the percentage of success. The failures were due to faults outside the observatory.

The Semaphore at the Port office failed on one occasion and was dropped correctly at 1 P.M. every other day; on the day it failed at 1 P.M. it was dropped correctly at 2 P.M.

3. **Meteorological Observations.**—In addition to the ordinary meteorological observations, extra observations were taken for storm warning purposes and telegrams sent to Simla on two occasions and to Calcutta on 107 occasions. A new Thermograph was received from Calcutta and brought into use on the 15th May 1912.

4. **Buildings.**—In addition to the usual annual repairs to the office and quarters, special repairs in the quarters were carried out during the year. The porch which was condemned early in the year was pulled down and rebuilt and malthoid sheeting was laid on the roof so that the quarters are now rain-proof. The Executive Engineer proposed to investigate the foundations of the transit circle in order to try and discover the cause of the large changes in level which have occurred during the last three years; but action was deferred till after the next inspection by the Director-General of Observatories.

5. **Instruments.**—The following is a list of the instruments at the observatory on the 31st December 1912:—

(a) Astronomical.

Eight-inch Equatorial Telescope—Troughton & Simms.
Sidereal Clock—Haswall.
,, Dent, No. 1408.
,, S. Riefler, No. 61.
Mean Time Clock—J. H. Agar Baugh, No. 105.
,, with galvanometer—Shepherd & Sons.
Meridian Circle—Troughton & Simms.
Mean Time Chronometer—V. Kullberg, No. 5394.
,, ,, No. 6544.
Portable Transit Instrument—Dollond.
Portable Telescope with stand.
Tape Chronograph—R. Fuess.
Relay for use with the Chronograph—Siemens.

(b) Meteorological.

Richard's Barograph—No. 10, L. Casella.
,, Thermograph—No. 29637, L. Casella.
Beckley's Anemograph—Adie.
Sunshine Recorder—No. 149, L. Casella.
Nephoscope—Mons Jules Daboseq & Ph. Pellin.
Barometer, Fortin's—No. 1771, L. Casella.
,, No. 725, L. Casella (spare).
,, No. 1420, L. Casella (spare).

Dry Bulb Thermometer—No. 94221, L. Casella.
" No. 38037, Negretti & Zambra (spare).
Wet Bulb Thermometer—No. 94219, L. Casella.
" No. 38037, Negretti & Zambra (spare).
Dry Maximum Thermometer—No. 8581, Negretti & Zambra.
Dry Minimum Thermometer—No. 60017, L. Casella.
Wet Minimum Thermometer—No. 91753, Negretti & Zambra.
Sun Maximum Thermometer—No. 10479, Negretti & Zambra.
Grass Minimum Thermometer—No. 3377, Negretti & Zambra.
Raingauge (8″ diameter)—No. 1042, Negretti and Zambra.
Measure glass for above.
Raingauge (5″ diameter).
Measure glass for above.

In its rainfall distribution the year was similar to the previous one. The first nine months were very dry—August excepted. During this time a steady and progressive change in the level of the transit circle took place from a small positive value at the beginning of the year to a large negative value in October. With the heavy rain in October and November the level changed rapidly to a small negative value and has remained almost constant since. The steady change during the first nine months suffered a slight check in August after a moderate fall of rain. With the dry weather however which followed, the change was resumed; the error reached its maximum in October. The azimuth was not much affected while these changes in level were going on. The observations for time were on the whole satisfactory and the rate of the Riefler clock has been very steady throughout the year, except for a short period of about ten days at the end of July and the beginning of August.

It is difficult to surmise the cause of these large annual changes in level which have been so prominent since 1910. According to the account given on pages V and VI in Volume I of "Madras Meridian Circle Observations, 1862, 1863 and 1864" the piers of the transit circle rest on the eastern end of a "solid pyramidal mass of masonry, 37 feet long by 6 feet wide at its upper surface, 6 feet in depth and 45 feet long by 12 feet broad below. A conical granite pier rests on the centre of this mass, 4 feet in diameter at its base tapering up to 2 feet at its total height of 18 feet and weighing certainly over ten tons." It is difficult to believe that the whole of this mass which is described as "probably little less firm or massive than a solid rock of similar dimensions" partakes as a rigid body of the movement revealed by the level observations. It is more probable that owing to local subsidences in the soil, the masonry bar has broken and that the transit instrument is on the smaller part of it. There is ample evidence of subsidences at the surface of the ground in the compound to the south of the observatory.

The transit instrument was overhauled during the visit of the Director in October and the collimators were taken down and readjusted. A specification for a new eyepiece to the transit was drawn up at the same time.

6. **Weather Summary.**—The following is a summary, in the usual form, of the meteorological conditions at Madras during 1912:—

Pressure.—Pressure was above normal in January, April, May, October and December and below normal in the remaining months. The greatest excess was 0·051 inch in April and the greatest defect 0·031 inch in August. The highest pressure recorded was 30·184 inches on January 19th and the lowest 29·522 inches on July 28th.

Temperature.—The mean temperature of air was about normal in all months except in January and December. The highest shade temperature recorded was 111°·6F. on May 19th and the lowest 60°·5F. on January 4th. The highest temperature in the sun was 149°·2F. on September 16th and the lowest on grass was 54°·9F. on January 10th.

Humidity.—Humidity was above normal almost throughout the year.

Wind.—The wind direction was normal in April, July and December. It was more southerly than usual in February, June and September, more northerly in October and more easterly in November. The wind velocity was apparently below normal in all the months except March. In July, the mean daily velocity was 43 miles below average. There is no doubt however that a change in exposure accounts in part for the low velocities relative to the average.

Cloud.—The percentage of cloud was normal in March, above normal in July and August and below normal in the remaining months.

Sunshine.—The percentage of bright sunshine was above normal in March, April, June, September and December and below normal in the other months.

Rainfall.—The rainfall was above the average in January, August and November, normal in October and below normal during the other months; the greatest excess being 8·60 inches in November and the greatest defect 4·98 inches in December. The total fall for the year was 46·69 inches against an average of 49·02 inches. The monsoon rainfall from October 15 to the end of the year was 32·70 inches against an average of 26·00 inches. The heaviest fall on any day was 4·05 inches on November 13.

MADRAS OBSERVATORY,
28*th January* 1913.

R. LL. JONES,
Deputy Director.

Appendix I.

KODAIKANAL Observatory Seismological Records.

No.	Date.		P.T. commence G.M.T.		L.W. commence G.M.T.		Maxima G.M.T.		End G.M.T.		Duration G.M.T.		Max. Amp.	Remarks.
	1912.		H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	MM. "	
1	Jan.	4 ..	4	07·4	4	12·3	4	15·1	4	30·0	0	22·6	0·8 = 0·3	
2		4 ..	16	09·9	16	40·7	16	44·0	18	29·5	2	19·6	1·1 = 0·4	
3		20 ..	4	22·3	..		..		4	48·0 ?	0	25·7	..	Widening of line. Instrument examined at 4h. 48m.
4		26 ..	14	52·4	14	57·7	14	58·2	15	25·9	0	33·5	0·7 = 0·3	
5		31 ..	13	33·9	..		..		13	45·0	0	11·1	..	Widening of line.
6		31 ..	20	44·0	21	08·5 14·4	21	21·1	21	47·9	1	03·9	1·0 = 0·4	
7	Feb.	13 ..	17	16·7	.		..		17	30·0	0	13·3	..	Do.
8		16 ..	10	00·3	10	19·1	10	19·3	10	35·4	0	35·9	0·6 = 0·3	
9	March	11 ..	11	23·1	..		.		12	19·0	0	55·9	..	Do.
10		11 ..	16	01·8	..		..		16	12·0	0	10·2	..	Do.
11		17 ..	?		7	31·2	7	31·5	7	39·7	0	08·5	0·8 = 0·4	Hour signal at 7h. 30m.
12		24 ..	12	28·3	..		12 12	30·6 32·0	12	47·4	0	19·1	0·8 = 0·3 0·7 = 0·3	
13	April	11 ..	5	54·8	..		..		6	20·0	0	25·2	..	Widening of line.
14		11 .	10	14·6	10	14·9	10	15 1	10	28·5	0	13·9	0·6 = 0·3	
15		20 ..	2	11·0	..		..		2	54·6	0	43·6	..	Do.
16		23 ..	3	54·1	3	54·4	3	55·9	4	01·8	0	07·7	0·7 = 0·3	
17		23 ..	21	52·2	..		21	54·6	22	10·5	0	18·3	0·7 = 0·3	
18		25 ..	?		..		10	32·6	10	39·7	0	07·1	..	Widening of line. Hour signal at 10h. 30m. Sudden displacement of trace through 0·1 mm. at 10h. 32m 6.
19	May	6 ..	19	22·3	19	49·5	19	57·2	21	12·0	1	49·7	2·7 = 1·3	
20		11 ..	17	30·8 ?	17	35·1	17	35·9	18	25·7	0	54·9	3·3 = 1·6	Hour signal at 17h. 30m.
21		15 ..	0	33·3 ?	0	33·3	0	34·4	..		0	54·1	0·4 = 0·2	Hour signal at 0h. 30m.
22		15 ..	..		1	12·0	1	14·4	1	27·4			0·6 = 0·3	
23		17 ..	17	13·1	..		..		17	29·0	0	15·9	..	Widening of line.
24		18 ..	23	09·1	..		..		23	25·1	0	16·0	..	Do.
25		19 ..	..		3	39·0	3	39·8	3	49·1 ?	0	10·1 ?	0·5 = 0·2	Instrument examined at 3h. 50m. 8.
26		21 ..	8	33·6	8	38·2	8	53·1	9	29·2	0	55·6	0·9 = 0·4	
27		21 ..	10	35·1	..		..		10	58·1	0	23·0	..	Widening of line.
28		22 ..	23	17·5	23	23·1	23	23·6	23	29·5	0	12·0	0·4 = 0·2	
29		23 ..	2	29·0	2	29·5	2 2 2	39·9 42·0 47·9	6	15·2	3	46·2	13·5 = 5·4 14·5 = 5·8 16·0 = 6·0	Burma.
30		28 ..	7	07·1	..		7	08·6	7	26·7	0	19·6	0·4 = 0·2	
31		28 ..	13	04·7	13	26·2	13	28·2	14	13·0	1	08·3	0·6 = 0·3	
32	June	1 ..	0	46·3	..		..		0	56·6	0	10·3	..	
33		2 ..	12	14·9	..		12	30·2	12	50·7	0	35·8	0·5 = 0·2	Widening of line.
34		3 ..	12	31·0 ?	..		..		12	48·9	0	17·9	..	Widening of line. Hour signal at 12h. 30m.
35		6 ..	11	30·5 ?	11	45·8	11	48·1	12	08·8	0	38·3	0·5 = 0·2	
36		7 ..	10	46·4	10	50·8	10	58·2	?		1	11·6	0·8 = 0·3	
37		7 ..	?		11	30·0	11	36·7	11	58·0			0·4 = 0·2	Beginning lost in end of No. 36.
38		7 ..	13	14·6	..		..		13	38·2	0	23·6	..	Widening of line.
39		7 ..	15	10·9	..		..		15	36·2	0	25·3	..	Do.
40		7 ..	18	55·1	19	03·3	19 19	09·5 26·9	20	09·4	1	14·3	0·9 0·9 = 0·4	
41		8 ..	7	40·7	7	47·2	7	51·0	8	16·0 ?	0	35·3 ?	0·8 = 0·3	
42		8 ..	?		8	25·7	8	37·2	9	27·0 ?	..		2·4 = 1·0	
43		8 ..	?		9	41·0	9	48·4	10	18·0 ?	..		1·4 = 0·6	
44		8 ..	13	49·9	13	56·9	14	02·0	14	23·1	0	33·2	1·0 = 0·4	
45		10 ..	16	33·1	16	58·6	17	10·1	18	41·0 ?	2	07·9	2·0 = 0·8	
46		18 ..	12	13·3	12	43·3	12	47·4	14	02·8	1	49·5	1·8 = 0·8	
47		26 ..	17	07·8	17	11·4	17	14·4	17	55·0	0	47·2	0·9 = 0·4	June 28th and 29th record incomplete.
48	July	7 ..	8	21·4	8	46·8	8	58·5	11	08·0	2	46·6	5·5 = 2·6	
49		8 ..	22	32·0	22	47·6	22	49·2	23	28·0	0	56·0	0·8 = 0·4	

Kodaikanal Observatory Seismological Records—*cont.*

No.	Date.			P.T. commence G.M.T.		L.W. commence G.M.T.		Maxima G.M.T.		End G.M.T.		Duration G.M.T.		Max. Amp.	Remarks.
	1912.			H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	MM. *	
50	July	24	..	12	12·3	12	13·6	12	17·4		?	1	52·3	1·9 = 0·9	
51		24	..		?	13	32·1	13	37·3	14	04·6			0·6 = 0·2	Beginning lost in end of No. 50.
52	Aug.	3	.		..	9	16·0	9	18·5	9	28 0	0	12·0	0·6 = 0·2	No P. Ts.
53		6	..	13	28·2	13	36·3	13	38·4	15	26·0	1	57·8	4·8 = 2·0	
54		6	..	21	23·6		..		..	22	37·9	1	14·3	..	Widening of line.
55		9	..	1	38·7	1	46·4	2	06·2	5	19·0	3	40·3	17 = 7·3	
56		10	..	22	54·0		..		.	23	17·2	0	23·8	..	Do.
57		17	..	19	20·8	19	28·2	19	48·1 50·4	22	28·6	3	07·8	5·5 = 2·4 5·2 = 2·3	
58		21	..	17	42·8		..		..	18	19·7	0	36·9	..	Do.
59		23	..	14	08·2	14	12·3	14	13 5	15	10·0	1	01·8	4·5 = 1·9	
60		23	..	21	51·3	21	53·1	21	57·4	22	14·6	0	22·3	1·0 = 0·4	
61	Sept.	1	..	0	03·3		..		..	0	39·2	0	35·9	..	Do.
62		11	..	0	52·3	0	58·5	1	00·8	1	53·6	1	01·3	3·8 = 1·[illegible]	
63		13–14	..	23	48·5	0	01·3	0	09·8	0	50·5	1	02·0	0·9 = 0·4	
64		26	..	19	32·0		..		..	19	56·7	0	24·7	..	Do.
65		29	..	21	01·0	21	09·1	21	31·5		..	3	10·0	2 6 = 1·0	
66		29–30	..		..	23	41·5	23	47·5	0	17·0			0·5 = 0·2	Beginning lost in end of No. 65.
67	Oct.	12	..	15	44·9		..		.	17	07·4	1	22·5	..	Widening of line.
68		18	..	10	18·1	10	43·0	10	44·0	13	22·0	3	03 9	1·0 = 0·4	*
69		31	..	17	41·3		..		.	18	44·4	1	03·1	..	Widening of line.
70	Nov.	7	..	7	57·8	8	33·8	8	45·3	10	29·0	2	31·2	2·2 = 1·1	
71	Dec.	1	..	8	39·2	8	51·5	8	54·5	9	20·3	0	41·1	0·7 = 0·3	
72		9	..	0	21·3	0	32·8	0	34·4	1	03·7	0	42·4	0·5 = 0·2	
73		9	..	9	54·1	10	28·0	10	30·3	10	48·5	0	54 4	0·6 = 0·3	
74		10	..	2	49·0		..		..	3	35·1	0	46·1	..	Do.
75		20	..	20	12·6		..		..	20	44·4	0	31·8	..	Do.
76		23	..	17	43·8		..		..	18	32·3	0	48·5	..	Do.
77		24	..	0	02·8	0	25·4	0	32·0	0	54·1	0	51·3	0·7 = 0·3	
78		24	..	18	30·0 ?	18	36·2	18	38·0	18	52·6	0	23·0 ?	0·5 = 0·2	Hour signal at $18^h. 30^m$.
79		25	..	17	33·8		.	17	38·8	18	16·9	0	43·1	0·4 = 0·2	
80		27	..	0	09 0		..		..	1	46·4	1	37·4	..	Widening of line.
81		28	..	8	09·0	8	27·7	8	32·0	9	08·0	0	59 0	0·7 = 0·3	

* Instrument disturbed in the day-time from the 17th to 23rd October during building operations.

Appendix II.

Latitude, 10° 13′ 50″ N.
Longitude, 5h 9m 52s E.

Mean monthly and annual meteorological results at the Kodaikanal Observatory in 1912.

Height of barometer cistern above mean sea level, 7,688 feet.

Month.	Barometer.		Dry bulb thermometer.				Wet bulb.		Tension of vapour.	Relative humidity.	Sun Max. *in vac.*	Min. on grass.	Wind.			Rain.		Clear sky.	Bright sun-shine.
	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	22·867	0·062	54·2	65·6	46·2	19·4	44·2	36·6	0·195	49	125·3	34·0	306	4	N.E.	0·70	2	80	278 6
February ..	·858	·068	56·5	67·6	49·4	18·2	50·3	43·4	·305	67	134 7	40·2	242	7	E. by N.	0·64	2	65	233·1
March	·867	·064	59·0	69·7	52·2	17·5	51·4	44·9	·307	62	136·6	44·7	271	9	E. by S.	1·14	3	62	222·2
April . ..	·867	·064	60·6	71·0	53·4	17·6	54·3	48·0	·363	68	140·7	48·1	282	8	E.	10·05	8	59	232·0
May	·828	·066	61·5	70·8	55·3	15·5	56·5	51·1	·408	75	140·6	50·1	233	4	N.E.	5·95	9	42	203·3
June	·766	·057	58·6	65·4	54·1	11·3	54·9	50·9	·396	80	131·4	51·1	390	26	W.N.W.	3·76	7	21	89·9
July	·746	·054	56·6	62·5	53·1	9·4	53·3	49·5	·377	82	129·2	50·1	408	26	W.N.W.	3·29	7	19	77·9
August	·768	·058	56·8	63·5	52·5	11·0	53·9	49·5	388	84	121·1	49·5	358	26	W.N.W.	5·39	9	24	124·4
September ..	·792	·066	57·8	66·2	52·2	14·0	54·3	49·2	·388	81	133·3	49·4	202	30	N.N.W.	7·04	11	32	119·9
October ..	·813	·067	55·7	62·0	51·6	10·4	53·8	49·3	·398	89	120·5	48·2	280	31	N. by W.	10·73	22	14	85·7
November ..	·820	·062	53·9	61·0	49·1	11·9	52·0	47·0	·372	89	117·2	44·5	280	2	N.N.E.	11·29	13	32	113·1
December ..	·851	·062	54·7	64·2	47·8	16·4	47·8	41·1	·269	63	120·8	40·0	381	7	E. by N.	5·25	9	54	217·8
Annual ..	22·820	0·062	57·2	65·8	51·4	14·4	52·2	46·7	0·347	74	129·3	45·8	303	2	N.N.E.	65·23	102	42	1,997·4

Extreme monthly meteorological records at the Kodaikanal Observatory in 1912.

Month.	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 . ..	22·981	19	22·784	8,10,11	0·197	72·7	10	40 7	7	31·3	4	11	5,10	135·9	30	24·1	10	525	19	144	30	0·36	17
February ..	·948	1	·771	25	·177	71·5	10	44·2	22	37·6	11	18	11	144·9	14	34·6	11,21	371	8	131	28	0·42	29
March	939	20	·800	14	·139	75·8	28	45·3	11	37·5	17	10	17	150·8	13	38 0	15	446	23	118	3	0 46	4
April	·976	12	787	20	·189	75·8	9	50·6	2	40·9	3	26	10	146·9	6	41·7	14	407	2	183	29	4·07	17
May	·901	4,7	·759	13	·142	77·3	19	52·8	28	46·5	26	43	19	148·8	15	46·1	23	355	11	109	22	1·27	9
June	·861	3	·683	9	·178	73·5	2	51·2	5	47·7	30	47	2	145·9	20	45·4	2	608	29	147	7	1·02	2
July	·835	3	·653	28	·182	67·8	3	50·2	23	45·1	22	46	22	144·9	6	43·9	3	693	22	200	1	0·71	11
August	·854	13	·676	24	·178	69·2	8	49·5	1	45·2	14	54	14	144·7	1	45·2	31	685	25	110	13	1·38	20
September ..	·868	9	·691	5	·177	70·6	11	50·0	3	41·3	23	38	23	150·9	11	37·6	7	329	22	120	25	1·42	13
October	·906	9	·716	30	·190	66·2	17	46·4	31	35·2	31	25	30	143·2	26	38 6	30	478	16	142	4	1·85	15
November ..	·894	23	·712	19	·182	70·3	13	43·9	7	36·6	13	36	13	139 9	14	30·0	7	624	19	140	7	2·72	20
December ..	·930	4	·757	18	·173	70·8	24	40·9	11	32·6	7	13	26	133·1	7	29·8	24	766	18	222	5	2·41	19

Appendix III.

KODAIKANAL mean hourly wind velocity for the year 1912.

Month.	Hours. 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 .	15	14	14	14	23	13	13	13	13	13	14	14	14	12	14	10	8	8	10	12	14	14	15	15
Februry	10	10	11	10	10	10	11	11	14	14	16	14	12	12	11	10	8	7	7	7	8	9	9	10
March	11	11	11	12	13	12	12	13	14	14	14	14	11	11	10	9	8	9	9	10	10	10	11	13
April ..	11	11	12	12	12	13	13	13	15	14	15	14	14	13	12	11	10	9	10	11	10	11	10	10
May ..	11	11	9	9	10	10	9	9	10	11	11	10	11	10	10	10	9	8	9	9	8	10	9	10
June ..	18	18	18	19	18	17	17	16	14	15	16	16	14	14	14	15	15	16	16	16	16	16	17	19
July ..	18	19	19	19	19	17	17	17	16	15	16	17	15	15	15	15	15	16	17	17	18	17	19	19
August ..	17	16	16	15	16	15	16	14	15	14	14	14	12	12	12	13	13	15	15	16	17	17	18	17
September ..	9	9	9	9	10	8	8	8	8	9	8	9	9	9	8	9	8	7	8	7	8	8	8	9
October ..	13	13	12	12	13	12	11	11	12	12	11	11	10	11	10	10	11	10	11	12	12	13	13	13
November ..	13	13	13	14	13	12	12	13	12	13	12	12	11	11	10	10	10	9	10	9	10	12	12	12
December ..	16	16	16	17	17	16	17	16	17	18	18	18	17	16	15	11	13	13	14	15	15	16	16	17
Mean ..	14	13	13	14	14	13	13	13	13	14	14	14	12	12	12	11	11	11	11	12	12	13	13	14

Appendix IV.

KODAIKANAL mean hourly bright sunshine for the year 1912.

Month.	Hours.												Remarks.
	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	
January	0·04	0·91	0·95	0·94	0·91	0·88	0·87	0·86	0·82	0·79	0·76	0·27	
February	·19	·86	·92	·97	·92	·84	·73	·69	·60	·57	·52	·23	
March	·02	·82	·88	·84	·79	·79	·69	·63	·48	·43	·44	·35	
April	·04	·86	·94	·97	·90	·83	·76	·69	·65	·50	·33	·24	
May	·25	·75	·87	·81	·82	·78	·70	·53	·43	·35	·21	·05	
June	·08	·40	·38	·37	·38	·36	·35	·22	·23	·14	·07	..	
July	·05	·20	·33	·39	·34	·29	·21	·17	·17	·21	·12	·05	
August	·12	·42	·50	·61	·53	·41	·39	·30	·34	·22	·14	·03	
September	·17	·55	·67	·65	·50	·44	·29	·29	·14	·16	·09	·04	
October	·04	·22	·40	·43	·35	·27	·24	·26	·25	·19	·08	·03	
November	·01	·40	·46	·56	·51	·43	·43	·39	·30	·18	·11	..	
December	·06	·64	·73	·73	·71	·71	·71	·70	·65	·69	·58	·11	
Mean ..	0·09	0·59	0·65	0·69	0·64	0·55	0·53	0·48	0·42	0·37	0·29	0·12	

Appendix V.

NUMBER of days in each month on which the Nilgiris were visible in 1912.

Month.	Very clear.	Visible.	Just visible.	Tops only visible.	Total.
January	..	20	4	2	26
February	..	3	7	3	13
March	..	4	1	..	5
April	..	..	..	1	1
May	..	1	2	..	3
June	4	6	3	..	13
July	1	4	4	1	10
August	1	3	2	..	6
September	6	7	2	..	15
October	..	13	1	..	14
November	2	3	2	..	7
December	1	20	1	2	24
Total ..	15	84	29	9	137

Appendix VI.

MADRAS OBSERVATORY.—Abnormals from monthly means for the year 1912.

Abnormals of	January.	February.	March.	April.	May.	June	July.	August	September.	October.	November.	December.	Annual.
Reduced atmospheric pressure	+ 0·037	— 0·014	— 0·007	+ 0·051	+ 0·011	— 0·02.	— 0·030	— 0·031	— 0·005	+ 0·004	— 0·013	+ 0·029	Same as
Temperature of air	— 0·9	+ 2·2	+ 2·5	+ 0·7	+ 2·3	+ 2·8	+ 1·4	+ 1·2	+ 1·7	+ 1·5	+ 0·5	— 0·3	+ 1·3
Do. of evaporation	+ 0·5	+ 3·0	+ 2·8	+ 1·5	+ 3·4	+ 3·6	+ 2·6	+ 2 5	+ 2·9	+ 1·9	+ 1·6	— 0·5	+ 2·1
Percentage of humidity	+ 5	+ 5	+ 2	+ 3	+ 5	+ 4	+ 6	+ 5	+ 5	+ 3	+ 6	— 1	+ 4
Greatest solar heat *in vacuo*	— 9·4	— 6·7	— 4·1	— 5·4	— 2·4	— 0·5	— 8·4	— 6·2	— 2·4	— 5·3	— 8·6	— 5 7	— 5·4
Maximum in shade	— 1·1	+ 0·1	+ 2·5	Same as	+ 2·4	+ 2 9	+ 1·2	+ 2·2	+ 1·3	+ 1·2	+ 0·3	— 0·2	+ 1·1
Minimum in shade	— 1·8	— 3·3	+ 2·2	+ 0·2	+ 1·7	+ 2·9	+ 1·2	+ 0·4	+ 1·3	+ 0·6	Same as	— 1·4	+ 0·9
Do. on grass	— 1·3	— 4·4	+ 3·0	+ 0·3	+ 2·2	+ 4·2	+ 1 7	+ 0·8	+ 2·1	+ 1·6	+ 1·4	— 1·0	+ 1·8
Rainfall in inches	+ 1·94	— 0·28	— 0·39	— 0·62	— 2·12	— 0 33	— 1·65	+ 0·83	— 3·33	Same as	+ 8·60	— 4·98	..
Do. since January	..	+ 1·66	+ 1·27	+ 0·65	— 1·47	— 1·80	— 3·45	— 2·62	— 5·95	— 5·95	+ 2·65	— 2·33	— 2·33
General direction of wind	1 point N.	2 points S.	1 point S.	Same as	1 point E	1 point S.	Same as	1 point W.	2 points S.	2 points N.	2 points E.	Same as	Same as
Daily velocity in miles	— 39	— 7	+ 8	— 23	— 19	— 7	— 43	— 21	— 28	— 10	— 23	— 21	— 19
Percentage of cloudy sky	— 18	Same as	— 11	— 8	— 12	— 23	+ 4	+ 2	— 15	— 6	— 10	— 18	— 15
Do. of bright sunshine	— 1·4	— 2·1	+ 4·0	+ 8·2	— 3·4	+ 3·2	— 11·3	— 5·0	+ 2·4	— 5·1	— 2·4	+ 4·1	— 5·2

+ Means above normal, — below normal.

Appendix VII.

ABSTRACT of the mean meteorological condition of Madras in the year 1912 compared with the average of past years.

Mean values of	1912.	Difference from	Average.
Reduced atmospheric pressure	29·864	same as	29·864
Temperature of air	82·4	1·3 above.	81·1
Do. of evaporation	76·6	2·1 ,,	74·5
Percentage of humidity	76	4 ,,	72
Greatest solar heat *in vacuo*	134·3	5·4 below.	139·7
Maximum in shade	91·9	1·1 above.	90·8
Minimum in shade	75·6	0·9 ,,	74·7
Do. on grass	73·5	1·6 ,,	71·9
Rainfall since January 1st on 78 days	46·69	2·33 below.	49·02
General direction of wind	S.E.	Same as	S.E.
Daily velocity in miles	152	19 below.	171
Percentage of cloudy sky	34	15 ,,	49
Do. of bright sunshine	53·2	5·2 ,,	58·4

DURATION and quantity of the wind from different points.

From	Hours.	Miles.	From	Hours.	Miles.	From	Hours.	Miles.	From	Hours.	Miles.
North ..	204	1,463	East ..	223	1,232	South ..	200	1,374	West ..	283	2,033
N. by E. ..	416	2,260	E. by S. ..	304	1,702	S. by W. ..	264	1,550	W. by N. ..	200	1,576
N.N.E. ..	474	2,728	E.S.E. ..	423	2,315	S.S.W. ..	248	1,664	W.N.W. .	116	862
N.E. by N.	467	3,006	S.E. by E.	659	3,807	S.W. by S.	202	1,330	N.W. by W.	102	604
N.E. ..	176	1,078	S.E. ..	457	3,302	S.W. ..	191	1,161	N.W. ..	36	247
N.E. by E.	165	855	S.E. by S.	829	6,894	S.W. by W.	201	1,238	N.W. by N.	43	200
E.N.E. ..	204	927	S.S.E. ..	445	3,308	W.S.W. ..	206	1,549	N.N.W. ..	80	517
E. by N. ..	156	773	S. by E. ..	281	1,668	W. by S. ..	244	1,726	N. by W.	101	663

There were 234 calm hours during the year. The resultant corresponding to the above numbers is represented by a south-east wind, blowing with a uniform daily velocity of 42 miles.

Appendix VIII.

Madras Observatory—Number of hours of wind from each point in the year 1912.

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 ..	25	72	59	135	80	106	76	52	62	29	11	..	.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	13	24
February ..	..	..	..	..	..		36	12	52	163	183	116	57	17	3	3	5	3	2	..	2	2	4	2	1	..	..	..	..	..	..	..	33
March ..	..	1	..	13	1	..	2	18	4	3	52	107	82	224	36	14	33	27	31	17	10	3	..	..	..	..	..	.	..		..	..	16
April ..	..	..	.	..	..	..	..		..	3	47	141	140	221	76	10	7	11	18	8	5	2	4	..	..	..	..	..	..	..	..	.	27
May	..	..	1	..	1	9	16	10	17	15	34	67	49	133	91	56	29	41	37	29	14	16	21	8	11	10	6	..	1	..	3	..	19
June	..	..	..	..	2	..	..	1	5	10	6	11	28	60	87	60	33	30	46	20	29	46	70	60	19	29	5	2	6	..	3	..	2
July	..	..	3	..	1	3	2	3	6	11	13	36	17	22	16	20	16	40	41	59	43	63	29	68	78	72	33	18	6	10	1	..	14
August ..	7	2	..	..	1	..	2	3	7	2	10	27	30	26	32	15	36	62	39	27	37	33	55	57	72	65	34	28	15	3	3	1	13
September ..	11	12	2	2	3	..	4	14	5	8	23	93	44	118	24	29	23	29	25	30	15	28	7	40	16	11	16	29	6	10	6	6	21
October ..	17	14	61	34	40	19	34	30	38	48	31	40	7	7	..	6	16	16	9	7	29	7	3	8	22	10	21	19	2	16	50	35	48
November ..	111	126	67	94	33	25	13	13	27	12	13	21	3	1	30	18	2	5	..	5	7	1	3	1	14	3	1	6	.	4	14	43	14
December .	33	189	291	189	14	3	19	..	..	..	..	..	..	..	..	..	..	.	..	..	..	..	..	..	..	..	..	..	..	..	..	3	3
Annual total ..	204	416	474	467	176	165	204	156	223	304	423	659	457	829	445	231	200	264	248	202	191	201	206	244	283	200	116	102	36	43	80	101	234

Appendix IX.

Madras Observatory.—Number of miles of wind from each point in the year 1912.

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	134	298	257	500	401	488	343	226	292	199	60	..	..	..	.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	60	3258
February	..	..	..	..	..	..	71	68	296	810	849	679	302	143	21	12	25	16	9	..	5	5	17	10	3	..	..	..	..	..	..	..	3341
March	..	8	..	52	10	..	12	75	35	25	247	577	454	1772	606	87	266	221	290	141	58	9	..	..	..	..	..	..	..	..	..	..	4945
April	..	..	..	..	..	..	..	..	..	35	316	781	1233	1677	513	60	59	75	148	67	30	12	38	..	..	..	..	..	..	..	..	..	5044
May	..	..	8	..	2	32	79	107	110	158	226	555	419	1345	781	569	334	346	315	260	142	124	180	75	102	97	60	..	6	..	15	..	6447
June	..	..	..	..	18	..	..	6	51	88	48	115	299	708	836	482	240	181	283	160	226	356	684	521	672	292	43	16	49	..	21	..	6400
July	..	..	23	..	9	16	29	12	40	64	69	242	153	185	125	112	95	193	207	284	261	406	194	500	572	522	291	120	47	34	10	..	4815
August	16	2	..	..	9	..	10	22	50	18	79	182	165	222	196	121	178	293	255	205	254	190	313	378	458	518	269	193	100	27	16	5	4744
September	38	34	18	20	16	..	27	41	35	62	157	441	213	790	144	154	112	162	128	157	88	104	95	192	92	90	121	183	37	46	23	22	3842
October	105	91	311	237	235	163	212	135	212	180	167	158	51	44	..	25	48	41	29	30	76	28	15	45	77	42	70	70	8	68	331	199	3503
November	831	568	378	729	283	135	75	82	111	64	97	7[illegible]	13	8	88	46	11	22	..	26	21	4	13	5	57	15	8	22	..	25	101	350	4263
December	339	1259	1723	1468	95	21	69	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	27	5011
Annual ..	1463	2260	2728	3006	1078	855	927	773	1232	1703	2315	3807	3302	6894	3308	1668	1374	1550	1664	1330	1161	1238	1549	1726	2033	1576	862	604	247	200	517	663	55613

Appendix X.

Madras Observatory.—Number of inches of rain from each point in the year 1912.

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 ..	0·25	1·18	..	..	..	..	..	0·14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1·24	0·02
February ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
March ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
April ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
May ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
June ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·03	0·02	..	..	..	..	0·20	..	..	0·12	..	..	..	1·41	..	..	..	..
July ..	..	..	..	..	..	..	0·08	0·04	0·07	..	..	0·18	..	0·02	0·06	..	0·18	0·10	0·10	0·16	0·21	0·04	0·02	0·03	0·05	0·41	0·42	0·04	0·01	..	..	..	..
August ..	..	..	..	..	..	..	..	..	0·02	..	0·09	..	0·02	0·01	..	0·06	0·05	0·09	0·02	0·13	0·10	0·77	..	0·31	..	0·20	0·80	1·04	0·11	0·97	0·60	..	..
September ..	..	..	..	..	..	..	..	..	..	..	..	..	0·10	..	0·10	..	..	..	0·07	..	..	..	0·22	..	0·05	..	0·81	0·01	..	..	..	..	..
October ..	0·31	..	0·37	0·21	0·41	..	0·06	0·25	0·86	0·01	0·19	..	..	0·81	..	..	0·49	0·26	0·01	0·50	0·88	..	..	1·03	..	..	0·16	..	..	0·24	3·31	0·46	0·18
November ..	1·66	0·84	0·48	2·44	1·67	0·76	1·06	2·69	1·30	0·08	1·96	1·46	0·21	..	0·55	..	..	0·14	..	3·58	0·05	..	..	..	..	..	..	..	0·58	..	0·05	0·25	..
December ..	..	0·02	0·02	0·26	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Annual ..	2·22	2·04	0·87	2·91	2·08	0·76	1·20	8·12	2·25	0·09	2·24	1·64	0·33	0·84	0·71	0·09	0·74	0·59	0·20	4·37	1·24	1·01	0·24	1·37	0·22	0·61	2·19	1·09	2·11	1·21	3·96	1·95	0·20

Appendix XI.

MADRAS OBSERVATORY.—Wind, cloud and bright sunshine, 1912.

Month.	Wind resultant.		Clouds (0—10).					Bright sunshine.	
	Velocity.	Direction.	8 H.	10 H.	16 H.	20 H.	Mean.	Average per day.	Greatest number of hours in a day.
	MILES.	POINTS.						HOURS.	HOURS.
January	92	N.E.	1·9	2·7	2·2	0·8	1·9	7·6	9·1
February	107	E. S. E.	2·6	3·7	1·9	1·1	2·4	8·8	10·6
March	138	S. E. by S.	1·7	1·8	1·0	0·7	1·3	9·3	10·5
April	156	S. E. by S.	2·9	3·3	1·1	0·6	2·0	9·6	11·0
May	151	S.S.E.	3·5	3·1	2·0	1·4	2·6	7·2	9·2
June	132	S.S.W.	3·6	3·1	4·9	4·7	4·1	5·5	7·9
July	37	S. W. by W.	7·3	7·2	7·6	7·7	7·5	2·5	8·2
August	82	S.W. by W.	7·1	6·8	6·5	6·8	6·9	4·3	10·0
September	62	S. by E.	4·3	4·4	5·6	4·4	4·7	5·3	9·3
October	50	N.E.	5·0	5·8	5·6	4·6	5·3	5·3	9·8
November . ..	98	N.N.E.	4·7	5·4	5·5	4·0	4·9	5·3	9·7
December	158	N.N.E.	2·9	3·8	4·1	2·7	3·4	6·5	8·3
Annual ..	42	S E.	4·0	4·3	4·0	3·3	3·9	6·4	—

Appendix XII.

MEAN Monthly and Annual Meteorological Results at the Madras Observatory in 1912.

Months.	Barometer.		Dry bulb thermometer.				Wet bulb.		Tension of vapour.	Relative humidity.	Sun Max. *in vac.*	Min. on grass.	Wind.			Rain.		Cloudy sky.	Bright sun-shine.	General weather.
	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.	PTS.	POINTS.	INCHES.	NO.	CENTS.	HOURS.	
January ..	30·034	0·108	74·2	83·5	65·7	17·8	69·7	65·4	0·634	78	129 0	61·8	105	4	N.E.	2·83	2	19	235·6	
February ..	29·950	·116	78·9	86·7	71·3	15·4	73·8	70·8	·768	78	133·0	68·2	115	10	E.S.E.	..	..	24	254·0	
March ..	·898	·133	82·5	91·7	74·3	17·4	76·7	73·5	·839	76	136·4	71·6	160	13	S.E. by S.	..	..	13	289·6	
April ..	·875	·126	84·7	92·9	77·4	15·5	79·1	76·5	·916	77	136·3	75·0	168	13	S.E. by S.	..	..	6	289·2	
May ..	·746	·122	89·0	100·2	82·5	17·7	81·7	78·6	·981	72	140·6	81·1	208	14	S.S E.	..	..	26	224·6	
June ..	·680	·117	89·2	101·2	83·2	18·0	80·2	76·6	·900	66	140·0	82·8	213	18	S.S.W.	1·78	4	41	165·2	
July ..	·686	·120	85·9	96·8	79·7	17·1	78·5	77·8	·875	71	130·3	78·3	155	20	S.W.	2·22	17	75	79·0	
August ..	·718	·129	84·5	95·9	77·7	18·2	78·5	77·0	·890	75	133·8	76·2	153	20	S.W.	5·39	18	18	131·9	
September .	·773	·128	84·7	94·5	78·4	16·1	79·2	75·4	·921	77	138·9	77·1	128	16	S.	1·36	5	47	158·2	
October ..	·846	·116	82·1	90·2	75·8	14·4	77·5	74·3	·882	81	133·8	74·4	113	5	N.E. by E.	11·00	12	53	164·4	
November ..	·911	·108	78·0	85·3	72·3	13·0	74·5	71·6	·813	85	128·8	70·9	142	4	N.E.	21·81	18	49	156·1	
December ..	30·007	·114	75·2	83·4	68·4	15·0	70·1	67·2	·667	76	130·1	65·4	162	2	N.N.E.	0·30	2	34	200·1	
Annual ..	29·844	0·120	82·4	91·9	75·6	16·3	76·6	73·8	0·843	76	134·3	73·5	152	12	S.E.	46·69	78	34	2,347·9	

EXTREME Monthly Meteorological Records at the Madras Observatory in 1912.

Months.	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 ..	30·184	19	29·913	13	0·271	87·1	13	60·5	4	60·5	4	50	7	137·5	31	54·9	10	169	17	49	26	1·47	15
February ..	·086	1	·798	25, 29	·288	89·3	28	66·5	26	65·7	26	56	24	135·3	13	62·8	26	152	10, 11	78	15	..	..
March ..	·048	10	·718	29	·330	94·9	22	68·3	17	67·9	17	43	8	139·9	2	64·4	2	272	29	97	16	..	..
April ..	·044	12	·704	30	·340	97·2	30	72·5	3	71·8	3	51	29	141·8	30	69·6	3	210	21	127	18	..	..
May ..	29 930	4	·564	17, 19	·366	111·6	19	76·4	1	72·9	1	40	24	148·3	20	75·5	1	323	16	131	9	..	..
June ..	·804	7	·529	29	·275	108·2	2	74·9	20	74·1	29	41	18	147·6	16	74·9	20	270	29	167	28	1·41	19
July ..	·815	30	·522	28	·293	102·6	30	75·2	20	72·1	23	34	29·30	145 4	30	74·5	20	270	27	88	14	0·89	19
August ..	·865	13	·565	27	·300	102·1	5	72·1	25	72·1	25	41	15	144·8	5	72·1	25	191	8	120	30	1·69	21
September ..	·916	9	·565	5	·351	99·7	1	71·1	17	71·1	17	56	6	149·2	16	72·7	17	175	7	51	22	0·86	17
October ..	·964	11	·690	30	·274	98·3	7	68·6	31	66·4	31	56	8	147·4	7, 11	65·4	31	211	17	50	22	2·92	20
November ..	30·007	29, 30	·789	1	·218	92·2	1	67·6	10	66·8	10	58	10	140·2	4	70·0	11	273	19	68	22	4·05	13
December ..	·107	14	·878	19	·229	84·8	23, 29	63·9	26	63·5	26	54	23	138·4	18	60·5	26	273	14	82	25	0·21	13