KODAIKÁNAL AND MADRAS OBSERVATORIES.

REPORT FOR THE YEAR 1908.

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KODAIKANAL AND MADRAS OBSERVATORIES.

I.—REPORT OF THE KODAIKÁNAL OBSERVATORY FOR THE YEAR 1908.

1. **Staff.**—The staff of the Observatory on the 31st December 1908 was as follows:—

Director	C. Michie Smith, B.Sc.
Assistant Director	J. Evershed.
First Assistant	K. V. Sivarama Aiyar, M.A. (*on leave*).
Second Assistant (Acting First Assistant). ..	S. Sitarama Aiyar, B.A.
Third Assistant (Acting Second Assistant) ..	G. Nagaraja Aiyar.
Acting Third Assistant	A. Y. Subrahmanya Aiyar, B.A.
Fourth Assistant	S. Balasundaram Aiyar.
Writer	L. N. Krishnaswami Aiyar.
Photographic Assistant	R. Krishna Aiyar.

The Director returned from furlough and took charge on January 2. The first assistant went, on July 20, on combined privilege leave and leave on medical certificate for 6 months and 23 days. The second and third assistants are acting as first and second assistants respectively, while the post of third assistant has been filled by A. Y. Subrahmanya Aiyar, B.A. The acting first assistant was on privilege leave for 41 days from September 21 and the acting second assistant is on two months' privilege leave from November 11.

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

2. **Distribution of work.**—The Director is in charge of the 40-foot spectrograph and the pyrheliometer; the Assistant Director is in charge of the spectroheliograph and associated instruments. The first, second, and third assistants are in charge of the work with the Cooke equatorial (spectroscopic), the Lerebour and Secretan equatorial (visual), the photoheliograph, the transit instrument, and the seismometer They have also to do the astronomical computing and the preparation of the observations for the press. The fourth assistant has charge of the clock comparisons and, 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**—(*a*) *Spectroheliograph building.*—The roof of this building has given some trouble from leaking and it has been resolved to cover it with ruberoid. Part of the work had been done by the close of the year. The moving roof has now been fitted up with winches by which it is easily opened and closed by one man.

(*b*) The aeromotor having been repaired was re-erected in August and has worked well.

(*c*) The new flagstaff referred to in the last report was erected in April.

(*d*) The grounds have been maintained in fair order during the year but some damage was done to them by a grass fire in February. The fire came from outside, driven by a strong wind, and though the fire lines were in good order and every available man was employed in fighting it, it leaped the fire line and spread rapidly over some 50 acres of the compound. Fortunately it was possible to save the greater part of the plantations so that the actual damage done was not great. This year the fire lines have been widened in parts and some new lines are being cut. The fire swept close past the spectroheliograph house on the east side leaving a large area of blackened soil close at hand. The effect of this on the steadiness of the solar image was very marked and the time of best seeing in the morning was greatly reduced. Some showers of rain fell a few days after the fire, and within three weeks the grass had sprung up thickly and normal conditions were nearly restored.

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 of 36 inches focus attached.
Spectrograph I—consisting of slit, collimator lens of 4 or 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.
A rhomb with ends cut at 45° mounted on a graduated circle can be placed in front of the slit so as to enable any part of the limb to be brought on to the slit.
Spectrograph II—consisting of slit, collimator lens of 3 feet focus, 3-inch plane grating and camera lens of 7 feet focus. Used in connection with the 12-inch photo-visual lens of the spectroheliograph.
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.
Six-prism table spectroscope—Hilger.
Photoheliograph Dallmeyer No. 4.
Theodolite, six-inch—Cooke.
Two phototheodolites by Steinheil, for cloud photography.
Sextant.
Evershed spectroscope with three prisms for prominence and sunspot work, by Hilger.
Mean time clock, Kullberg 6326.
Do. Shelton.
Mean time Chronometer 6299.
Sidereal chronometer, Kullberg 6134.
Tape chronograph, Fuess.
Micrometer for measuring spectrum photographs, Hilger.
Dividing engine, Cambridge Scientific Instrument Company, Limited.
Two Balfour Stewart actinometers.
Buchanan's solar calorimeter.
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.
Ångström Pyrheliometer.

An 18-inch concave mirror by Henry of Paris belonging to the Assistant Director has been mounted in the spectroheliograph room for general spectrum work and for large scale photographs of sunspots.

OBSERVATIONS.

(*a*) Solar Physics.

5. The following table shows for each day the solar observations that were made. The number of days on which observations were possible under each head was nearly the same as in the previous year. The most striking divergence from normal was the exceptionally fine weather in November, when visual prominence observations were possible on 27 days. There were 20 days in the year on which no solar observations were possible.

Table A.

SOLAR Observations in 1908.

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

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

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

SOLAR Observations—Abstract.

—	1908.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
A	29	27	31	30	31	28	28	29	29	26	27	29	344
B	8	5	1	16	14	7	4	11	S	3	10	9	96
C	28	27	29	30	31	22	14	25	27	21	27	29	810
D	29	27	31	30	31	25	27	28	29	25	27	29	388
E	29	27	31	30	31	25	26	29	28	25	27	29	337

6. **Photographs of the sun** with the Dallmeyer photoheliograph were taken on 338 days, as against 339 in 1907. The worst month for this work was October, when six days were missed. Twelve solar negatives for 1908, 3 for 1907 and 30 for 1906 were sent to Greenwich to fill in the gaps in the Greenwich and Dehra Dun series of daily photographs. Double exposures are now taken twice a month for determining the error of orientation of the solar photographs. Formerly this error was determined by actual measurements made on the ground glass and these determinations were probably equally accurate, but there are certain advantages in the permanent record. The chief drawback is that the want of rigidity in the mounting of the instrument renders it somewhat difficult to obtain the two exposures without shaking the telescope.

Tests of the object glass of the photoheliograph show that it is not altogether suitably corrected, and during part of the year a new object glass, which was got for the spectrograph, was used. It is proposed to apply for a new instrument of more modern design.

A number of large-scale photographs of individual spots have been taken both with the 20-foot lens and the 40-foot lens. Some of these show great detail in the spot structure.

7. **Observations of sunspots.**—The sun is examined for spots and faculae every morning when the weather permits. The sun's image is projected on an 8-inch disc and the positions of spots and faculae are marked on it. In previous years and up to April 30 of the year under report this disc was blank except for the north-south and east-west lines, but the discs in use since that date have lines of solar latitude and longitude printed on them. The discs are printed by the cyanotype process from negatives made from the large drawings prepared by Father R. de Beaurepaire. These were drawn for differences of half a degree in the latitude of the sun's centre and consequently the positions of spots can be obtained by inspection with considerable accuracy.

8. **Sunspot spectra.**—(*a*) *Visual.*—This work is done in accordance with the suggestions issued by the Committee of the International Union for Solar Research. It includes the comparison of the spot spectrum with Hale's provisional photographic map for the region 5210Å to F and the detailed study of the following lines:—5383·58, 5397·34, 5404·36, 5405·99, 5424·29, 5429·91, 5445·26, 5447·13, 4924·1, 5234·79, 5816·79 and 5535·06.

(*b*) *Photographic.*—Good photographs of spot spectra have been obtained during the year in the regions C to D and G to K with spectrograph No. II. Spectrograph No. I has also been employed, chiefly in the region about D and from F to G.

9. **General spectroscopic work.**—Spectrograph No. II has been employed by the Assistant Director on the following lines of investigation:—

(1) Determinations of the rotation velocities of the higher gases of the chromosphere.

(2) Determinations of the rotation velocities of the quiet prominences at a considerable height above the sun's limb.

(3) Determinations of relative shifts of certain lines in spot and in limb spectra; the lines chosen being those subject to large pressure shifts.

(4) Determination of the amount and probable cause of the general shift towards the red of the lines at the sun's limb discovered by Halm.

(5) Discussion of the differences in the relative intensities of the lines in the spectra of the sun's limb and centre; and the relation of limb to spot spectra.

A large number of good plates have been obtained during the year and a considerable proportion of these have been measured and discussed. The relative pressure in the region of absorption in spots and in the photosphere has been determined and in the limb spectra certain iron lines most affected by pressure are found to be systematically displaced about 0·005 Å towards the violet compared with the same lines at the sun's centre. The general shift of all the lines at the limb towards the red is clearly brought out by the measures but the precise amount of this shift is not yet determined.

10. **Prominences.**—Prominences were recorded visually on 310 days against 305 in 1907. On 48 days the combined visual and photographic record was imperfect owing to unfavourable weather conditions. The record of the prominences is made round the disc on which spots and faculæ have been projected and with the new discs, referred to above, the apparent latitudes of prominences are easily read off directly. The visual record is compared with the photographs taken with the spectroheliograph and all prominences shown in the photograph but not in the drawing are added in blue pencil. Where there is much difference between the photograph and the drawing the differences are noted. In the case of eruptive or metallic prominences the spectra are examined, the most conspicuous bright lines are recorded, and all large displacements of the C line are also noted and their amounts estimated.

11. **Spectroheliograms.**—The spectroheliograph was in use throughout the year and photographs of the disc in K_2 light were obtained on 337 days.

A new camera slit, made in the observatory workshop, was fitted in March and this has considerably improved the general quality of the photographs. On 42 days the results were not altogether satisfactory owing to unfavourable weather. Disc photographs have also been obtained with the camera slit set on the shading of the K line (K_1).

Prominence photographs in K_2 light were obtained on 300 days; very satisfactory results being obtained whenever the weather was favourable. The minutest details of structure in the prominences are clearly recorded, the photographs surpassing in this respect any drawings that can be made from eye observations. Several notable eruptive prominences have been photographed and their rapid changes of form recorded.

Measures are made of the position angles and heights of the prominences on the best limb photograph of each day and an enlarged positive of the best disc photograph is made on bromide paper. All such positives obtained during a month are correctly oriented and pasted on a large card-sheet this being found most convenient for a general study of the markings.

Prominence spectroheliograms for 55 days were received from the Solar Observatory, South Kensington, and flocculi plates for 328 days were sent in exchange.

12. **Solar radiation.**—Observations with an Ångström Pyrheliometer were begun in February 1908 and are made on all days that are suitable. These will usually be numerous during the first four months of the year but rare in the other months.

A new scheme has been devised for determining the amount and period of variations in the solar radiation which will be independent of all other methods at present in use, and free from many of the uncertainties attending them.

Owing to the accuracy with which the relative densities of photographic images may be determined with a suitable photometer, variations (if any) of the solar radiation not less than 1 per cent. ought to be determinable from photometric comparisons of images of the full moon and of certain selected stars known to be approximately constant in their light.

2

With this end in view apparatus has been prepared for obtaining out-of-focus images of bright stars on the same plate with similar images of the full moon. In order to reduce the moon's light to an amount comparable with that of a star and to employ the full aperture of the lens for both stars and moon, the latter is reflected at a known angle from a convex quartz plate. In this way the intensity can be reduced by any desired amount and the out-of-focus image formed from the integrated light of the whole disc of the moon becomes a circular disc of uniform density similar in all respects to that produced by the stars. The relative densities can then be easily measured. The moon and stars are photographed at altitudes not less than 60° and, for each plate, at as nearly as possible the same altitudes.

The only sources of uncertainty to which this method seems subject are want of uniformity in the transparency of the sky near the zenith and possible small variations in the magnitudes of the stars chosen for comparison.

A series of photographs taken during each lunation before and after full moon during good atmospheric conditions should eliminate the former uncertainty, whilst errors arising from the latter could be neutralised by taking a sufficient number of comparison stars.

A considerable amount of experimental work has already been done and it is hoped that a systematic series of comparisons will shortly be commenced.

Summary of Results.

13. **Sunspots.**—The following table shows the monthly number of new groups observed, the mean daily number 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	24	17	16	35	26	19	23	26	21	15	19	21	262
Daily number	3·5	3·4	2·7	5·3	4·4	3·8	3·5	5·0	5·0	2·9	3·6	3·7	3·9
North	11	6	4	9	9	11	8	12	11	8	9	12	110
South	13	11	12	26	17	8	15	14	10	7	10	9	152

During the whole of 1906 northern groups were far more abundant than southern ones and this state continued till March 1907. In April the southern groups preponderated and have continued to do so except in September and October 1907 and June, October, and December 1908. In April, groups were nearly three times as numerous in the south as in the north.

The mean latitude of the spots varied somewhat irregularly from month to month but the mean latitude for 1908 was less than for 1907. The change was from 10°·9 in the northern hemisphere and 12°·4 in the southern in 1907, to 9°·9 in the northern and 10°·7 in the southern in 1908. This change is normal for this epoch in the spot cycle.

There was a considerable fall in spot activity in the year under report, there having been only 262 new groups with a daily average of 3·9, against 301 and 4·6 in 1907. The maximum daily average in any one month was 5·3 in April, as against 7·1 in February 1907 and 7·2 in July 1906.

On four days the sun's surface was quite free from spots at the time of observation. The lower spot activity is also indicated by the fact that there were fewer returns of old spots and only one returned for a second time; in the previous year there were many returns and one of them came round five times.

Some 60 large spots were seen during the year and the following notes refer to the most important of these :—

Nos. {1321, 1323, 1343, 1352} These four groups seen in January and February behaved more or less alike. They came into view containing large spots which, however, tended to dwindle rapidly and disappear as they neared the west limb. The case of No. 1343 was somewhat striking. It came round the east limb as a regular spot on January 29. On February 1 it was still a fairly large spot but with the umbra divided; on the 2nd the whole spot broke up into two nearly equal parts; the following spot, however, was reduced to a biggish dot on the 3rd and disappeared on the 5th.

Nos. 1361, 1469, 1483. These three belonged to the class of spot groups developing rapidly as they approached the west limb. No. 1361 formed on February 26 as a train of dots within 4 days march of the west limb and developed very large spots within the next two days. It must, however, have filled up rapidly; for it did not return. The growth of No. 1483, which was first seen on August 13, was nearly as large and rapid.

Nos. 1378, 1379, 1388, 1406, 1407, 1408, 1409, 1433, 1434, 1437, 1438. All these groups contained fairly large spots and were most of them active as indicated either by changes in form from day to day or by disturbances in the C and D_3 lines in their spectra. But the chief feature about them was that they were confined to one particular region of the surface with mean heliographic longitude about 170.° The first three were visible at one time, in the early part of April, the second four in May, and the third four in June. The spot activity in those months was not great outside that region. Two other fairly large groups, Nos. 1452 and 1453, were seen about the end of June, and they too were very near this region.

Nos. 1477, 1478, 1479, 1489, 1496, 1498, 1503. These were found in another active part of the sun's surface. The region lying between latitudes + 15° and — 20° and longitudes 30° and 34° was on the visible hemisphere in the early part of August and contained the first four large and active groups. C, D_1, D_2 and D_3 were bright over the umbrae of 1478, on the 3rd and 5th. When this region came round the east limb again, about the end of the month, it still contained 6 groups, 3 of which, Nos. 1496, 1498, and 1503 were large; C was strongly reversed on one of the spots in 1496 on the 30th. But the region of greatest activity appeared to have drifted in a north-westerly direction, for its limits now were latitudes + 20° and — 15° and longitudes 45° and 355°.

No. 1545. This formed on the visible disc near the east limb on November 7 as a few dots, but developed a large spot by the morning of the 8th. It rapidly developed further till it became a train of large spots. Reversals and displacements of C and the darkening of D_3 were frequently seen in this group.

No. 1571 was first seen as a few dots on December 18 about 15° to the east of the central meridian. On the 19th it became a fairly large double spot group and did not change much after that date.

Nos. 1578, 1580. These were large spots that came round the east limb about the end of December. No. 1580 was a return of 1561; C was reversed on its umbra on January 4, 1909.

14. **Prominences.**—The year as a whole has been one of great activity. The mean profile area for the first six months reached 6·67 square minutes per diem, this being considerably in excess of any previous estimates. During the second half of the year the mean area fell to 3·93 square minutes per diem.

The general activity of the two hemispheres compared with the previous year is given in the following table:—

Mean daily profile areas of Prominences.

	1907. Square minutes.	1908. Square minutes.
North	1·92	2·41
South	2·27	2·98
Total ..	4·19	5·39

The unsymmetrical distribution of the prominences in the two hemispheres noticed in the last report has continued and the southern polar region has produced many large prominences, the activity of this region has however shown a marked decrease in the later months of the year.

Two zones of great activity are indicated in the northern hemisphere, in latitudes 10° to 15° and 30° to 35°, whilst south of the equator the greatest activity is in the zone 15° to 20°, with a secondary maximum between 45° and 55°.

Metallic prominences were far more numerous in the southern hemisphere than in the northern and they extended over a greater range of latitude in the south than in the north.

The mean and extreme latitudes observed are given in the following table :—

—	Number observed.	Mean latitude.	Extreme latitudes.	
North	23	14°·6	3°	34°
South	58	16°·8	2°	50°

There were in addition to the above three metallic prominences recorded in high latitudes; one in the north in latitude + 69° and two in the south in latitudes – 58° and – 78°.

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

Month.	Prominences one minute or more in height.	Metallic prominences.
January	71	21
February	53	8
March	69	12
April	88	16
May	67	9
June	33	3
July	27	..
August	48	4
September	25	..
October	42	2
November	52	6
December	39	3

The usual apparent deficiency of metallic and tall prominences during the monsoon months is evident, but November having been exceptionally fine, as noted previously, does not show this deficiency.

The following were the more noteworthy prominences of the year :—

January.—The highest prominence of the month, at latitude–48° west on the 12th, was a changing, irregular streak 150″ high at $9^h\ 16^m$ and 200″ at $9^h\ 48^m$. It occurred in an active region in which fairly large prominences were observed almost every day from the 11th to the 20th. An eruptive prominence at latitude–18° west on the 19th underwent rapid changes of form, but unlike most prominences of the kind persisted until the next day.

February.—One of the largest prominences ever observed was recorded on the 18th. Between 8^h and 9^h it was a more or less connected group occupying 30° of the east limb and 75″ high at the highest part. It was, however, changing both in form and height and was repeatedly photographed until sunset. The main feature indicated by the successive photographs was the vertical rise, with an accelerating speed, of the entire mass. The highest point recorded was 9 minutes from the limb, measured on the last photograph. It had disappeared by next morning.

Eruptive prominences reaching to considerable altitudes were also photographed on the 4th and 17th, both on the west limb and in latitude $-60°$.

The spectrum of a prominence at the east limb on the 7th showed about 30 lines, belonging mainly to Na, Mg, Fe, Ti, and He. The list also contained certain "unknown" lines.

March.—There were two prominences $2\frac{1}{2}'$ high in this month; one on the equator on the 7th, and one near the south pole on the 14th.

May.—A persistent group of large prominences was visible alternately on the west and east limbs, which reached its maximum development on the 17th of this month. It first appeared on March 28, was conspicuous in April, and vanished early in June.

July.—A prominence observed at latitude $+10°$ east on the 31st underwent many minor changes as shown by successive Ca photographs, but the main part which had the form of a well defined ring or horse-shoe persisted with little or no change in all the photographs of that day and could also be traced in a photograph taken on the previous day. This prominence was associated with spot No. 1478, first seen at the east limb on the 31st and which showed reversals of C, D_1, D_2 and D_3 on the umbra as it advanced westwards.

August.—The highest prominence of the month was photographed in Ca, on the 13th, at latitude $-28°$ east. It was 210″ high at $7^h\ 59^m$ but had totally disappeared by $8^h\ 23^m$. Close to it was a group of bright prominences showing displacement towards red of 2 Å in F and about 1Å in D_3. It was photographed eight times between $7^h\ 59^m$ and $10^h\ 43^m$ and underwent great changes during this period.

On August 11 at latitude $-16°$ west F was displaced about 4 Å to red and 3 Å to violet at $9^h\ 9^m$ but there was then no prominence in that position. At $9^h\ 12^m$ the displacement had almost gone and a prominence had appeared 20″ high. The height had increased to 70″ by $9^h\ 14^m$ and to 90″ by $9^h\ 18^m$ but the top was then very faint. There was no displacement whatever at $9^h\ 16^m$.

September.—On the 1st at 9^h F was displaced to violet at latitude $-9°.5$ east; at this position there was a small prominence which very rapidly increased in height from less than 10″ at $9^h\ 2^m$ to 100″ at $9^h\ 8^m$ and 120″ at $9^h\ 10^m$. The amount of displacement and the area affected were changing rapidly. At $9^h\ 5^m$ it extended over a wide area and the maximum amount was 6 Å. It was only 3 Å and confined to one point at $9^h\ 13^m$ and it was still further reduced at $9^h\ 25^m$, but the direction was still towards violet. At $9^h\ 27^m$, however, F was displaced 1·5 Å to red from latitude $-10°$ to $-14°$. The amount was 6·4 Å to red in C at $9^h\ 30^m$. The form and height were changing in the meantime equally rapidly. The height had increased to 150″ by $9^h\ 15^m$, but fell to 40″ at $9^h\ 33^m$, 25″ at $9^h\ 39^m$ and 15″ at $9^h\ 49^m$. In the Ca photographs the eruption was not recorded, probably on account of the large displacement of the spectrum lines which would throw the Ca line K off the camera slit of spectroheliograph.

October.—A group of very tall and faint disconnected streaks extending over 35° of the north-east limb was photographed at $8^h\ 17^m$ on the 12th. The tallest of them reached a height of $6\frac{1}{4}'$. Later photographs showed the group to be rapidly fading and there was nothing left by $10^h\ 11^m$.

Another eruptive prominence was seen on the same day near the south pole; it was 150″ high at $8^h\ 17^m$ and attached to the limb at one point only; by $8^h\ 57^m$ it was completely detached, the base being 60″ above the limb and the top 150″. It continued rising till $11^h\ 30^m$ when only a small cloud remained 360″ above the limb and this had vanished at $14^h\ 34^m$.

November.—The tallest prominence of the month was observed on the west limb on the 13th and was found to be rapidly changing. It was 270″ high in Ca at $9^h\ 26^m$, but the height was only 70″ at $9^h\ 54^m$ and there was nothing left by $10^h\ 22^m$.

December.—A group of prominences on the north-east limb on the 14th was 90″ high at $8^h\ 58^m$ but rose to 180″ in about three hours. The maximum height was 240″ at $13^h\ 45^m$. More striking than the increase in height were the rapid changes in form the prominences were undergoing throughout the period of observation.

Another remarkable prominence was observed at the east limb on the 27th, apparently associated with the large spot No. 1578 then nearing the east limb. When first seen it was an ordinary, compact bank occupying about 16° of the limb and 50″ in height. At 9^h 22^m it had apparently burst asunder and at the northern extremity there appeared a floating cloud 140″ above the limb which in subsequent photographs was seen to grow larger, rise higher, and drift rapidly northwards. The maximum height measured was 5′ at 11^h 12^m, when only a small bright cloudlet remained. At 9^h 47^m an enormous eruption burst out from a point 4° south of the original prominence and streamed northward arching over the remains of the earlier outburst. This also rose to a height of 5′ and then quickly dissolved away.

(*b*) OTHER OBSERVATIONS.

15. **Time.**—The error of the standard clock is usually determined by reference to the 16^h signal sent 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 Madura division who takes much interest in the accuracy of the time service. Time determinations are made with the transit instrument at frequent intervals as a check.

The mean-time standard clock and two chronometers were cleaned during the year.

The usual time signal to the station was given, by means of a flag, throughout the year.

16. **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 pressure are recorded by a Richard thermograph (wet and dry bulb) and barograph, and the mean temperatures and pressure are obtained from the traces corrected by reference to the eye observations. The wind direction and velocity are got from a Beckley anemograph.

Temperature.—The mean temperature for the year was 56°·2 or 0°·1 below the average. In January the temperature was nearly a degree above the average; in March it was 1°·1 and in November 2°·3 below the average. The highest shade temperature was 75°·2 on April 25 and the lowest 38°·0 on December 10. The highest temperature in the sun was 141°·4 on April 12, and the lowest temperature on the grass was 19°·2 on January 23.

Humidity.—The mean relative humidity for the year was the same as the normal. The largest departures from normal were in February when it was 7 per cent. below and March when it was 7 per cent. above normal.

Rain.—The rainfall for the year as a whole was nearly normal but the distribution was peculiar. The fall was largely in excess in February and October and largely in defect in May, November, and December. Rain fell on only 4 days in November and on 3 days in December against a ten years' average of 17 and 13 days. The heaviest fall on one day was 2·38 inches on February 24.

Wind.—On the average for the year winds were slightly weaker and 1 point more northerly than usual. The strength was largely below normal in January, June, July, and September and largely above normal in November. The largest amount of wind on any one day was 776 miles on December 24, and the smallest amount was 92 miles on June 4.

Transparency of the atmosphere.—The transparency of the lower atmosphere as judged by the visibility of the Nilgiris—100 miles distant—was about normal.

Cloud and sunshine.—The year was on the whole less cloudy than usual and the amount of bright sunshine was 184 hours above the average. There was an excess of bright sunshine in all months except July and October The excess was large in April, November, and December.

17. **Seismology.**—The Milne horizontal pendulum worked well throughout the year and the results are given in appendix I. Earthquakes were very numerous and the number recorded here was 67 as against 24 in 1907. The original records of the earthquakes are retained at the Observatory, but copies of the more important shocks are sent to the British Association Committee, the Strassburg International Bureau, and to other workers on the subject who ask for them.

18. **Library.**—The library catalogue was completed and has been kept up to date. One hundred and sixty-four books were bound during the year.

19. **Publications.**—Bulletins Nos. XII. and XIII., which complete Volume I., were issued during the year and No. XIV. was in type at the close of the year. They all deal with prominence observations. Part I. of the Memoirs of the Observatory is nearly ready for the press. It is devoted to a full discussion of the photographs of sunspot spectra taken in 1907. In addition to these the following papers were published during the year :—

"Solar Prominences in 1907, observed at the Kodaikánal Observatory" by John Evershed. (M.N., R.A.S. Vol. LXVIII., No. 7.)

"A Large Prominence" by John Evershed. (A.P.J. Vol. XXVIII., No. 1.)

"Note on the Wave-length of $H\delta$ and $H\epsilon$ in the solar spectrum" by John Evershed. (A.P.J. Vol. XXVIII., No. 2.)

20. **General.**—The Director-General of Observatories visited the Kodaikánal and Madras Observatories in February. He was accompanied by Prof. and Mrs. Schuster.

The Director visited Madras in November and superintended the erection of the new dome for the 8-inch equatorial and re-erected the telescope. He also re-wired the transit instrument and the collimators and readjusted them.

The sanction of Government has been obtained for an electric installation for the Observatory and it is hoped that the work will begin at an early date.

The staff of the Observatory worked well throughout the year and so made it possible to keep abreast of the ever-growing work.

KODAIKÁNAL,
3rd February 1909.

C. MICHIE SMITH,
Director, Kodaikánal and Madras Observatories.

II.—REPORT OF THE MADRAS OBSERVATORY FOR THE YEAR 1908.

1. **Staff.**—Mr. R. Littlehailes was in charge of the Observatory till the 7th of September, when I returned from furlough and relieved him.

Both the computer and the second assistant were on privilege leave during the year. Mr. M. G. Subrahmanyam, the first assistant, left the Observatory on the 8th February to take up his work at the Bombay Meteorological office, and Mr. A. A. Narayana Aiyar was appointed in his place.

2. **Time service.**—No change was made during the year in the programme of astronomical observations, nor in the system of time signals distributed from the Observatory. In the meridian observations, which formed practically the whole of the work, all the transits were recorded on the chronograph, and the determinations have on the whole been very satisfactory. The time-gun at the Fort was fired correctly at noon and 8 P.M. on 705 occasions out of 732, giving 96·3 as the percentage of successes against 97·1 last year. Bad tubes, defects in the apparatus and line, have been the causes of the failures. As we have no measuring instrument here to test the current in the line and its insulation, it is not possible to differentiate quickly and with certainty between the two latter sources of trouble. Proposals relating to this matter will form the subject of a separate communication. The time ball at the Port office was dropped at 1 P.M. correctly on all occasions except 13. On eight of these it was dropped correctly at 2 P.M. None of these failures were due to faults at the Observatory.

Since the 11th April records of the 8 and 16-hour roll of signals have been taken by the chronograph, the tape receiving at the same time seconds from the Riefler clock. These show that the hand-sent signals are extremely good and that any improvement in the sending effected by substituting an automatic arrangement would not be appreciated unless the methods of receiving the signals are very materially improved.

3. **Meteorological observations.**—Meteorological observations were made at the usual hours 8, 10, 16, and 20 local mean time. The 10-hour and 16-hour observations were reduced and sent to the India Meteorological office on Form F. Observations on cloud movement were continued. Besides the ordinary weather messages, special storm observations were sent on one occasion to Simla and on 133 occasions to Calcutta. The tabulations of the traces of the autographic meteorological instruments at Madras and of the Anemograph at Dodabetta are brought up to date.

4. **Buildings.**—Certain repairs to the buildings were effected during the year. In September the materials for the construction of a new dome over the 8-inch equatoreal were received from England. The clock, the telescope and its mountings were safely taken down early in October, and the work of removing the old dome and preparations for erecting the new one taken in hand at once. All work was however stopped by the heavy rain at the end of October. In November the Director visited the Observatory and during the fine weather that set in after the first week, the work on the new dome was resumed under his superintendence, and I was relieved of responsibility in a matter in which I had no previous experience to guide me, and no time to acquire any by a tedious process of trial and error. The erection of the dome was completed and the telescope remounted early in December and nearly all work on the structure was finished before the end of the year.

5. **Instruments.**—The following is the list of instruments at the Madras Observatory on the 31st December 1908 :—

(*a*) *Astronomical.*

Eight-inch Equatorial Telescope—Troughton & Simms.
Sidereal Clock—Haswall.
" Dent, No. 1408.
" S. Riefler, No. 61.
Mean Time Clock with galvanometer—Shepherd & Sons.
Meridian Circle—Troughton & Simms.

Mean Time Clock—J. Monk.
Mean Time Chronometer—V. Kullberg, 5394.
" " 6544.
" Parkinson & Frodsham, 2352.
Portable Transit Instrument—Dolland.
Portable Telescope with stand.
Tape Chronograph—R. Fuess.
Relay for use with the Chronograph—Siemens.

(*b*) *Meteorological.*

Richard's Barograph—No. 10, L. Casella.
Richard's Thermograph—No. 3618, L. Casella.
Beckley's Anemograph—Adie.
Sunshine Recorder—No. 149, L. Casella.
Anemoscope—P. Orr & Sons.
Nephoscope—Mons. Jules Daboscq & Ph. Pellin.
Barometer, Fortin's—1771, L. Casella.
" 725, L. Casella (spare).
" 1420, L. Casella (spare).
Dry Bulb Thermometer—No. 94221, L. Cassella.
" 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. 69047, L. Casella.
Wet Minimum Thermometer—No. 91753, Negretti & Zambra.
Sun Maximum Thermometer—No. 10479, Negretti & Zambra.
Grass Minimum Thermometer—No. 3377, Negretti & Zambra.
Rain-gauge (8" diameter)—No. 1042, Negretti & Zambra.
Measure glass for above.
Rain-gauge (5" diameter).
Measure glass for above.

The micrometer frame of the transit was rewired by the Director in November, and a new system of wires was put in the south collimator; the north collimator was also rewired. The instrument has been steady throughout the year. The Riefler keeps a steady rate for long periods. On September 11–12, however, it was subjected to some unknown disturbance and gained as much as 12 seconds in 18 hours. Its daily rate had been 0·15 second, gaining, previous to this and was very unsteady for some weeks after this. During the last two months of the year the rate has been remarkably steady.

The Haswall clock which was taken down with the telescope had not been put up again at the end of the year.

6. **Weather summary.**—The following is a summary of the meteorological conditions at Madras during the year 1908 :—

Pressure.—Pressure was above normal in January, March, July, and December, below normal during the other months; in May it was normal. The greatest excess was 0·020 inch in January and the greatest defect was 0·041 inch in April. The highest pressure was 30·176 inches on January 8 and the lowest 29·569 on June 29.

Temperature.—The mean temperature was above the average in all months except September, November, and December. The maximum shade temperature was also above normal in all months except January, February, September, November, and December, the greatest excess being 3·9 in June and the defect being 2·4 in September. The minimum in the shade was above normal in January, February, April, May, June, and July and below normal in the remaining months; the minimum on grass was below normal in March, October, November, and December and above normal during the other months. The maximum in the sun was below the average in all the months of the year. The highest shade temperature recorded was 109°·6 on April 26 and May 30, and the lowest 60°·8 on January 20; the highest reading of the black bulb thermometer in vacuo was 154°·0 on May 11.

Humidity.—The percentage of humidity was normal in June and November, in slight defect in March and December and above normal in all the other months. The driest day was March 8 with 13 per cent. of humidity.

Wind.—The wind direction was normal or nearly normal in all months except in October when it was 3 points more southerly. The amount of air movement was in defect throughout the year.

Cloud.—The percentage of cloud was in slight excess in February, March, and July and in defect in all the other months.

Sunshine.—The percentage of bright sunshine was below normal throughout the year, the greatest defect being 21·9 in February. There were 2,145·8 hours of bright sunshine during the year.

Rainfall.—The rainfall was above the average in February, August, September, and October and below during the remaining months of the year. The greatest excess was 13·78 inches in October and the defect was 3·00 inches in December. The rainfall for the whole year was 55·97 inches on 88 days, being 6·95 inches above the normal. The monsoon rainfall from October 15 to the close of the year was 39·07 inches against an average of 26·00 inches. The greatest fall on any day was 7·28 inches on October 23.

Storms.—(1) On the 25th September, a storm crossed the coast near Cocanada, and caused a strong indraught from the Arabian sea across the Peninsula, followed by exceptionally heavy rain in the Deccan during the period 26th to 28th.

(2) On the 29th December a storm of some severity was formed in the south-west of the Bay and moved in a westerly direction giving moderate to heavy rain at Madras and over the south of the Presidency.

MADRAS OBSERVATORY,
3rd February 1909.

R. LL. JONES,
Deputy Director.

Appendix I.

KODAIKÁNAL Observatory Seismological Records in 1908.

No.	Date.	P.T. Commence G.M.T.	L.W. Commence G.M.T.	Maxima G.M.T.	End.	Max. Amp.	Duration.	Remarks.
	1908.	H. M.	H. M.	H. M.	H. M.	MM. "	H. M.	
2	Jan. 11 ..	3 43·8	4 00·8	4 05·3	5 04	6·0 = 2·6	1 20	
3	12 ..	..	10 32·1	10 34·1	10 42	0·2 = 0·1	0 10	
4	15 ..	13 35·2	13 38·2	13 39·1	13 54	0·2 = 0·1	0 19	
5	25 ..	20 22·3	..	..	20 28·5	..	0 06	Widening of line.
6	27 ..	16 06·2	16 13·5	16 15·5	16 27	0·6 = 0·3	0 21	
7	29 ..	21 25·9	..	..	21 39	..	0 13	Widening of line.
8	Feb. 2 ..	0 43·5	0 46·0	0 52·8	1 12	0·6 = 0·3	0 28	
9	6 ..	1 35·2	1 40·1	1 44·3	2 12	0·4 = 0·2	0 37	
10	9 ..	18 18·0	18 26·6	18 31·0	19 21	3·0 = 1·4	1 03	
11	11 ..	14 33·1	..	..	14 40	..	0 07	Widening of line.
12	Mar. 4 ..	?	15 24·3	15 25·9	15 32	0·5 = 0·3	?	
13	5 ..	2 26·4	2 46·5	2 51·6	4 11	4·5 = 2·2	1 45	
14	13 ..	6 27·9	6 34·3	6 36·4	6 54	0·4 = 0·2	0 26	Felt at Mandalay.
15	15 ..	10 06·1	10 13·3	10 18·4	10 40	1·4 = 0·7	0 34	
16	23 ..	12 32·3	12 57·7	12 58·8	13 16	1·5 = 0·7	0 44	
17	26–27 ..	23 23·8	23 46·6	23 48·6	..	1·6 = 0·8	..	
		..	..	0 43·3	..	2·9 = 1·5	..	
		.	..	0 53·1	2 15	2·5 = 1·3	2 51	Chilapa.
18	27 ..	4 15·0	?	?	6 03	0·5 = 0·3	1 48	Sheet marked at 4h 52m.
19	Apr. 2 ..	6 15·1	6 24·4	6 27·4	6 51	0·6 = 0·3	0 36	
20	4 ..	6 24·6	6 31·0	6 38·2	6 55	0·6 = 0·3	0 30	Assam ?
21	10 ..	0 06·1	0 21·5	0 28·7	0 51	0·6 = 0·3	0 45	
22	16 ..	No P. Ts.	17 52·2	17 53·7	18 01	0·5 = 0·2	0 09	
23	19 ..	8 15·5	..	..	8 49	..	0 38	Widening of line.
24	23 ..	0 02·6	0 13·1	0 15·2	1 40	4·2 = 2·0	1 37	
25	May 5 ..	6 33·0	6 51·7	6 52·7	8 04	3·6 = 1·8	1 31	
26	5 ..	No P. Ts.	11 22·3	11 23·3	12 03	3·0 = 1·5	0 41	
27	6 ..	11 44·8	..	..	12 09	..	0 24	Widening of line.
28	11 ..	13 07·8	13 10·8	13 11·9	13 27	0·4 = 0·2	0 19	
29	15 ..	8 56·7	9 27·4	9 32·5	10 56	1·1 = 0 5	1 59	
30	20 ..	7 51·4	7 58·5	8 00·5	..	0·8 = 0·4	..	
		..	..	08·6	8 52	1·0 = 0·5	1 01	
31	June 3 ..	15 59·7	16 07·8	16 08·5	16 46	2·4 = 1·2	0 46	
32	30 ..	2 27·4	2 31·0	2 32·2	2 51	0·5 = 0·2	0 24	
33	July 13 ..	21 46·6	21 48·6	21 50·1	22 18	0·6 = 0·3	0 31	
34	20 ..	12 38·2	..	..	12 48	..	0 10	Widening of line.
35	26 ..	16 12·0	16 20·8	16 22·8	16 52	2·0 = 1·0	0 40	
36	26 ..	17 27·4	17 34·2	17 36·1	18 03	1·6 = 0·8	0 36	
37	Aug. 4 ..	14 29·7	..	..	15 47	..	1 17	Widening of line.
38	12 ..	16 01·7	..	..	17 18	..	1 16	Widening of line.
39	12 ..	18 56·0	19 16·0	19 51·0	19 55	1·0 = 0·5	0 59	
40	17 ..	11 02·8	11 35·1	11 38·2	13 17	2·5 = 1·1	2 14	
41	20 ..	9 53·7	10 06·6	10 09·1	11 28	2·6 = 1·1	1 34	
42	22 ..	12 12·5	..	12 17·2	12 29	..	0 17	Widening of line.
43	22 ..	19 33·6	..	..	19 51	..	0 17	Widening of line.
44	Sept. 9 ..	6 54·6	..	..	7 16	..	0 21	Widening of line.
45	9 ..	20 42·3	..	..	20 51	..	0 09	Widening of line.
45A	21 ..	6 01·0	..	..	7 58	..	1 57	Widening of line.
46	23 ..	7 09·0	7 13·1	7 15·1	8 10	4·1 = 1·8	1 01	
47	26 ..	5 46·3	6 08·4	6 09·5	6 37	0·4 = 0·2	0 51	
48	28 ..	6 41·6	6 53·0	6 55·5	7 10	0·6 = 0·3	0 28	
49	Oct. 13 ..	5 44·2	6 38·6	6 42·2	7 18	0·3 = 0·1	1 34	
50	14 ..	15 37·7	15 41·8	15 44·9	15 49	1·0 = 0·5	0 11	
51	20 ..	2 49·5	3 08·0	3 10·9	3 47	0·6 = 0·3	0 57	
52	24 ..	21 26·4	21 27·4	22 01·6	22 16	0·7 = 0·3	0 50	Punjab, Simla.
52A	Nov. 2 ..	5 18·2	?	5 27·1	7 10	4 0 = 1·7	1 52	Sheet out 5h 20m.
52B	2 ..	7 28·0	7 30·5	7 32·0	7 57	1·1 = 0·5	0 29	
53	6 ..	7 23·4	7 54·6	7 59·7	8 56	0·6 = 0·2	1 33	
54	6 ..	14 15·1?	14 38·2	14 39·2	15 07	0·7 = 0·3	0 52	
55	9 ..	16 26·4	..	16 36·1	16 53	..	0 27	Widening of line.
56	11 ..	13 26·2	13 45·8	13 47·4	14 51	4·0 = 1·7	1 25	
57	12 ..	16 44·4	16 48·5	16 50·5	16 59	0·7 = 0·3	0 15	
58	12 ..	22 00·8	22 06·4	22 09·0	22 21	0·9 = 0·4	0 20	
59	15 ..	1 47·4	1 56·6	1 58·1	2 14	0·6 = 0·3	0 27	
60	23 ..	12 58·7	13 20·3	13 22·8	13 35	0·6 = 0·3	0 36	
61	25 ..	3 08·6	..	..	3 19	..	0 10	Widening of line.
62	Dec. 1 ..	3 08·8	3 11·9	3 14·4	3 27	0·6 = 0·3	0 18	
63	12 ..	12 59·9	13 04·5	13 10·6	14 25	5·0 = 2·3	1 25	
64	12 ..	19 07·4	19 25·4	19 25·8	19 59	0·5 = 0·2	0 52	
65	18 ..	15 42·6	15 49·6	15 52·7	17 07	3·6 = 1·7	1 24	
66	22 ..	3 04·7	..	..	3 23	..	0 18	Widening of line.
67	28 ..	4 29·4	4 58 6	5 00·4	7 28	3·0 = 1·4	2 54	Messina; sheet cut 5h 44m.

Appendix II.

Latitude—10° 13′ 50″ N.
Longitude—5h 09m 52s E.

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

MEAN monthly and annual Meteorological Results at the Kodaikánal Observatory in 1908.

Month.	Barometer. Reduced to 32°.	Barometer. Daily range.	Dry bulb thermometer. Mean.	Dry bulb thermometer. Max.	Dry bulb thermometer. Min.	Dry bulb thermometer. Range.	Wet bulb. Mean.	Wet bulb. Min.	Tension of vapour. By Blanford's tables.	Relative humidity. By Blanford's tables.	Sun Max. *in vac.*	Min. on grass.	Wind. Daily velocity.	Wind. Mean direction.		Rain. Amount.	Rain. Days.	Clear sky.	Bright sun-shine.
	INCHES.	INCHES.	°	°	°	°	°	°	INCHES.	CENTS.	°	°	MILES.	POINTS.	POINTS.	INCHES.	NO.	CENTS.	HOURS.
January ..	22·862	0·074	54·0	63·9	47·8	16·1	48·0	42·1	0·280	67	114·5	36·9	287	10	E. S. E.	1·12	6	59	234·8
February ..	·822	·075	55·0	65·2	48·3	16·9	46·7	40·0	·240	55	120·0	38·2	329	2	N. N. E.	4·99	3	63	225·4
March ..	·857	·072	56·8	67·5	50·0	17·5	49·3	41·7	·280	61	128·7	38·7	299	8	E.	3·44	5	64	238·4
April ..	·822	·071	61·0	70·5	54·8	15·7	53·8	47·8	·346	65	130·3	46·0	297	8	E.	3·41	6	67	253·8
May ..	·818	·073	60·3	68·7	55·0	13·7	54·8	50·0	375	72	128·5	47·5	256	4	N. E.	5·06	10	50	222·2
June ..	·772	·060	58·0	65·0	53·7	11·3	53·6	49·5	·369	76	121·7	47·2	356	25	W. by N.	2·35	12	31	130·4
July ..	·771	·058	55·6	61·8	52·2	9·6	52·9	49·2	·376	85	111·7	48·5	407	27	N.W.byW.	4·89	13	17	75·0
August ..	·760	·061	56·5	63·3	52·4	10·9	53·4	49·2	·379	83	119·7	47·4	321	29	N.W.byN.	5·08	10	35	153·4
September ..	·762	·074	56·8	63·2	52·9	10·3	54·0	49·5	·392	85	120·1	48·7	254	28	N. W.	8·91	16	28	113·8
October ..	·787	·080	55·1	60·8	51·6	9·2	53·2	50·1	·388	89	112·2	46·2	263	2	N. N. E.	16·42	20	24	100·4
November ..	·796	·070	51·6	59·3	46·6	12·7	48·7	44·3	·317	82	111·3	41·6	323	25	W. by N.	1·73	4	52	194·5
December ..	·808	·066	53·3	63·3	46·5	16·8	47·1	40·9	·267	66	112·0	37·1	298	6	E.N.E.	1·77	3	51	235·4
Annual ..	22·803	0·070	56·2	64·4	51·0	13·4	51·3	46·2	0·334	74	119·2	43·7	308	1	N. by E.	59·17	108	45	2,177·5

EXTREME monthly Meteorological Records at the Kodaikánal Observatory in 1908.

Month.	Barometer. Highest.		Barometer. Lowest.		Barometer. Range.	Dry bulb thermometer. Highest.		Dry bulb thermometer. Lowest.		Wet bulb. Lowest.		Humidity. Lowest.		Sun Th. *in vacuo.* Highest.		Grass therm. Lowest.		Wind. Highest.		Wind. Lowest.		Rain. Greatest Fall.	
	INCHES.	DAY	INCHES.	DAY.	INCHES.	°	DAY.	°	DAY.	°	DAY.	CENTS.	DAY.	°	DAY.	°	DAY.	MILES.	DAY.	MILES.	DAY.	INCHES.	DAY.
January ..	22·956	7	22·731	31	0·225	73·2	25	42·4	21	32·4	21	9	21, 25	124·0	13	19 2	23	595	6	136	15	0·23	7
February ..	·944	9	·731	23	·213	72·6	4	42·8	9	34·0	10	10	11	133·8	6	20·7	1	550	24	141	3	2·38	24
March ..	947	21	·766	1	·181	72·6	16	45·6	4	33·7	5	7	5	139·4	2	30·2	15	465	4	133	1	2·27	25
April	·907	21	·742	7	·165	75·2	25	51·8	13	41·2	13	25	22	141·4	12	36·6	3	480	13	224	17	0·76	17
May	·891	2	·734	6	·157	73·4	27	51·1	17	44·9	14	39	9	135·9	5	38·2	16	387	7	126	29, 30	1·32	7
June	·869	3	·691	24	·178	70·0	5, 7	50·7	16	43·8	21	39	21	136·6	2	36·4	2	688	30	92	4	0·32	11
July	·874	8, 9	·686	27	·188	65·7	2	49·9	30	44·5	1	49	1	132·1	3	40·9	8	716	1	151	7	1·10	7
August ..	·832	13, 25	·680	2	·152	66·6	23, 27	50·8	3	42·9	28	43	28	137·6	18	42·8	22	570	8	118	25	1·70	11
September ..	·847	19	·689	28	·158	67·5	30	50·4	19	41·1	24	35	24	139·2	22	43·4	25	407	27	114	18	1·30	8
October ..	·891	11	·642	24	·249	64·6	2	50·0	21	46·4	2	42	12	130·6	19	37·2	14	531	22	127	6	2·12	5
November ..	·893	9	·658	3	·235	64·7	23	40·6	15	38·0	12	34	7	122·6	21	32·6	21	611	1	139	25	0·55	26
December ..	·888	10	·673	31	·215	70·5	20	38·0	10	31·6	9	6	4, 20	120·3	5	20·5	8	776	31	160	5	0·90	24

Appendix III.

KODAIKÁNAL Mean Hourly Wind Velocity for the year 1908.

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	11	11	10	12	12	12	13	14	14	14	14	14	14	13	12	10	9	9	10	11	11	12	12	13
February	15	14	15	16	16	16	16	16	17	18	17	16	15	13	11	10	8	8	9	10	11	13	15	16
March	14	13	14	14	14	14	14	16	17	17	16	16	13	12	10	9	8	8	8	9	9	10	12	13
April	13	12	13	13	12	12	12	13	15	15	15	14	13	12	11	12	11	10	10	11	11	11	13	14
May	12	12	11	11	11	10	10	10	11	11	13	12	12	11	10	11	10	8	9	9	9	10	11	12
June	15	15	16	15	16	15	14	14	14	14	14	14	14	14	14	15	14	14	14	15	16	16	16	16
July	17	19	19	18	19	18	18	18	16	14	14	14	15	14	15	16	17	18	18	18	18	19	19	19
August	15	15	15	15	15	16	15	13	13	11	12	12	12	11	11	12	13	13	13	13	13	13	16	16
September	12	13	15	15	15	14	13	10	10	9	10	10	9	8	9	8	8	8	9	9	10	11	11	12
October	12	11	11	10	10	10	10	10	11	11	12	12	12	11	12	11	10	11	10	10	11	11	12	12
November	15	15	16	16	17	16	15	15	14	14	15	14	14	12	11	11	9	11	11	12	12	13	14	13
December	13	13	13	13	13	13	14	13	13	15	15	14	14	13	12	10	9	8	11	12	11	12	13	13
Annual ..	14	14	14	14	14	14	14	14	14	14	14	14	13	12	12	11	10	10	11	12	12	13	14	14

Appendix IV.

KODAIKÁNAL Mean Hourly Bright Sunshine for the year 1908.

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	0·15	0·73	0·79	0·86	0·83	0·87	0·83	0·73	0·61	0·56	0·53	0·07	
February	·09	·73	·89	·90	·85	·80	·79	·70	·72	·65	·52	·13	
March	·15	·85	·89	·92	·91	·83	·76	·65	·50	·48	·42	·31	
April	·21	·80	·93	·95	·97	·95	·87	·83	71	·55	·50	·20	
May	·19	·65	·90	·97	·93	·84	·74	·62	·49	·35	·35	·13	
June	·12	·38	·56	·59	·57	·49	·38	·33	·39	·22	·21	·10	
July	·05	·26	·41	·45	·39	·31	·20	·16	·09	·07	·02	..	
August	·17	·59	·71	·70	·73	·70	·54	·32	·25	·15	·09	..	
September	·01	·38	·63	·56	·59	·54	·39	·23	·13	·10	·17	·06	
October	..	·32	·49	·49	·35	·42	·31	·21	·23	·21	·16	·04	
November	·08	·56	·83	·84	·82	·81	·67	·62	·57	·36	·27	·05	
December	·07	·51	·72	·85	·86	·86	·89	·85	·80	·70	·46	·04	
Mean ..	0·11	0·56	0·73	0·76	0·78	0·70	0·61	0·52	0·46	0·37	0·31	0·09	

Appendix V.

NUMBER of days in each month on which the Nilgiris were visible in 1908.

Month.	Very clear.	Visible.	Just visible.	Tops only visible.	Total.
January	1	10	4	3	18
February	..	8	1	3	12
March	5	4	6	1	16
April	3	1	3	..	7
May	2	2	5	..	9
June	9	7	2	..	18
July	3	4	3	.	10
August	3	8	5	..	16
September	13	4	5	1	23
October	4	2	7	..	13
November	..	3	8	1	12
December	9	7	2	3	21
Total ..	52	60	51	12	175

Latitude—10° 9′ N.

Longitude—5h 10m 10s E.

Appendix VI.

Height of barometer cistern above mean sea level 944 feet.

Mean monthly and annual Meteorological Results at the Periyakulam Observatory in 1908.

Month.	Barometer. Reduced to 32°.	Barometer. Daily range.	Dry bulb thermometer. Mean.	Dry bulb thermometer. Max.	Dry bulb thermometer. Min.	Dry bulb thermometer. Range.	Wet bulb. Mean.	Wet bulb. Min.	Tension of vapour. By Blanford's tables.	Relative humidity. By Blanford's tables.	Sun Max. *in vac.*	Min. on grass.	Wind. Daily velocity.	Wind. Mean direction.	Wind. Mean direction.	Rain. Amount.	Rain. Days.	Clear sky.	Remarks.
	INCHES.	INCHES.	°	°	°	°	°	°	INCHES.	CENTS.	°	°	MILES.	POINTS.	POINTS.	INCHES.	NO.	CENTS.	
January ..	28·888	0·123	75·7	86·8	66·3	20·5	66·9	63·1	0·549	61	137·0	62·5	40·2	12	S.E.	5·72	5	44	
February ..	·960	·156	76·6	89·6	65·0	24 6	66·3	60·9	·511	56	142·0	56·9	47·1	8	E.	2·19	3	62	
March ..	·973	·157	80·3	92·9	68·8	24·1	69·0	64·4	·563	54	147·0	60·6	46·6	11	S.E. by E.	5·19	5	68	
April ..	·860	·144	83·8	96·6	73·9	22·7	73·4	69·5	·652	57	150·4	68·3	42·4	30	N.N.W.	3·65	3	73	
May ..	·866	·117	82·7	96·3	72·7	23·6	72·5	68·8	·664	60	153·1	69·0	59·1	22	W.S.W.	3·18	5	66	
June ..	·839	·110	81·6	93·8	72·2	21·6	70·8	67·2	·609	57	150·3	69·0	89·9	20	S.W.	0·45	2	53	
July ..	·864	·107	81·1	92·8	72·2	20·6	79·5	67·2	·568	54	..	69·0	83·3	16	S.	0·47	1	36	Sun maximum Thermometer was in use only on 11 days in July.
August ..	·854	·112	82·1	95·2	71·4	23·8	70·1	66·4	·577	53	153·6	66·7	83·2	19	S.W. by S.	0·40	1	59	
September ..	·862	·128	81·0	92·8	71·6	21·2	70·6	67·6	·553	52	150·5	67·3	74·0	28	N.W.	3·01	5	55	
October ..	·914	·127	79·3	89·2	71·4	17·8	71·1	68·2	·653	66	141·7	68·4	47·1	16	S.	8·80	12	51	
November ..	·966	136	77·3	87·6	67·8	19·8	67·8	64·2	·559	59	138·1	61·7	32·2	15	S. by E.	0·30	1	68	
December ..	29·002	·132	75·8	87·1	64·4	22·7	65·3	60·8	·489	55	134·5	58·1	47·7	13	S.E. by S.	0·12	0	76	
Annual ..	28·904	0·129	79·8	91·7	69·8	21·9	70·3	65·7	0·579	57	* 145·3	64·8	57·7	18	S.S.W.	38·48	43	59	* Mean of 11 months.

Extreme monthly Meteorological Records at the Periyakulam Observatory in 1908.

Month.	Barometer. Highest.	DAY.	Barometer. Lowest.	DAY.	Barometer. Range.	Dry bulb thermometer. Highest.	DAY.	Dry bulb thermometer. Lowest.	DAY.	Wet bulb. Lowest.	DAY.	Humidity. Lowest.	DAY.	Sun. Th. *in vacuo.* Highest.	DAY.	Grass therm. Lowest.	DAY.	Wind. Highest.	DAY.	Wind. Lowest.	DAY.	Rain. Greatest fall.	DAY.
	INCHES.		INCHES.		INCHES.	°		°		°		CENTS.		°		°		MILES.		MILES.		INCHES.	
January	28·972	31	28·794	16	0·178	90·4	14	58·4	22	56·0	22	27	30&31	149·0	16	52·9	21	90·1	8	22·7	27	2·50	16
February	29·169	9	·798	2	·371	93·5	14	57·1	12&13	53·2	12	13	16	151·0	7	45·8	12	85·2	10	21·3	3	1·04	24
March	·144	12	·819	1	·325	97 1	15	57·9	11	53·5	11	14	10	154·6	15	46·9	11	80·3	25	20·4	1	2·38	25
April	·012	13	·720	28	·292	102·0	29	70·7	23	62·5	14	25	3	161·9	29	62·9	1	117·0	27	19·5	16	2·61	17
May	28·991	2	·720	8	·271	101·3	25	69·2	16	65·5	14	33	24	162·5	18	64·0	16	114·3	29	24 6	5	1·02	21
June	·939	3	·716	12	·223	99·6	1	67·7	21	63·2	6	30	2	163·1	26	63·0	21	169·5	11	22·0	14	0·18	14
July	·980	8	·716	27	·264	97·7	1	69·5	2	64·7	30	19	1	160·6	1	65·4	30	145·6	28	19·9	24	0·31	25
August	·955	25	·717	9	·238	98·2	27	67·6	28	61·7	28	30	25	171·0	4	61·2	28	132·0	26	35·1	30	0·11	31
September	·992	19	·722	25	·270	97·9	30	66·0	25	62·5	25	31	24	161·1	1	60·1	25	163·5	27	24·2	14	1·18	14
October	29·046	11	·741	24	·305	97·1	1	68·3	30	65·0	2	33	1	159·6	3	62·3	2	95·8	1	15·0	30	1·71	27
November	·100	24	·717	3	·283	89·8	30	59·5	12	56·8	11&12	24	11	144·6	23	49·8	12	60·3	14	8·7	1	0·21	1
December	·152	10	·807	31	·345	90·8	23	57·2	9	54·3	9	31	11	146·8	21	48·2	9	72·7	12	14·9	5	0·07	26

Appendix VII.

MADRAS OBSERVATORY.—Abnormals from monthly means for the year 1908.

Abnormals of	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Reduced atmospheric pressure	+ 0·020	— 0·035	+ 0·019	— 0·041	Same as	— 0·010	+ 0·017	— 0·022	— 0·024	— 0·008	— 0·005	+ 0·003	— 0·007
Temperature of air	+ 0·8	+ 0·2	+ 0·2	+ 1·3	+ 1·7	+ 1·8	+ 1·1	+ 0·6	— 0·8	+ 0·5	— 1·6	— 0·5	+ 0·4
Do. of evaporation	+ 2·3	+ 1·5	Same as	+ 2·2	+ 1·6	+ 1·4	+ 1·9	+ 1·9	+ 2·5	+ 1·6	— 1·7	— 1·0	+ 1·2
Percentage of humidity	+ 6	+ 6	— 1	+ 3	+ 2	Same as	+ 5	+ 5	+ 14	+ 5	Same as	— 2	+ 8
Greatest solar heat in *vacuo*	— 5·5	— 4·6	— 4·3	— 1·5	— 0·7	— 2·5	— 7·8	— 6·4	— 8·5	— 8·2	— 9·7	— 9·0	— 5·7
Maximum in shade	— 0·2	— 0·1	+ 0·5	+ 2·8	+ 2·8	+ 3·9	+ 1·0	+ 1·5	— 2·4	+ 0·4	— 1·1	— 1·2	+ 0·7
Minimum in shade	+ 0·8	+ 0·2	— 0·9	+ 1·3	+ 0·9	+ 1·8	+ 1·2	— 0·2	... 0·6	— 0·5	— 3·3	— 1·4	Same as
Do. on grass	+ 2·0	+ 1·1	— 0·3	+ 2·2	+ 1·5	+ 2·2	+ 1·7	+ 0·9	+ 0·2	— 0·4	— 3·5	— 1·3	+ 0·6
Rainfall in inches	— 0·87	+ 0·20	— 0·39	— 0·62	— 2·03	— 1·68	— 2·25	+ 0·14	+ 4·82	+ 13·78	— 1·20	— 3·00	+ 6·95
Do. since January	..	— 0·67	— 1·06	— 1·68	— 3·71	— 5·34	— 7·59	— 7·45	— 2·63	+ 11·15	+ 9·95	+ 6·95	..
General direction of wind	1 point E.	1 point S.	Same as	1 point S.	1 point S.	Same as	1 point W.	1 point S.	1 point W.	3 points S.	Same as	1 point E.	Same as
Daily velocity in miles	— 36	— 34	— 60	— 28	— 49	— 35	— 59	— 57	— 69	— 28	— 35	— 2	— 41
Percentage of cloudy sky	— 8	+ 2	+ 3	— 3	— 3	— 4	+ 5	— 1	— 5	— 11	— 19	— 8	— 5
Do. of bright sunshine	— 11·1	— 21·9	— 15·5	— 4·7	— 15·1	— 12·3	— 11·6	— 15·8	— 3·6	— 3·8	— 0·8	— 7·7	— 9·7

+ means *above* normal, — *below*.

Appendix VIII.

ABSTRACT of the mean meteorological condition of Madras in the year 1908 compared with the average of past years.

Mean values of	1908.	Difference from	Average.
›duced atmospheric pressure	29·857	0·007 below.	29·864
›mperature of air	81·5	0·4 above.	81·1
Do. of evaporation	75·7	1·2 „	74·5
›rcentage of humidity	75	3 „	72
·eatest solar heat in *vacuo*	134·0	5·7 below.	139·7
ıximum in shade	91·5	0·7 above.	90·8
ınimum in shade	74·7	Same as	74·7
Do. on grass	72·5	0·6 above.	71·9
ıinfall in inches on 88 days	55·97	6·95 „	49·02
›neral direction of wind	S.E.	Same as	S.E.
ily velocity in miles	130	41 below.	171
rcentage of cloudy sky	44	5 „	49
Do. of bright sunshine	48·7	9 7 „	58·4

DURATION and quantity of the wind from different points.

From	Hours.	Miles.	From	Hours.	Miles.	From	Hours.	Miles.	From	Hours.	Miles.
›rth ..	102	646	East ..	178	872	South ..	265	1,608	West ..	331	2,630
by E. ..	321	1,798	E. by S. ..	286	1,128	S. by W...	282	1,370	W. by N...	150	1,114
N.E. ..	324	1,938	E.S.E. ..	326	1,368	S.S.W. ..	272	1,480	W.N.W...	117	819
E. by N...	464	3,320	S.E. by E.	264	1,377	S.W. by S.	173	698	N.W. by W.	54	367
E. ..	237	1,602	S.E. ..	556	3,342	S.W. ..	165	833	N.W. ..	53	340
E. by E.	285	1,582	S.E. by S.	610	4.528	S.W. by W.	176	862	N.W. by N.	60	297
N.E. ..	177	915	S.S.E. ..	453	3,020	W.S.W. ..	291	1,621	N.N.W. ..	106	600
by N. ..	167	1,064	S. by E. ..	342	1,855	W. by S...	274	1,701	N. by W...	187	998

There were 786 calm hours during the year. The resultant corresponding to the above umbers is represented by a S.E. wind, blowing with a uniform daily velocity of 27 miles.

Appendix IX.

MADRAS OBSERVATORY.—Number of hours of wind from each point in the year 1908.

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	..	16	61	94	72	49	42	40	87	71	56	22	30	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	104
February	..	..	1	12	27	62	47	60	7	89	76	36	20	14	24	57	3	12	3	..	..	..	..	..	..	..	..	..	..	..	..	..	146
March	..	..	..	..	..	..	9	6	33	54	93	41	137	99	14	38	10	10	9	1	1	..	..	..	..	..	..	..	..	..	..	..	189
April	..	..	..	..	..	..	1	..	1	5	9	24	119	231	99	33	49	28	36	6	7	4	6	..	3	3	1	1	2	..	1	..	51
May	1	..	3	1	..	6	1	1	1	..	4	16	98	98	128	56	85	54	39	11	22	10	16	6	21	8	17	2	9	1	8	3	18
June	1	..	2	4	3	1	3	5	4	4	8	14	34	31	61	26	39	32	52	37	25	23	52	55	98	33	27	18	11	3	1	3	10
July	..	..	..	..	..	1	..	1	..	1	6	8	9	21	14	37	16	52	25	35	31	55	115	84	113	46	12	6	6	2	2	1	45
August	..	1	1	..	1	..	2	5	3	5	9	25	11	58	46	57	29	59	55	49	33	40	29	70	42	37	16	7	5	2	1	..	46
September	..	1	2	1	1	..	3	8	2	4	16	25	32	31	39	28	22	22	44	27	41	32	43	28	39	16	36	17	10	20	5	..	125
October	29	38	18	19	12	13	41	28	40	46	48	38	66	27	11	9	11	13	9	5	4	11	30	29	15	5	7	3	6	7	31	35	40
November	36	114	92	141	35	24	16	6	..	7	1	15	..	..	17	1	1	..	..	2	1	1	..	2	..	2	1	..	4	25	51	113	12
December	35	151	144	192	86	79	12	7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	32	..
Annual ..	102	321	324	464	237	235	177	167	178	286	326	264	556	610	458	342	265	252	272	173	165	176	291	274	331	150	117	54	58	60	106	187	786

Appendix A.

Madras Observatory.—Number of miles of wind from each point in the year 1908.

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	..	89	382	628	403	214	204	232	402	216	226	191	146	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3333
February	..	..	5	78	121	359	259	410	57	341	285	126	69	78	84	201	19	52	17	..	..	..	..	..	..	..	..	..	..	..	..	..	2561
March	..	..	..	..	..	..	26	54	191	199	413	275	665	597	88	157	70	70	50	7	2	..	..	..	..	..	..	..	..	..	..	..	2864
April	..	..	..	..	..	..	11	..	5	6	38	100	838	1876	748	179	337	220	287	43	61	24	37	..	31	17	6	10	16	..	10	..	4900
May	12	..	29	8	..	62	9	9	3	..	35	123	890	906	1000	392	519	266	218	71	141	82	87	39	189	66	171	21	79	8	61	31	5527
June	3	..	14	34	19	13	22	29	29	28	60	122	291	311	547	235	291	203	298	215	146	134	348	457	894	289	232	155	95	9	1	20	5544
July	..	..	..	..	..	7	..	2	..	8	37	42	62	142	99	217	62	221	112	104	187	283	672	553	946	373	84	44	27	9	2	1	4296
August	..	5	6	..	6	..	12	29	15	20	38	129	41	333	251	292	160	206	259	136	129	177	161	432	286	277	123	41	21	11	15	..	3611
September	..	5	14	5	6	..	14	46	6	26	54	89	151	170	128	155	101	82	193	97	140	119	205	118	223	60	157	89	50	65	28	..	2596
October	127	181	73	96	51	53	149	144	164	248	179	150	199	115	41	22	47	50	46	17	23	39	111	99	61	24	39	7	81	26	152	175	2938
November	217	634	541	793	215	170	94	40	..	36	3	30	..	..	34	5	2	..	..	8	4	4	..	3	..	8	7	..	21	170	304	565	3908
December	287	884	874	1678	781	704	115	69	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	27	206	5625
Annual ..	646	1798	1938	3320	1602	1582	915	1064	872	1128	1368	1377	3342	4528	3020	1855	1608	1370	1480	698	833	862	1621	1701	2680	1114	819	367	340	297	600	998	47693

Appendix XI.

MADRAS OBSERVATORY.—Number of inches of rain from each point in the year 1908.

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	..	..	..	..	..	..	..	..	0·02	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
February	..	..	..	..	..	..	0·02	0·06	..	0·26	0·14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
March	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
April	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
May	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·02	..	..	0·07	..	..	..	..	..	..	..	..	..	..	..	..	..	..
June	..	..	..	..	0·09	..	0·02	0·03	0·01	..	..	..	0·02	0·01	0·05	0·04	..	0·01	..	..	0·01	..	..	0·04	0·06	0·02	0·01	..	..	..	..	0·04	0·02
July	..	..	..	..	..	..	..	0·05	..	..	..	..	.	..	0·01	0·01	0·02	0·09	0·11	0·07	0·02	0·27	0·15	0·01	0·23	0·07	0·12	0·19	0·05	..	..	..	0·15
August	..	..	..	..	0·06	..	..	..	..	0·09	0·40	..	..	0·51	..	..	..	0·17	0·62	0·50	0·64	..	0·23	0·11	0·24	..	0·03	0·10	0·10	..	0·05	..	0·85
September	..	..	..	..	..	..	..	..	..	..	..	0·23	..	..	0·06	..	..	0·15	0·18	0·19	1·17	1·42	0·96	0·01	1·56	0·14	0·44	1·61	0·66	0·22	0·17	..	0·34
October	0·56	4·08	1·12	1·48	0·69	0·16	0·92	0·11	0·11	0·14	0·38	0·08	0·39	1·25	2·32	..	..	..	..	..	..	0·08	0·10	0·02	..	..	2·17	0·32	0·86	1·86	4·36	1·22	..
November	0·57	1·53	1·16	0·16	0·83	0·05	0·31	0·10	..	0·12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·50	0·38	..	0·83	0·57	3·25	1·65	..
December	0·03	0·46	0·10	0·39	0·46	0·60	0·17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·07	..
Annual ..	1·16	6·07	2·38	2·03	2·13	0·81	1·44	0·35	0·14	0·61	0·92	0·31	0·41	1·77	2·44	0·07	0·02	0·42	0·98	0·76	1·84	1·77	1·44	0·19	2·09	0·73	3·15	2·22	2·50	2·65	7·83	2·98	1·36

Appendix XII.

MADRAS OBSERVATORY.—Wind, cloud, and bright sunshine, 1908.

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.							HOURS.	
January	88	E.N.E.	3·5	4·0	2·0	2·1	2·9	7·2	9·3
February	68	E.	2·7	3·0	2·6	2 0	2·6	8·1	9·8
March	83	S.E.	2·8	3·4	2·6	1·9	2·7	7·6	9·9
April	145	S.S.E.	4·0	3·0	1·8	1·2	2·5	8·4	11·0
May	152	S. by E.	3·6	3·4	3·8	3·9	3·5	6·6	8·5
June	98	S.W.	6·0	5·6	6·3	6·2	6·0	4·4	7·4
July	101	S.W. by W.	7·6	7·3	7·5	7·7	7·6	2·6	7·5
August	45	S.W. by S.	6·5	6·3	7·4	5·9	6·6	3·2	8·7
September	42	S.W. by S.	6·8	5·5	5·9	5·1	5·7	4·9	9·3
October	29	E. by N.	4·1	4·5	5·6	4·9	4·8	5·7	10·4
November	111	N. by E.	3·7	4·4	4·5	3·1	4·0	6·2	9·9
December	172	N.E. by N.	4·4	4·8	4·5	3·8	4·4	5·6	8·3
Annual ..	27	S.E.	4·6	4·6	4·5	3·9	4·4	5·9	..

Appendix XIII.

MEAN monthly and annual Meteorological Results at the Madras Observatory in 1908.

—	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.	Dew point.
	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.		INCHES.	NO.	CENTS.	HOURS.	°
January	30·017	0·123	75·9	84·4	68·3	16·1	71·5	68·0	0·679	79	132·9	65·1	108	6	E. N. E.	0·02	1	29	221·5	68·2
February	29·930	·120	76·0	86·4	68·2	18·3	72·3	67·8	·733	79	135·1	64·9	88	9	E. by. S.	0·48	4	26	235·9	69·1
March	·924	·121	80·2	90·1	71·2	18·9	73·9	70·4	·758	73	136·2	68·3	92	12	S. E.	..	..	27	235·6	69·6
April	·785	·131	85·3	95·7	78·5	17·2	79·8	77·2	·945	77	140·2	76·9	163	14	S. S. E.	..	..	25	252·3	76·1
May	·735	·119	88·4	100·6	81·7	18·9	79·9	77·1	·910	69	142·3	80·4	178	16	South	0·09	2	35	205·7	74·5
June	·693	·116	88·2	102·2	82·1	20·1	78·0	75·1	·823	62	138·0	80·8	185	19	S.W. by S.	0·48	9	60	132·0	71·5
July	·738	·123	85·6	96·6	79·7	16·9	77·8	75·1	·849	70	131·4	78·3	139	21	S.W. by W.	1·62	18	76	81·0	72·7
August	·727	·130	83·9	95·2	77·7	17·5	77·9	74·9	·874	75	133·6	76·3	117	18	S. S. W.	4·70	12	66	97·6	73·9
September	·753	·176	82·2	90·8	76·5	14·3	78·8	75·7	·940	86	132·8	75·2	87	19	S.W. by S.	9·51	19	57	146·9	76·5
October	·834	·120	81·1	89·4	74·7	14·7	77·2	73·8	·884	83	130·9	72·4	95	10	E. S. E.	24·78	11	48	177·0	74·5
November	·919	·114	75·9	83·9	69·0	14·9	71·2	68·1	·706	79	127·7	66·0	130	2	N. N. E.	12·01	8	40	187·0	67·9
December	·981	·109	75·0	82·4	68·4	14·0	69·6	67·0	·654	75	126·8	65·1	181	3	N.E. by N.	2·28	4	44	173·3	65·7
Annual ..	29·836	·121	81·5	91·5	74·7	16·8	75·7	72·5	·813	75	134·0	72·5	130	12	S. E.	55·97	88	44	2,145·8	71·9

EXTREME monthly Meteorological Records at the Madras Observatory in 1908.

—	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	30·176	8	29·805	31	0·371	87·9	29	60·8	20	60·3	20	41	29	137·9	8	57·1	20	199	1	27	28	0·02	17
February	.141	8	·792	29	·349	92·3	16	63·9	12	63·9	12	51	5	141·2	16	59·3	12, 14	178	8	39	3	0·25	22
March	·096	12	·758	31	·338	97·5	10	62·5	9	60·3	9	13	8	143·4	8	57·5	9	145	15	45	4	..	..
April	29·934	13	·608	27	·326	109·6	26	75·1	1	74·5	1	38	27, 28	150·1	27	72·3	1	247	29	105	13	..	..
May	·889	2	·591	9	·298	109·6	30	78·0	2	72·3	14	30	15	154·0	11	75·9	31	227	25	113	8	0·07	30
June	·795	3	·569	29	·226	107·5	1	77·2	28	71·6	16	28	25	145·7	2	75·2	28	244	16	133	28	0·11	17,30
July	·860	9	·573	27	·287	101·1	3	73·3	11	71·8	11	38	1,2	144·6	20	72·0	11	189	22	39	12	0·25	19
August	·848	25	·589	2	·259	98·9	17	71·6	25	71·5	25	38	15	145·0	18	71·0	25	166	1	51	8	1·40	6
September	·882	15	·597	28	·285	98·2	2	73·9	22	72·7	17, 18	59	28	146·0	1	70·2	18	206	26	28	15	1·28	22
October	·969	11	·676	1	·293	96·6	2	70·1	12	69·7	12	51	14	144·7	8	65·9	12	205	24	54	6	7·28	23
November	30·061	24	·636	2	·425	87·4	10	65·0	10	64·5	10, 15	40	15	137·2	22	60·1	10	228	30	51	11	6·58	2
December	·132	13	·812	31	·320	85·4	25	62·4	8	61·9	8	49	11	137·1	8	58·7	8	366	31	122	25	1·72	31