KODAIKÁNAL AND MADRAS OBSERVATORIES.

REPORT FOR THE YEAR 1904.

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KODAIKÁNAL AND MADRAS OBSERVATORIES.

I.—REPORT OF THE KODAIKÁNAL OBSERVATORY FOR THE YEAR 1904.

1. **Staff.**—The staff of the Observatory on the 31st December 1904 was as follows:—

Director	C. Michie Smith, B.Sc.
First Assistant	K. V. Sivarama Aiyar, M.A. (*on furlough*).
Second Assistant, acting First Assistant.	S. Sitarama Aiyar, B.A.
Third Assistant, acting Second Assistant.	G. Nagaraja Aiyar.
Acting Third Assistant	M. G. Subrahmanya Aiyar, B.A.
Fourth Assistant	S. Balasundaram Aiyar.
Writer	L. N. Krishnaswamy Aiyar (*on privilege leave*).
Acting Writer	A. P. Subrayulu Naidu.

The Acting Director, Mr. C. P. Butler, left on the 1st February 1904 and the Director returned from furlough on the 4th February 1904. The First Assistant left on combined leave on the 7th April 1904. The Second and Third Assistants have since acted as First and Second Assistants respectively, while the post of Third Assistant was filled temporarily by Mr. N. C. Krishna Aiyar till Mr. M. G. Subrahmanya Aiyar could be spared from the Madras Observatory.

The Government of India and the Secretary of State for India have sanctioned the appointment of a European Assistant but he has not yet joined the staff.

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

The Magnetic Observatory is now under the Survey of India and details regarding it no longer find a place in this report.

2. **Distribution of Work.**—The Director takes charge of the spectrograph and spectroheliograph with the help, when necessary, of the First or Second Assistant. The First and Second Assistants take charge of the work with the Cooke equatorial (spectroscopic), the Lerebour and Secretan (visual), and with the photoheliograph. They take the spectroscopic work on alternate days. They have also to do most of the computing. The Third Assistant helps in the work with the Lerebour and Secretan equatorial and with the photoheliograph. He is also in charge of the seismograph and of the clock comparison work. The Fourth Assistant is in charge of all meteorological work. The writer has the correspondence and accounts and assists in making meteorological observations. The Acting Second Assistant, who has become an expert photographer, usually does all special photographic work.

3. **Buildings and grounds.**—(*a*) *Main building.*—A porch has been erected in front of the south door to protect the laboratory from the rain which always drifted in during stormy weather of the north-east monsoon. A glazed verandah has been built to protect the north-west corner of the building which is exposed to the chief storms during the greater part of the year. The beam of light from the siderostat which feeds the spectrograph now passes through the verandah and the tube formerly employed has been removed. There has been great delay in the erection of this building, and though the original orders were that it should be completed by the end of March 1904 it is not yet quite finished.

(*b*) *Spectroheliograph building.*—This consists of two rooms separated from each other by a space of 10 feet. The south room is a masonry building roofed with corrugated iron covered with tilestoneite. The main room is 46 feet long from north to south and 20 feet wide with an alcove on the east side and a large dark room on the west. It was completed in June 1904. In this room much trouble is experienced from moisture which condenses on the roof and drops down in the early morning. This is probably mainly due to no arrangements having been made for ventilation at night, a matter which will be put right as soon as possible. The north room is 30 feet long and 20 feet wide and consists of a low wall covered by a roof running on rails. The roof consists of an iron framing covered with wood and painted canvas. This part of the building has given a great deal of trouble, and was not completed till the end of November, though it was possible to make use of it from the middle of October. The Acting Director, when designing the buildings, arranged for a system of enlarging with a positive lens, and consequently the space between the siderostat and the spectroheliograph is very much greater than is required with the negative enlarging lens that is to be used. This is unfortunate as every additional foot in the length of the beam adds to the difficulty in obtaining a steady image. It will probably be necessary to modify the present arrangement, but work is being carried on as originally designed pending the decision of the Public Works Department as to the best means of rendering the moving roof a success. As originally designed it was so weak that after the first storm the walls were two inches out of plumb and twenty men were unable to push it along the rails. The framing has now been strengthened and two powerful winches have been erected for moving it. It can now be used with moderate comfort, but is not nearly strong enough to withstand for long the strains to which it is exposed.

(c) *Photoheliograph house.*—Plans and estimates for a new dome to take the place of the present iron building have been prepared and sent up for sanction. Meanwhile there is no difficulty in working with the present house except during high winds.

(d) *Transit house.*—The walls of this house have been coated with Sizerelmey stone petrifying liquid, which appears to have rendered them much more waterproof. The hinges in the roof broke in June and it took several months to get them replaced, but the building is now again fit for use.

(e) *New buildings.*—Estimates have been sanctioned for a new workshop and for a house for the Fourth Assistant. Plans and estimates are being prepared for a house for the newly sanctioned European Assistant and an excellent site has been fixed upon near the Director's house.

(f) *Grounds.*—The grounds have been kept in good order immediately round the buildings. A part near the spectroheliograph buildings has been cleared and planted with good grass, and the removal of the hill grass (which entails a constant risk from fire) is in progress over another considerable area. The season was an unfavourable one for tree planting so that not very much has been done in this direction. A large number of young trees have, however, been raised from seed and will be planted out whenever the weather is suitable. These young trees are largely pines of various kinds from the hills of Southern California for which the Director is indebted to Mr. Lukins of Pasadena. A number of pine seeds brought from the Lick Observatory have also grown and the seedlings promise to do well. It is very important, for the sake of shelter, that many more trees should be planted round the Observatory and the work is being carried out as rapidly as circumstances will permit.

(g) The aermotor and pumps have been brought into use and the supply of water to the dark rooms has thus been greatly simplified. The only difficulty now will be in the dry months of the year when the water in the well runs very low, or fails altogether, and water has to be brought from a distance.

4. **Instruments.**—The following are the principal instruments belonging to the Observatory :—

Six-inch Cooke equatorial.

Six-inch Lerebour and Secretan equatorial, remounted by Grubb with a 5-inch Grubb portrait lens of 36 inches focus attached.

Spectrograph—consisting of an 11-inch polar siderostat, 6-inch Grubb lens of 40-feet focus, and a 4-inch concave grating of 10-feet focus, mounted on Rowland's plan. A plane grating with collimator and camera lenses of 8-feet focus can be substituted for the concave grating.

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.

Six-inch transit instrument and barrel chronograph, formerly the property of the Great Trigonometrical Survey of India.
Six-prism table spectroscope—Hilger.
Photoheliograph—Dallmeyer No. 4.
Theodolite, six-inch—Cooke.
Two phototheodolites by Steinheil for cloud photography.
Sextant.
Spectroheliograph with 18-inch siderostat and 12-inch Cooke triple achromatic lens of 20 feet focus, by the Cambridge Scientific Instrument Company, Limited.
Evershed spectroscope with three prisms for prominence and sunspot work, by Hilger.
Mean time clock, Kullberg 6326.
Sidereal clock, Shelton.
Mean time chronometer, Kullberg 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.

There are also available for use a small grating spectroscope and a parabolic grating the property of the Director. The latter was obtained on the advice of Professor Jewell for sunspot work, but arrived only towards the close of the year and has not yet been set up.

The Evershed spectroscope arrived early in the year, but it had been so injured by rough handling during transit that it had to be sent back to the makers for repairs. It was received back at the end of November and was at once brought into use. It is very convenient and gives an excellent spectrum.

The spectrograph.—The polar siderostat has been fitted with electrical slow motions and the lens has been remounted in such a way that the focussing can be done rapidly from the eye end. This has been shown to be necessary, for, though the changes in focus with this instrument are comparatively small, they are large enough to render small readjustments necessary from time to time. Owing to the building of the glazed verandah referred to above this instrument has been out of use for the greater part of the year, but as soon as the building is completed, it will be used for work on sunspot spectra, for which work it has now been fitted with a plane grating and collimator.

The spectroheliograph.—The cases containing this instrument arrived between August 14th and August 22nd and by the 26th it had been set up and roughly adjusted. The instrument consists of a 12-inch triple achromatic lens by Cooke and Sons of 20 feet focal length, fed by a Foucault siderostat with an 18-inch mirror, and the spectroheliograph proper. The design adopted for the latter is that one of Professor Hale's in which the image of the sun and the camera remain stationary, while the collimating lens, the camera lens, the prisms, and slits are carried on a rigid frame which moves across at right angles to the optical axis. The collimating and camera lenses are of 5 inches aperture and 6 feet focus. There are two 60° prisms 4 inches high and $6\frac{1}{2}$ and $6\frac{3}{4}$ inches across and a plane mirror of 6 inches diameter. In front of the collimating slit is a collective lens of $3\frac{1}{2}$ inches aperture. The moving frame, which is very rigid, is carried on three steel balls lying between plane steel plates and is guided in the necessary line by two guide wheels running against two planed bars. The speed of the motion is regulated by a piston working in oil and containing a valve easily adjusted by a micrometer screw. With the valve wide open the slit crosses the sun's image in about four seconds; with the valve nearly closed the corresponding time is over six minutes. The whole details of the design were worked out by the Cambridge Scientific Instrument Company, with the help of Mr. H. F. Newall, to whom and to Mr. Horace Darwin this Observatory is very greatly indebted for the extreme care and skill with which the work has been done. An enlarging lens to permit of parts of the sun's disc being photographed on a larger scale, and a plane grating which can, when required, be put in the place of the plane mirror have been ordered and are expected shortly. A machine for cutting curved slits for use on the spectroheliograph was supplied at the same time as the instrument, and by its means slits of any required curvature can be cut. It is the intention to use the same collimating slit for all lines, but slits of different curvatures will be required for the camera slit.

The slow motions of the siderostat are worked by electric motors driven by primary batteries. but it is found difficult to get suitable batteries and it is very desirable that the Observatory should for this and for other purposes be supplied with a small electric installation. Estimates for this are being prepared.

OBSERVATIONS.

(a) Solar Physics.

5. The year has been an exceptionally favourable one for work on the sun as there were only 22 days on which some observations could not be made. The following table shows for each day the observations made :—

Solar Observations in 1904.

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

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

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

6. **Photographs of the sun** with the Dallmeyer photoheliograph were taken on 264 days and could have been taken on more days had it not been that the stock of photographic plates was allowed to run short in the early part of the year and, as a fresh supply of suitable plates could not be got in India, photographs were taken only when they would be of special interest till a fresh supply of plates was received. When high winds are blowing the shaking of the instrument is apt to render the photographs rather poor, but at other times very good negatives are usually obtained showing much detail of the solar surface. The prevailing direction of the wind here for the year being north-westerly and the photographs being taken in the early forenoon, a dome will usually protect the instrument from wind and so more uniformly good results may be expected when the dome is built.

7. **Observations of sunspots.**—The sun is examined for spots and faculae every morning when the weather permits. If possible, the sun's image is projected on an 8-inch disc, and the positions of the spots and faculae are marked on it. The spots are then carefully studied visually and sketches are made of important details. There were only 22 days throughout the whole year in which this part of the work could not be done more or less completely.

8. **Sunspot spectra.**—Observations of the spectra of sunspots were made on 227 days. This does not represent the whole number of days on which such work was possible since there were a good many days throughout the year on which there was no spot visible which was large enough for the work. This work, during the first eleven months of the year, was carried on with the grating spectroscope described in last report; since then it has been done with the Evershed spectroscope attached to the 6-inch Cooke equatorial. Whenever a spot is large enough for this work the spectrum between D and F is studied and some 12 of the most widened lines are selected between D and b and other 12 between b and F. An estimate of the amount of widening is made in each case. Such an estimate is, of course, only a rough one, but it is better than no estimate at all, and with lengthened experience on the part of the observers it is likely to get more and more trustworthy. When time is available and the sky good after the other routine work has been finished a record is made of all widened lines between C and F. All spots, except the very minute ones, are examined as regards the behaviour of hydrogen and helium. For the former the examination is made either in the C or in the F line and for the latter in D_3. Where the displacements are large the amounts are recorded, and where changes are taking place rapidly a continuous examination is kept up for as long as is necessary. The wave-lengths of all the widened lines observed are at once determined by reference to Rowland's map and Rowland's *Preliminary Table of Wave-lengths.*

9. **Prominences.**—Prominences were observed on 251 days, but on 21 of these clouds came up before the whole limb had been examined. The record of prominences is made round the disc on which the spots and faculae have been projected, and these discs form a very convenient index of the condition of the sun day by day. The general form is sketched as accurately as possible and the heights of all large prominences are measured and recorded. Notes are also made of bright lines seen in the spectra and of any displacements observed in the C line. When the prominences show rapid changes of form several sketches are usually made at short intervals.

10. **Spectroheliograms.**—The work with the spectroheliograph was largely preliminary, but by the close of the year the chief difficulties connected with the use of the instrument had been overcome and fair or good negatives were being got regularly. There has, unfortunately, been some difficulty in getting a supply of suitable photographic plates, since the size required (5 inches by 4 inches) is one rarely used in this country. This has hampered the work considerably, but it is only a temporary difficulty and an ample supply of plates is expected shortly. Spectroheliograms good enough for preserving were obtained on 22 days; only one was obtained in November owing to the absence of the Director during most of the month, but during December one or more was obtained on every possible day. Photographs of the disc and prominences are usually taken on the same plate by a double exposure, with and without the shield. Some very good prominence photographs have been obtained and a number of plates have been compared with the sketches made by the assistants with the spectroscope. The agreement was very satisfactory. The scale of the photographs is, however, hardly large enough to do justice to the prominences and

for the present the work of sketching the prominences at the spectroscope will be continued. When the enlarging lens is received it may be possible to do the whole work photographically.

Summary of Results.

11. **Sunspots.**—There was a marked but by no means uniform increase in the number of spots over the previous years. The following were the monthly numbers for the year:—

—	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
New groups	13	11	22	19	26	12	15	24	17	21	29	30	239
Mean daily number of groups	3·2	2·3	4·1	3·8	4·2	3·1	3·6	4·1	2·7	4·2	4·0	5·0	3·7

The sun has not been free from spots since 1903 September 23, but there were a number of days during 1904 on which only one group was visible, viz., on January 30 and 31, February 1, 4, 17, 18, March 13, June 2, September 5, 6, 16, 17, November 9 and December 29. On the other hand six or more groups were visible at the same time on January 1, March 8, 19, 21, 24, 25, 26, 29, 30, 31, May 6, 11, 12, 13, 16, July 16, 20, 21, 26, September 24, October 11, November 2, 6, 19, 27, 29, 30, December 8 to 17 and 22. On December 13 no fewer than eleven groups were visible at once.

The distribution of spots between the two hemispheres was far from uniform, for in most months the northern spot groups have exceeded the southern both in number and in importance. Of the 238 new groups recorded 133 were in the northern and 105 in the southern hemisphere. During the year spots appeared in the northern hemisphere between latitude 5° and latitude 38° and in the southern between latitude 3° and latitude 32°, but the great majority in both hemispheres had latitudes of between 10° and 25°.

The most important spot groups visible during the year were the following:—

No. 209, visible from January 13 to January 24.

No. 221, visible from February 5 to February 16, was a very fine and active group; it showed many changes while under observation, and the hydrogen lines in and near it were frequently reversed and distorted.

No. 229, visible from March 2 to March 7.

No. 237, visible from March 15 to March 27, was chiefly notable for the large size of the chief spot.

No. 254, visible from April 8 to April 21, was preceded and followed by a very large area of faculæ, and a fine group of prominences was seen close to the spot on the 21st.

No. 266, visible from April 21 to May 3, was also preceded by a large area of faculæ, and prominences of considerable size appeared near it on the 21st, 22nd and 23rd.

No. 314, visible from July 16 to July 27, was seen first as a large leader and a number of small spots following. The leader continued to increase in size as it crossed the disc, while the followers disappeared one after another.

No. 339, visible from August 22 to September 2, was a large scattered group and was followed at short intervals by three other very similar groups in almost the same latitude (14° to 21°S).

No. 354, visible from September 18 to September 25, appeared first as a small spot far from the limb in latitude 18°S and rapidly developed into a considerable group.

No. 356, visible from September 23 to September 27, appeared first as four or five minute dots a little to the east of No. 354 and in latitude 23°S and by the following day had developed into an important group showing much disturbance.

No. 376, visible from October 24 to November 2, was another example of a group which developed rapidly from a very small beginning. At its maximum it covered nearly 18° of longitude and 6° of latitude. The C line was frequently seen reversed in and near it.

The series of groups, 413, 414, 416, 417, 418, 419, 420, all visible at the same time in the northern hemisphere in mid December, formed a nearly complete belt across the sun.

12. **Spot spectra.**—Owing to the very large number of observing days it has not been possible fully to reduce the spectroscopic observations and no useful summary of them can yet be given. The work is well in hand and will be completed as soon as possible.

13. **Prominences.**—Complete observations of the sun's limb for prominences were not begun till the middle of February and the following list is complete only after February 21. The list contains only a small proportion of the prominences recorded as it has been restricted to those which attained a height of a minute or more, or covered 5° or more of the limb, or were eruptive and showed either displacements in the C line or bright metallic lines. The heights given do not claim to be within less than 10″.

Date.	Time.	Latitude.	Height.	Remarks.
	H. M.	°	″	
21st February 1904 ..	8–48.	− 41 W.	60	
	..	− 38 W.	86	
23rd ,, ,, ..	8–30.	− 47 W.	96	
	8–45.	− 32 W.	89	
24th ,, ,, ..	8–30.	− 32 W.	60	
25th ,, ,, ..	11–35.	− 36 W.	120	
28th ,, ,, ..	9–40.	− 43 W.	72	
29th ,, ,, ..	10–17.	− 38 W.	82	
	10–53.	− 54 E.	70	
7th March ,, ..	9– 0.	− 70 E.	60	
16th ,, ,, ..	9–31.	− 48 E.	72	
23rd ,, ,, ..	10–22.	− 4 W.	60	
24th ,, ,, ..	10–34.	+ 13 E.	72	
25th ,, ,, ..	9–25.	− 35 W.	77	
26th ,, ,, ..	11–35.	− 67 E.	60	
27th ,, ,, ..	9– 9.	− 5 W.	77	
	10– 0.	+ 40 E.	65	
	10–56.	− 29 E.	60	
3rd April ,, ..	9–45.	+ 44 to + 54 E.	..	A number of short jets.
4th ,, ,, ..	10– 0.	− 40 W.	85	
7th ,, ,, ..	9–55.	− 60 E.	96	
	10– 5.	+ 4 E.	60	
	10–15.	+ 54 E.	96	
10th ,, ,, ..	9–25.	− 64 W.	60	
12th ,, ,, ..	8–30.	− 66 W.	72	
13th ,, ,, ..	9–50.	− 66 W.	96	
	10–34.	+ 44 E.	66	
	..	+ 11 W.	84	Faint.
15th ,, ,, ..	10–15.	+ 31 W.	75	
18th ,, ,, ..	8–35.	− 75 W.	84	
	8–10.	+ 39 E.	72	
20th ,, ,, ..	8–55.	− 78 E.	96	
	10– 0.	− 59 W.	60	
21st ,, ,, ..	9–30.	− 9 W.	60	
22nd ,, ,, ..	9–45.	+ 36 W.	60	
23rd ,, ,, ..	10–30.	− 59 W.	72	
25th ,, ,, ..	9–45.	+ 28 E.	96	
26th ,, ,, ..	10–12.	− 28 W.	60	
	..	− 22 W.	60	
	..	+ 39 W.	84	
	..	+ 62 W.	100	
27th ,, ,, ..	10–45.	+ 60 W.	75	Faint pyramid detached from chromosphere.
28th ,, ,, ..	11– 0.	+ 56 W.	72	Joined at top.
	..	+ 60 W.	72	
29th ,, ,, ..	10– 0.	+ 51 E.	108	A number of tall stems, tops of some of them hanging down on one side.
	11– 0.	− 26 W.	84	
30th ,, ,, ..	12– 0.	+ 24 W.	88	Pyramid.

Date.	Time.	Latitude.	Height.	Remarks.
	H. M.	°	″	
1st May 1904	..	+ 9 E.	66	
2nd ,, ,,	..	+ 10 W.	92	
	..	+ 19 W.	80	
3rd ,, ,,	..	+ 34 E.	60	
4th ,, ,,	11–22.	+ 39 to + 36 E.	188	Bright, slender, very tall, with small sharp jets at base.
	11– 8.	+ 30 to + 25 E.	52	
5th ,, ,,	..	+ 37 E.	60	
	..	+ 29 to + 19 E.	27	
6th ,, ,,	10–15.	+ 34 to + 19 E.	68	Very bright.
	10– 0.	+ 31 E.	24	Bright jets, showed displacements to red and violet; spot and faculae near.
	10–54.	— 10 to — 15 W.	36	
7th ,, ,,	9–15.	+ 32 to + 22 E.	48	
	9–30.	— 12 W.	66	
9th ,, ,,	9–45.	+ 6 to + 16 W.	42	
10th ,, ,,	..	— 5 W.	60	
	..	— 19 W.	60	
12th ,, ,,	..	+ 34 to + 23 E.	24	
22nd ,, ,,	8–58.	— 23 W.	90	
23rd ,, ,,	8–35.	— 24 W.	108	
	8–50.	— 31 E.	84	
	8–50.	— 35 E.	84	
27th ,, ,,	9– 0.	— 22 E.	96	
	..	+ 18 E.	12	Bright single jet, showed displacement to red; spot and faculae not far from limb.
1st June 1904	10–50.	+ 30 W.	60	
11th ,, ,,	8–10.	— 24 E.	84	Faint.
	8–45.	+ 9 W.	60	
13th ,, ,,	10–50.	+ 69 to + 57 E.	24	
21st ,, ,,	9–18.	+ 61 W.	84	Pyramidal.
	9–20.	+ 38 E.	60	
	9–40.	— 49 W.	60	Faint jet.
22nd ,, ,,	9–10.	— 13 W.	75	
	..	— 10 W.	60	
7th July 1904	9–40.	— 27 to — 21 W.	24	Spot and faculae close to limb.
9th ,, ,,	10–40.	+ 21 to + 32 W.	48	
10th ,, ,,	10–15.	+ 22 to + 28 W.	30	Overhanging cloud connected with the limb by three stems.
12th ,, ,,	11–49.	+ 24 to + 43 W.	48	About nine jets.
15th ,, ,,	11– 3.	— 20 E.	48	An intensely bright jet showing displacement to red; D_1, D_2, b_1, b_2, b_3, b_4, all bright in the prominence itself; a spot with faculae came round this part of limb next day.
23rd ,, ,,	9–46.	+ 33 to + 23 E.	24	
26th ,, ,,	9–24.	+ 12 to + 18 W.	24	Very bright; spot and faculae near.
27th ,, ,,	10– 3.	+ 14 to + 22 W.	24	Three bright prominences close together.
3rd August 1904	9–35.	— 17 W.	60	
6th ,, ,,	8–40.	— 47 E.	60	
9th ,, ,,	9–10.	— 12 E.	..	Small, but an intensely bright jet; metallic lines D_1, D_3, b_1, b_2, b_3, bright in prominence itself; a spot not far from limb.
10th ,, ,,	9– 0.	+ 63 to + 57 E.	24	A number of bright jets with fainter matter between.
	8–56.	+ 19 to + 11 E.	30	A number of small bright and faint jets.
12th ,, ,,	8–40.	— 15 E.	24	A very bright stem curved and overhanging 6° of limb, a spot near this part of limb.
	9–40.	+ 18 to + 27 W.	24	
14th ,, ,,	8–45.	— 36 to — 27 W.	30	
15th ,, ,,	9–20.	— 33 W.	60	
16th ,, ,,	10–40.	+ 26 to + 32 W.	24	Bright, low, massive.
17th ,, ,,	8–45.	+ 10 to + 18 W.	24	A number of bright jets; faculae close to limb.
	..	— 40 to — 43 E.	48	
21st ,, ,,	9– 3.	— 38 to — 42 E.	60	
23rd ,, ,,	9–25.	— 19 to — 25 E.	48	An arched cloud connected with limb at the extremities.
24th ,, ,,	9– 0.	+ 28 to + 31 W.	72	
28th ,, ,,	9– 8.	+ 15 E.	72	
	9–15.	+ 37 to + 43 W.	18	
29th ,, ,,	9–28.	+ 62 E.	60	
	9–12.	— 31 E.	120	
	9–10.	— 42 E.	72	
	9–10.	— 44 E.	72	
30th ,, ,,	9–52.	— 34 E.	72	
4th September 1904	8–50.	— 5 to — 71 E.	28,18	
	8–27.	— 0 to — 71 E.	24,18	About 14 small jets all along this part of the limb.
	8–44.	+ 60 to + 66 W.	48,24	
6th ,, ,,	9–30.	+ 41 E.	60	Bright thin streak.
7th ,, ,,	9–50. *	— 18 to — 8 W.	65	

* A number of bright streaks were first seen at 9 hours 50 minutes between position angles 275° and 282°. Within 10 minutes a terrace-like prominence had formed at P. A. 285 of about 65″ in height and from this an overhanging arch stretched out to another broad eruptive jet at P. A. 275. This jet showed displacement in C to as much as λ 3·5 to red end. There were seen very many bright metallic lines in the prominence of which D_1, D_2, b_1, b_2, b_3, 5,014·457, 6,678·235 were the most important.

Date.	Time.	Latitude.	Height.	Remarks.
	H. M.	°	″	
9th September 1904.	8-25.	− 70 E.	72	
10th " "	10-15.	− 50 to − 54 E.	60	
16th " "	8-32.	+ 18 to − 1 E.	36,24	
17th " "	10-40.	− 30 to − 20 W.	24	
18th " "	8-36.	− 38 E.	72	
19th " "	8-52.	0 E.	108	A detached jet about 1′ away from limb and 48″ in height.
	8-40.	− 40 to − 45 E.	72	
	8-36.	− 60 E.	72	
	9-4.	+ 60 W.	72	
20th " "	..	− 32 to − 40 E.	48	A number of faint spikes.
	9-20.	− 59 E.	60	
26th " "	8-41.	− 21 E.	60	
	8-34.	− 50 to − 53 E.	60	
	9-35.	− 58 to − 57 W.	60	
	9-29.	− 54 W.	66	
	9- 0.	+ 59 W.	60	
27th " "	9- 8.	− 49 to − 54 E.	72	A tall spike at one end and a pyramid at the other with an overhanging cloud between.
	9-28.	+ 62 W.	60	
28th " "	9- 5.	+ 61 to + 66 W.	60	
1st October 1904	9-10.	+ 61 to + 69 W.	54	
2nd " "	9-20.	+ 59 to + 71 W.	48	
	9- 6.	− 47 E.	60	
	9-32.	+ 44 W.	96	
3rd " "	9-50.	+ 59 to + 66 W.	48	
	9-20.	+ 26 E.	78	
	9-59.	− 6 W.	102	
4th " "	9-20.	+ 59 to + 70 W.	48	
	8-55.	+ 38 to + 25 E.	60	
	8-40.	− 48 E.	72	
	9-14.	− 9 W.	98	Detached from limb.
	9-10.	− 4 to − 7 W.	72	
	9- 8.	+ 5 W.	96	
5th " "	11-48.	+ 39 E.	60	
6th " "	8-47.	+ 32 to + 25 E.	24	
7th " "	8-43.	+ 34 to + 25 E.	48	A number of short jets.
13th " "	11- 3.	+ 7 E.	36	A curved prominence overhanging nearly 6° of limb.
	10-48.	− 64 to − 68 E.	48	
18th " "	8-52.	+ 44 to + 38 E.	28	A low massive bank.
27th " "	9-0*.	− 19 E.	24	
	10-0.	+ 4 to + 15 W.	36	
31st " "	..	− 11 to − 9 W.	72	
3rd November 1904.	9-3.	− 14 to − 9 W.	28	
	9-0.	− 2 to + 8 W.	28	
4th " "	8-26.	− 52 W.	60	
	8-40.	+ 25 W.	72	
5th " "	9-50.	− 32 to − 35 E.	60	
	9-45.	− 61 to − 66 E.	36	
	10-20.	− 52 W.	100	
	10-10.	+ 27 W.	66	
	10-9.	+ 38 to + 46 W.	24,36	
6th " "	9-42.	+ 38 to + 35 W.	60	
7th " "	9-10.	+ 17 to + 10 E.	48	
	8-58.	+ 59 E.	72	
8th " "	8-47.	+ 10 to + 4 E.	96	
	8-58.	+ 51 to + 58 W.	48	
9th " "	8-35.	+ 9 to 0 E.	72	
	8-19.	− 58 E.	60	
11th " "	8-40.	− 1 to − 13 E.	48	
13th " "	10-22.	+ 28 to + 46 W.	24,48	
14th " "	8-14.	− 23 to − 37 E.	36	
15th " "	9-20.	+ 1 to − 6 E.	48	
16th " "	9-10.	− 39 E.	168	A bright large filamental prominence quite detached from limb and about 1′ from it was 96″ in height. In half an hour this had changed completely and had drifted away nearly 10° and had also grown taller and fainter.
17th " "	8-58.	− 61 to − 56 W.	48	
19th " "	9-8.	+ 35 to + 42 W.	36,48	
20th " "	9-15.	+ 21 W.	..	A small but intensely bright jet showed displacement to violet side ; D_1, D_2, b_1, b_2, b_3, b_4, 5,098·629, 4,924·107 were seen bright in the prominence as also many other lines.
21st " "	9-35.	− 30 to − 20 W.	60	
22nd " "	9-5.	− 19 E.	..	Very small, but displacement in C for about λ 2·5 to red end was observed.
	9-50.	− 60 to − 66 E.	..	Very bright.
	9-42.	+ 6 to + 13 W.	48	
25th " "	9-30.	+ 37 to + 27 E.	60	Three bright spikes connected at top by a fainter cloud.

* An intensely bright double jet ; was seen to change very rapidly. It showed displacements in both directions at the same place ; red end about λ 3·0, violet λ 1·5 ; many metallic bright lines were seen ; D_1, D_2, b_1, b_2, b_3, b_4, 5,018·628, 5,316·790 were the most conspicuous.

Date.	Time.	Latitude.	Height.	Remarks.
	H. M.	°	"	
27th November 1904 ..	8–55.	+ 26 to + 32 W. ..	60	Three bright prominences connected at top.
28th ,, ,, ..	9–5.	− 14 W.	24	An intensely bright jet with numerous bright metallic lines; spot and faculae near limb.
	9–32.	− 59 E.	60	
1st December ,, ..	9–35.	− 58 E.	60	
	..	− 59 E.	168	
	10–0.	+ 67 W.	84	Faint and detached from limb.
6th ,, ,, ..	11–18.	+ 11 to + 8 E.	..	Intensely bright low and massive; showed slight displacement both to red and violet ends; spot and faculae near limb.
	11–40.	− 22 to − 13 W. ..	..	
12th ,, ,, ..	10–40.	+ 43 W.	..	
15th ,, ,, ..	8–55.	− 10 to − 20 E.	..	
16th ,, ,, ..	9–20.	− 4 to − 12 E.	47	
	9–12.	− 23 to − 25 E.	84	
	9–6.	− 62 E.	60	
	9–53.	− 59 W.	60	
	9–51.	− 34 W.	60	
	9–49.	− 23 W.	60	
	9–41.	+ 26 to + 33 W. ..	24	
22nd ,, ,, ..	10–52.	− 33 to − 30 W. ..	120	Top blown off and overhanging about 7° of limb.
	10–27.	+ 15 W.	..	Two bright rapidly changing jets; showed displacement to violet side; spot and faculae close to limb.
	9–21.	+ 44 to + 46 W. ..	60	
	10–15.	+ 81 to + 79 E. ..	60	
23rd ,, ,, ..	9–2.	+ 35 to + 21 E. ..	42	
	9–31.	− 6 to − 1 W. ..	48	A number of connected jets.
26th ,, ,, ..	8–30.	+ 20 to + 15 E. ..	42	
		+ 15 E.	60	
		+ 10 E.	90	
28th ,, ,, ..	9–15.	+ 38 to + 27 E. ..	60	
	9–45.	− 14 W.	72	
29th ,, ,, ..	..	+ 25 E.	90	Top broad and bent over 8° of limb.
		− 11 W.	132	Detached cloudlets extending over 8° of limb and connected with limb by 2 stems.
		+ 18 to + 32 W. ..	30	
30th ,, ,, ..	9–20.	+ 30 to + 21 E. ..	48,36,120	The tallest quite detached from limb.
	9–55.	− 13 W.	120	
31st ,, ,, ..	9–40.	+ 30 to + 22 E. ..	30,24	
		+ 33 to + 45 W. ..	48,24	

(b) Other Observations.

14. **Time.**—Time is determined with the transit instrument when required, preferably by observations of stars but occasionally by the sun. Unlike the experience of last year, no difficulty has been experienced in getting as many observations as were required, but as no work is in progress here for which very accurate time is required only such observations are made as are necessary for rating the clocks and for keeping the assistants in practice. The 4 P.M. signal which is sent daily over all the Indian telegraph lines from the Madras Observatory is transmitted direct to Kodaikánal and is received on the Fuess chronograph. A direct comparison is thus made daily between the Madras and Kodaikánal clocks. During the time that the transit building was under repair the time received from Madras was accepted as the standard for rating the clocks and chronometers.

During the season a time signal was given daily to the station by means of a flag signal. The flag was "broken" at 10 A.M. and hauled down at 10 hours 10 minutes. This signal was much appreciated.

15. **Meteorology.**—Meteorological observations have been carried on as in former years; no change was made either in the instruments or in the methods of observing.

The year was a distinctly abnormal one in several respects, but especially in the low rainfall. The fall for the year was only 46·62 inches falling on 86 days as against an average of about 64 inches falling on 130 days. In November, when a fall of about 10 inches is due, less than a tenth of an inch fell. On the other hand thunderstorms, many of them accompanied by hail, were very numerous during March, April and May. There was 5 per cent. less cloud than for the mean of the previous four years while the number of hours of bright sunshine was in considerable excess of the mean. The average wind direction was one point more northerly than in any of the other years for which a record exists, and the average daily velocity was 343 miles. The highest wind record for a day was 824 miles on June 7th, and for the whole of June the average daily velocity was 552 miles. The highest shade temperature recorded was 77°·3 on April 6th and the lowest 39°·9 on January 7th. The grass minimum fell to 23°·4 on February 1. As usual, the humidity fell very low on some occasions in January, February, March, November, and December.

16. **Seismology.**—The Milne horizontal pendulum Seismograph was in use throughout the year. In February it was thoroughly cleaned and glass plates were placed under the three levelling screws, as suggested to the Director by Professor Milne. This has made the adjustments much simpler. One case containing the supply of bromide paper for three months was lost in the wreck of the S.S. Den of Seaton and the packet sent to replace it was lost on the railway for six weeks. The following quarter's supply was happily received just two days before the exhaustion of all the paper that could be obtained in India by borrowing from Bombay and Calcutta.

17. **Library.**—In addition to books and periodicals purchased about 500 books and pamphlets were received as exchanges. The library also received 103 sheets of the Greenwich Astrographic Chart and 79 sheets of the French *Carte Photographique du Ciel*. One hundred and forty-one volumes were bound during the year.

18. **Publication.**—The first Bulletin of the Observatory is in type and will soon be distributed.

19. **General.**—The Director inspected the Madras Observatory in November. The Periyakulam Observatory was inspected by the Director in November and by the first assistant in August. The whole of the staff has worked well during the year and the acting first and second assistants deserve special mention for the energy which they have displayed, and the interest which they have shown in their work.

The advantages of co-operation in astronomical work are so evident that it is almost unnecessary to state that this observatory has welcomed the proposals put forward by Professor Hale for co-operation in Solar research, and has undertaken to do as much as possible to help forward the work. Though the scheme is still only in course of elaboration it may not be out of place to state that, in the opinion of the Director, the fundamental principle laid down by Professor Hale is the only one on which such co-operation can ever be a success—unity of purpose with perfect freedom in execution to the individuals taking part in the work.

KODAIKÁNAL,
1st February 1905.

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

II. REPORT OF THE MADRAS OBSERVATORY FOR THE YEAR 1904.

Staff.—The First Assistant, Mr. M. G. Subrahmanyam, was deputed to act as Third Assistant at the Solar Physics Observatory, Kodaikánal, on the 12th of June, and Mr. C. Chengalvaraya Mudaliar, of the Meteorological office, was appointed to act in his place.

Mr. Solomon Pillai, the Computer, took one month's privilege leave from the 9th May, and the Acting First Assistant took privilege leave from 1st November to 15th December.

2. **Time Service.**—The astronomical observations made during the year were, as usual, solely directed to time determinations. For this the transits of 503 clock stars and 99 azimuth stars were observed, and 98 determinations of level and collimation were made. During the latter part of the year transits of the sun were observed occasionally in order to check the rate of the clock when cloud or unfavourable weather prevented the regular star observations from being made.

In addition to these observations, special observations were made every night from the 2nd to the 8th March by Mr. Solomon Pillai to determine the clock rate, in connection with the pendulum observations then being made at the Observatory by Major Lenox-Conyngham, R.E., of the G.T. Survey of India.

One change was made during the year in the system of time signals sent from the Observatory. The Director suggested that in the 4 P.M. roll the signal at the 60th second should be omitted at the end of the 1st and 2nd minutes, while the last signal of all, at the end of the third minute, *i.e.*, at 4 P.M., should be given by the clock alone and not by hand and the clock as hitherto. This change was effected on the 2nd of May, and I understand that the roll is much improved in consequence, identification of the signals when the spacing is imperfect is easier, and the last signal is much clearer.

The time gun at the Fort was fired correctly at noon and at 8 P.M. on 688 occasions out of 732, giving a percentage of successes of 94·0. This result is not satisfactory. Out of 44 failures, 16 occurred in October and November. These and many of the other failures were ultimately traced to defective earth at the Observatory. The earth-wire here is led into and buried in an old well and has always proved good hitherto. Owing, however, to the unprecedented deficiency in rainfall up to the end of November of the year under report, the well dried up, the earth connection became defective and the current became too weak to actuate the firing apparatus. A new earth-wire was put in by the Telegraph authorities in December and all trouble arising from this cause has ceased.

The time ball at the Port office was dropped correctly on all except two occasions. On one of these it was dropped correctly at 2 P.M.; on the other occasion it failed at 2 P.M.

3. **Meteorological Observations.**—Meteorological observations were made as in former years, namely, at 8 hr., 10 hr., 16 hr. and 20 hr. The observations of 10 hr. and 16 hr. were reduced and sent to the office of the Meteorological Reporter to the Government of India, Calcutta, every month, together with the record of movements of the clouds observed by means of the nephescope. Besides the ordinary daily weather messages special storm observations were called for and supplied to (i) Simla on four occasions, and (ii) Calcutta on the following dates:—January 9; May 7, 23, 26; October 8, 9, 14–16, 19; November 16, 20–22; December 4, 5, 18–21.

The tabulation of the traces of the barograph, thermograph, and anemograph at Madras and of the anemograph at Dodabetta have been brought up to date.

4. **Buildings.**—Some repairs to the buildings are urgently required. A full list of these with details has been given to the officer deputed by the Consulting Architect to Government to examine and report on them. Work had, however, not commenced at the end of the year. The dome sheltering the 8-inch equatorial will probably have to be replaced before long as it is very old and in an indifferent state of repair.

5. **Instruments.**—All the instruments are in good order except the transit clock by Dent. The rate of this clock has not been satisfactory, and were it not for the two Kullberg chronometers, which have been behaving very well, there would have been, on occasions, more uncertainty about the time than is at all desirable.

6. **Weather Summary.**—The following is a summary of the meteorological and weather conditions at Madras during the year 1904:—

Pressure was above normal in February and from September to December, and below normal during the remaining months of the year: the greatest excess was 0·051 inch in November, and the greatest defect 0·045 inch in April. The highest daily mean pressure was 30·212 inches on December 31st and the lowest 29·522 inches on June 19th.

Temperature.—The mean temperature of the air was above the average in all months except February, March, and May. The greatest excess was 2°·1 in June and the greatest deficiency 1°·0 in February. The maximum temperature in the shade was above normal in all months except January, February, March, and May. The minimum in the shade and the grass minimum were above the average in January, April, June, August, September, and December and below normal during the remaining six months. The highest maximum temperature recorded was 103°·5 on June 3rd and the lowest minimum was 61°·2 on February 1st. The greatest "solar heat in vacuo" was 161°·2 on September 12th.

Humidity.—Humidity was above the average during the year except in June and from August to December. The driest day was November 5th when it was only 27 per cent.

Rainfall.—The rainfall was very much below the average in all months except July, the greatest defect being 13·01 inches in November. The monsoon rainfall from October 15th to the end of the year was only 5·11 inches against an average of 26 inches. The rainfall for the whole year was only 20·64 inches on 79 days—28·38 inches below the average. The rainfall in November (0·20 inch) was the lowest ever recorded at Madras since 1813. In November 1823 the fall was 0·90 inch and in November 1832 it was 0·41 inch. The greatest fall in one day was 1·64 inches on September 20th.

Winds.—The direction of the wind differed little from the normal except in June when it was 3 points more westerly and in October when it was 3 points more northerly than usual. The daily velocity was above normal in January, April, June, and December and below normal during the rest of the year. The greatest velocity for any day was 365 miles on December 20th.

Cloud.—The amount of cloud was below the average in all months except January, May, June, and December. In November it was 27 per cent. less than the average.

Sunshine.—The percentage of bright sunshine was above normal in July, August, September, and November and below the average during the rest of the year. There were 2,365·8 hours of bright sunshine during the year, which was 53·5 per cent. of the possible maximum.

Storms.—No storm crossed the Madras coast. One storm formed in the Bay to the east of Madras in November, but it took a north-easterly course, ultimately crossed the Arakan coast and drew the rain into Bengal and Burma.

7. The following is the list of the publications in store at the Observatory on the 31st December 1904:—

	Number of copies. Wrapper.	Bound.
1. Madras Astronomical Observations in 1832–33 ..	10	2
2. Do. do. in 1834–35 ..	12	3
3. Do. do. in 1836–37 ..	23	3
4. Do. do. in 1838–39 ..	22	3
5. Madras Solar, Lunar and Planetary Observations, 1831 to 1847	8	3
6. Madras Astronomical Observations (Jacob's), 1848 to 1852	10	1
7. Madras Meteorological Observations, 1822—1843 ..	24	..
8. Do. Hourly Magnetical Observations, 1846—1850.	11	..

		Number of copies.	
		Wrapper.	Bound.
9.	Dodabetta Meteorological Observations, 1847–1848 ..	56	..
10.	Madras Hourly Meteorological Observations, 1851–1855	..	41
11.	Madras Hourly Magnetical Observations, 1851–1855.	..	82
12.	Telegraphic Longitude Determinations (Pogson), 1870–1875	..	6
13.	Madras Meridian Circle Observations, 1862–1864 ..	..	42
14.	Do. do. do. 1865–1867 ..	..	37
15.	Do. do. do. 1868–1870 ..	..	38
16.	Do. do. do. 1871–1873 ..	..	26
17.	Do. do. do. 1874–1876 ..	..	35
18.	Do. do. do. 1877–1879 ..	..	31
19.	Do. do. do. 1880–1882 ..	..	32
20.	Do. do. do. 1883–1887 ..	..	33
21.	Second Madras Catalogue of Stars, Epoch 1875 ..	..	144
22.	Madras Hourly Meteorological Results, 1856–1861 ..	..	87
23.	Do. Meteorological Results, 1861–1890	..	122
24.	Do. Daily Meteorological Means, 1796–1890 ..	..	154

MADRAS,
20*th February* 1905.

R. LL. JONES,
Deputy Director.

Appendix I.

KODAIKÁNAL 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.	Max. Amp.	Duration.	Remarks.
	1904.	H. M.	H. M.	H. M.	H. M.	mm. "	H. M.	
1	Mar. 2 ..	4 59·3	4 59 9	5 02·9	5 29·8	4·0=2·2	0 30·5	E.Q. ?
2	,, 28 ..	3 49·5	..	..	..	..	..	Slight displacement.
3	,, 31 ..	2 25·7	2 29·3	2 29·8	3 12·3	3·0=1·4	0 46·6	
4	,, 31 ..	5 56·4	5 59·5	6 00·6	6 22·1	1·8=0·8	0 25·7	
5	Apr. 4 ..	10 21·9	10 50·3	10 56·5	11 46·3	1·0=0·6	1 24·4	Many maxima.
6	,, 5 ..	10 26·4	10 26·4	10 44·6	11 16·1	0·8=0·5	0 49·7	
7	,, 9 ..	5 33·1	..	5 39·2	5 46 6	0·5=0·2	0 13·2	
8	,, 24 ..	7 10·9	..	7 12 0	7 14·9	..	0 4·0	Slight.
9	May 1 ..	15 42·9	15 46·2	15 52·9	16 17·9	0·6=0·4	0 35·9	Felt at Quetta ?
10	June 1 ..	9 33·9	..	..	..	..	..	Thickening of line.
11	,, 4 ..	8 49 2	..	..	..	..	..	Do.
12	,, 7 ..	2 02·8	..	..	2 54 6	..	..	Do.
13*	,, 7 ..	5 35·2	..	..	6 11·7	..	..	Do.
14	,, 7 ..	8 28 0	8 36·2	8 36·8	9 05·6	0·6=0·4	0 37·6	
15	,, 7 ..	10 35·4	..	..	..	..	..	Thickening of line.
16	,, 16 ..	19 54·3	..	..	20 04·6	..	..	Do.
17	,, 18 ..	22 22·1	..	..	22 35·9	..	..	Do.
18	,, 24 ..	1 54·3	..	..	2 01·6	..	..	Do.
19	,, 25 ..	15 07·7	15 28·0	15 34·4	16 15·4	2·0=1 3	1 07·7	
				38·0		3·0=1·9	..	
20	,, 25 ..	21 22 1	21 22·2	21 51·3	23 05·2	1·5=0·9	1 43·1	
21	,, 26 ..	11 25·2	11 33·4	11 34·3	12 03·6	0·5=0·3	0 38·4	
22	,, 27 ..	0 30 8	0 32·3	1 10·3	1 59·5	1·5=0·9	1 28·7	Thickening of line.
23	,, 27 ..	4 49·5	..	..	4 56·2	..	0 06·7	Do.
24	,, 27 ..	5 45·5	..	..	..	..	..	Do.
25	,, 29 .	2 27·6	..	..	3 54·2	..	..	Do.
26	July 23 ..	0 50 3	..	0 56·4	..	0·5=0·3	..	
27	,, 27 ..	5 36·4	5 41·0	5 42·0	5 58·0	0·6=0·3	0 22	Occasional widening of line till 9h. 40m.
28	Aug. 2 ..	2 21·7	..	2 23·6	2 28·7	0 6=0·3	0 07	
29	,, 12 ..	4 10·8	..	4 11·0	4 37·8	0·5=0·3	0 27	
30	,, 16 ..	4 45·	..	..	5 59·	..	..	Widening of line.
31	,, 17 ..	2 58·7	3 11·0	3 14·6	3 35·0	0 6=0·4	0 36	
32	,, 18 ..	4 59·7	5 12·1	5 13·1	..	0·9=0·6	..	
				16·2	?	1·1=0 7	?	Clock driving badly.
33	,, 19 ..	3 47 3	..	3 50·3	4 14·8	..	0 27	Widening of line.
35	,, 24 ..	21 09·4	21 19·2	21 44·1	22 44·0	2·0=1·1	1 ·35	
36	,, 27 ..	22 20·0	22 47·2	23 04·1?	23 53·0	?	1 33	
38	,, 30 .	11 54·9	..	12 05·7	12 26·2	1·8=1·0	0 31	Trace faint.
40	Sep. 11 ..	5 25·9	5 59·4	6 09·8	7 01·0	1·1=0·7	0 35	

Kodaikánal 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.	Max. Amp.	Duration.	Remarks.
	1904.	H. M.	H. M.	H. M.	H. M.	mm.	H. M.	
41	Oct. 3 ..	3 08·7	3 08·7	?	?	?	?	Boom went off scale at 8h. 35m. and caught.
42	,, 8 ..	18 59·7	19 02·8	19 03·9	19 19·3	0·6=0·2	0 20	
43	,, 9 ..	14 24·5	..	..	14 57·6	..	0 33	Slight.
44	,, 28 ..	14 12·0	14 16·1	14 17·1	..	0·5=0·2	..	
				27·4	14 56·5	0·9=0·4	0 45	
45	Nov. 5 ..	20 52·8	..	20 54·3	20 57·4	..	0 05	Slight.
46	,, 6 ..	4 32·1	4 46·1	4 47·7	5 01·6	0·6=0·2	0 30	
48	,, 11 ..	11 21·0	..	11 29·2	11 37·0	0·4=0 2	0 16	
49	,, 20 ..	0 02·5	0 07·7	0 08·2	0 17·6	0 4=0·2	0 15	
50	Dec. 4 ..	10 56·4	..	..	11 01·5	..	0 06	Widening of line
51	,, 13 ..	9 04·4	9 12·0	9 14·1	9 40·0	0 9=0·5	0 36	
52	,, 16 ..	7 13·5	..	7 15·7	7 21·2	..	0 08	Slight.
53	,, 19 ..	18 31·9	..	18 45·1	..	0·4=0·2	..	
				49·6		0·5=0·2		
				53·2	19 22·7	0·3=0·1	0 51	
54	,, 20 ..	6 18 8	6 28·0	6 30·2	..	0·6=0·3	..	
				39·0	..	0·6=0·3	..	Record faint.
				7 19·0	..	1·0=0·5	..	
				31·1	8 17·8	1·1=0·5	1 59	

Appendix II.

MEAN monthly and annual meteorological results at the Kodaikánal Observatory in 1904.

Month.	Barometer.		Dry bulb thermometer.				Wet bulb.		Tension of vapour.	Relative humidity.	Sun Max. in Vac.	Min. on grass.	Wind.			Rain.		Clear sky.	Bright sunshine.
	Reduced to 32°.	Daily range.	Mean.	Max.	Min.	Range.	Mean.	Min.	By Blanford's tables.				Daily velocity.	Mean direction.		Amount.	Days.		
	Inches.	Inches.	°	°	°	°	°	°	Inches.	Cents.	°	°	Miles.	Points.	Points.	Inches.	No.	Cents.	Hours.
January	22·829	0·071	52·4	62·1	46·2	15·9	45·3	38·7	0·237	61	116·2	39·6	317	9	E by S	3·39	4	60	185·8
February	·829	·069	53·9	64·7	46·6	18·1	45·1	38·4	·218	53	122·2	37·3	329	6	ENE	0·15	..	70	239·3
March	·830	·070	57·6	69·6	50·1	19·2	46·8	39·6	·216	45	129·5	40·3	370	8	E	0·04	..	76	264·5
April	·817	·071	60·2	70·4	54·0	16·4	53·9	47·2	·332	64	130·9	44·2	287	9	E by S	4·21	5	60	222·1
May	·788	·069	59·6	68·1	54·3	14·1	54·5	49·5	·376	74	131·5	47·8	241	2	NNE	7·64	18	38	162·2
June	·762	·061	55·9	61·3	52·8	8·5	52·9	49·7	·374	84	115·2	50·0	552	27	NW by W	2·60	7	17	68·0
July	·747	·057	55·4	61·7	51·7	10·0	52·7	49·2	·371	84	121·6	48·5	458	28	NW	4·27	9	24	116·2
August	·778	·061	56·4	64·2	51·6	12·6	52·9	48·3	·368	81	125·2	45·8	328	28	NW	2·53	4	31	158·4
September	·809	·074	55·7	62·8	51·3	11·5	52·6	48·3	·369	83	123·4	46·3	334	29	NW by N	6·51	13	37	148·5
October	·802	·074	55·2	62·2	51·1	11·1	52·7	48·9	·375	86	120·6	46·7	315	26	WNW	12·29	20	36	148·6
November	·849	·067	52·6	62·5	45·9	16·6	48·1	42·1	·293	74	119·8	36·0	244	1	N by E	0·09	..	60	213·5
December	·835	·068	52·5	61·2	47·4	13·8	47·9	41·9	·292	74	110·6	41·2	338	3	NE by N	2·90	6	58	172·8
Annual ..	22·806	0·068	55·6	64·3	50·3	14·0	50·4	45·2	0·318	72	122·2	43·6	343	1	N by E	46·62	86	47	2,099·9

REMARKS.—The height of the barometer cistern above mean sea level is 7,688 feet.

EXTREME monthly meteorological records at the Kodaikánal Observatory in 1904.

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	22·919	8	22·745	20	0·174	72·1	31	**39·9**	**7**	32·0	21	6	24	135·4	20	28·0	30	637	24	138	31	**2·33**	**2**
February	·919	12	·738	9	·181	71·1	15	42·6	27	**30·6**	**8**	4	9	135·1	20	**23·4**	**1**	586	5	107	1	0·07	11, 12
March	·927	9	·762	31	·165	72·1	20	47·2	1	34·1	20	9	20	139·6	11	34·5	3	586	29	195	1	0·04	11
April	·895	14	·707	6	·188	**77·3**	**6**	48·8	15	39·0	22	20	6	140·8	2	37·3	26	423	30	164	18	2·20	15
May	·874	31	**·650**	**25**	·224	76·3	3	51·6	7	42·8	2	24	2	146·1	28	42·6	2	423	1	135	24, 30	1·38	14
June	·846	1	·665	19	·181	66·2	11	50·6	11	47·2	12	61	3, 11	133·6	1	46·0	29	**824**	**7**	335	15	0·64	1
July	·840	26	·656	2	·184	65·6	27	49·6	19, 26	44·2	14	58	8	**146·2**	**27**	45·2	14	756	3	209	27	1·39	26
August	·867	28	·676	1	·191	67·2	12	49·0	22	41·5	24	41	24	141·6	16	35·5	25	618	1	133	26	0·82	31
September	·921	26, 27	·700	12	·221	67·0	26	48·5	25	44·1	25	45	12	136·6	26	38·2	25	758	12	**105**	**19**	1·27	18
October	·880	7	·723	17	·157	67·2	19	45·3	31	43·6	30	52	13	135·8	24	41·9	31	531	22	122	8	1·53	26
November	·937	19	·769	5	·168	69·0	27	40·5	28	32·1	27	**3**	**27**	132·2	24	25·2	26	416	15	159	7, 17	0·09	10
December	**·952**	**31**	·734	10	·218	71·4	1	43·1	15	33·0	30	10	29	124·6	31	30·7	26	708	18	189	9	0·76	19

Appendix III.

Kodaikânal mean hourly wind velocity for the year 1904.

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	14	14	14	13	14	15	15	16	15	16	17	15	14	13	12	10	9	9	10	12	12	12	13	13
February	16	15	15	14	15	15	15	15	17	18	18	18	15	13	11	10	9	8	8	11	12	13	14	15
March	15	14	15	16	17	18	18	19	21	22	21	20	18	16	14	13	12	10	8	9	10	12	13	14
April	12	11	11	11	10	11	11	12	14	16	17	16	14	14	12	12	10	10	10	11	10	9	10	11
May	11	10	10	11	10	10	10	10	11	12	12	11	10	9	10	10	9	8	8	9	10	10	11	11
June	24	23	25	25	24	24	23	23	22	23	21	21	21	20	21	21	21	23	24	25	24	24	25	25
July	20	20	22	22	22	21	21	20	20	22	17	18	17	17	18	17	17	18	19	19	19	18	19	19
August	15	15	15	15	16	16	15	14	14	14	14	12	12	12	12	12	13	12	12	13	13	13	14	15
September	15	15	15	16	16	15	15	13	14	14	13	12	11	12	12	13	13	13	14	14	13	14	14	15
October	14	13	13	14	14	14	15	15	15	16	14	13	12	13	12	12	11	12	12	12	11	12	13	13
November	11	12	12	12	12	11	11	10	11	11	11	11	10	11	10	9	8	7	8	9	9	9	10	11
December	16	15	16	15	15	15	16	15	15	14	14	15	14	13	12	11	10	11	13	13	14	15	16	16
Sums ..	183	177	183	184	185	185	185	182	189	198	189	182	168	163	156	150	142	141	146	157	157	161	172	178
Means ..	15	15	15	15	15	15	15	15	16	16	16	15	14	14	13	12	12	12	12	13	13	13	14	15

Appendix IV.

KODAIKÁNAL.—Maen hourly bright sunshine for the year 1904.

Month.	Hours.	6 7.	7-8.	8-9.	9-10.	10-11.	11-12.	12-13.	13-14.	14-15.	15-16.	16-17.	17-18.	Remarks.
January		0·05	0·52	0·65	0·65	0·63	0·68	0·65	0·66	0·62	0·54	0·31	0·04	The total number of hours of bright sunshine for the year was 2,099·9 or 48 per cent. of the maximum possible.
February		·18	·81	·89	·90	·90	·86	·79	·77	·72	·71	·60	·13	
March		·16	·95	·99	1·00	·98	·92	·83	·73	·63	·58	·51	·25	
April		·26	·81	·94	·94	·92	·86	·74	·58	·50	·41	·29	·17	
May		·23	·59	·67	·69	·69	·61	·51	·35	·29	·23	·25	·12	
June		·03	·19	·24	·28	·32	·24	·24	·26	·22	·13	·08	·04	
July		·11	·34	·44	·55	·48	·41	·30	·27	·31	·22	·17	·05	
August		·30	·65	·75	·68	·63	·50	·47	·30	·31	·26	·21	·05	
September		·23	·57	·75	·67	·63	·59	·38	·34	·25	·27	·19	·07	
October		·11	·54	·59	·64	·63	·59	·55	·36	·29	·25	·24	·01	
November		·09	·80	·90	·92	·87	·78	·75	·61	·60	·44	·30	·03	
December		·02	·45	·57	·66	·70	·68	·67	·59	·55	·37	·27	·04	
Total ..		1·77	7·22	8·38	8·58	8·38	7·72	6·97	5·82	5·29	4·41	3·42	1·00	
Mean ..		0·15	0·60	0·70	0·72	0·70	0·64	0·58	0·48	0·44	0·37	0·28	0·08	

Appendix V.

Kodaikánal Observatory.—Number of days in each month on which the Nilgiris were visible.

Month.	Very clear.	Visible.	Just visible.	Tops only visible.	Total.
January	3	11	2	6	22
February	..	8	3	4	15
March	3	5	6	2	16
April	..	..	..	..	..
May	6	3	11	..	20
June	7	5	3	1	16
July	3	11	4	..	18
August	1	5	7	..	13
September	7	4	2	1	14
October	11	2	4	..	17
November	3	9	6	1	19
December	6	5	1	2	14
Total ..	50	68	49	17	184

Appendix VI.

Mean monthly and annual meteorological results at the Periyakulam Observatory in 1904.

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.
	Inches.	Inches.	°	°	°	°	°	°	Inches.	Cents.	°	°	Miles.	Points.	Points.	Inches.	No.	Cents.
January	29·029	0·131	73·0	84·0	62·4	21·7	66·5	60·9	0·566	70	136·9	57·4	47·6	12	S.E.	1·09	3	55
February	·005	·151	76·6	89·9	63·0	26·8	67·1	60·7	·541	59	113·4	56·9	55·1	11	S. E. by E.	..	..	73
March	28·951	·157	81·4	95·8	66·3	29·5	69·7	62·9	·571	53	150·1	59·6	66·1	13	S. E. by S.	0·20	1	81
April	·877	·146	85·6	100·3	73·0	27·3	74·0	69·7	·686	56	156·3	68·7	72·0	11	S. S. E.	1·41	4	70
May	·850	·126	82·9	96·0	73·0	23·0	71·3	70·7	·733	65	154·5	69·9	68·8	21	W.	7·23	11	53
June	·872	·112	80·4	90·4	72·2	18·2	72·0	69·2	·672	65	149·5	68·6	81·1	15	S. by E.	0·76	4	30
July	·857	·114	80·6	92·2	71·0	21·1	71·4	68·4	·618	62	155·3	67·5	87·0	21	S.W. by W.	2·72	5	35
August	·881	·122	82·1	95·1	70·2	21·8	71·2	67·3	·619	56	158·0	66·2	99·0	17	S. by W.	0·08	..	53
September	·920	·133	81·3	94·8	70·8	24·0	71·1	67·3	·636	60	159·6	67·0	95·5	19	S. W. by S.	1·58	7	48
October	·933	·126	78·4	89·0	70·7	18·3	72·4	69·3	·718	74	116·5	67·9	51·6	17	S. by W.	7·59	19	48
November	29·027	·128	77·6	88·6	67·2	21·4	69·5	64·8	·615	65	143·3	61·8	42·8	16	S.	0·14	..	66
December	·036	·128	75·3	86·0	65·6	20·4	67·6	63·2	·571	65	138·1	60·0	52·4	15	S. by E.	0·28	1	47
Annual ..	28·936	0·131	79·6	91·8	68·8	23·0	70·6	66·2	0·632	62	149·3	64·3	68·2	16	S.	23·08	55	55

Remarks.—The height of the barometer above mean sea level is 945 feet.

Extreme monthly meteorological records at the Periyakulam Observatory in 1904.

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 ..	29·152	8	28·878	20	0·274	89·1	30	57·0	30	56·0	7, 25, 30	39	21, 29	145·8	14, 20	50·4	30	83·9	17	17·2	29	0·50	1
February ..	·134	25	·865	27	·269	93·1	19	56·5	8	55·0	8	28	5	149·8	27	50·3	8	90·1	8	25·0	2	..	..
March ..	·104	9	·799	30	·305	98·7	20	60·5	9	56·5	9	28	20, 23, 28	154·8	12	51·4	9	85·0	28	47·3	1	0·17	26
April ..	28·981	12, 13, 22	·655	6	·326	104·0	7	69·0	15	66·0	23	25	25	164·3	18	65·5	15	98·1	7	41·2	4	0·48	3
May ..	·987	31	·685	23	·302	103·9	3	68·1	20	66·9	20	30	2	161·3	17	66·1	20	137·0	7	25·3	9	2·25	14
June ..	·971	28	·755	19	·236	97·2	22	67·4	29	65·4	29	33	21	162·0	13	63·4	29	148·5	30	21·5	9	0·14	8
July ..	·958	26	·742	21	·216	96·8	23	67·9	29	65·7	19	38	8	164·7	30	64·2	29	164·7	9	37·3	14	6·97	12
August ..	·996	31	·731	1	·265	98·9	12	67·1	24	64·1	24	30	12	167·1	30	62·5	24	154·3	15	42·1	1	0·05	2
September ..	29·058	26	·725	12	·333	98·3	4, 8	67·5	9	63·0	9	30	12	167·0	4	62·3	9	161·9	13	40·8	23	0·31	23
October ..	·051	26	·790	14	·261	95·1	1	65·0	31	63·5	31	32	1, 2	157·8	4	60·1	31	122·4	16	19·3	11	1·76	5
November ..	·158	28	·863	5	·295	91·3	5	60·0	27, 28	58·4	28	33	29	152·4	21	52·3	28	71·5	10	20·4	5	0·08	14
December ..	·229	31	·857	19	·372	92·8	20	57·2	30	56·0	30	35	15	153·8	22	50·0	30	84·5	9	14·7	19	0·11	19

Appendix VII.

ABSTRACT of the mean meteorological condition of Madras in the year 1904 compared with the average of past years.

Mean values of	1904.	Difference from	Average.
Reduced atmospheric pressure	29·868	0·004 above.	29·864
Temperature of air	81·7	0·6 ,,	81·1
Do. of evaporation	74·6	0·1 ,,	74·5
Percentage of humidity	71	1 below.	72
Greatest solar heat in *vacuo*	136·6	3·1 ,,	139·7
Maximum in shade	91·4	0·6 above.	90·8
Minimum in shade	74·3	0·4 below.	74·7
Do. on grass	72·0	0·1 above.	71·9
Rainfall since January 1st on 79 days	20·64	28·38 below.	49·02
General direction of wind	S.E.	Same as	S.E.
Daily velocity in miles	166	5 below.	171
Percentage of cloudy sky	43	6 ,,	49
Do. of bright sunshine	53·5	4·9 ,,	58·4

DURATION and quantity of the wind from different points.

From	Hours.	Miles.	From	Hours.	Miles.	From	Hours.	Miles.	From	Hours.	Miles.
North ..	54	500	East ..	203	1,000	South ..	115	914	West. ..	254	2,443
N. by E. ..	191	1,160	E. by S. ..	258	1,309	S. by W...	182	1,314	W. by N...	220	1,807
N.N.E. ..	269	1,838	E.S.E. ..	167	873	S.S.W. ..	185	1,268	W.N.W. ..	111	893
N.E. by N...	609	4,544	S.E. by E.	351	1,921	S.W. by S.	230	1,418	N.W. by W.	82	661
N.E. ..	643	4,431	S.E. ..	382	2,194	S.W. ..	130	966	N.W. ..	44	285
N.E. by E.	481	3,739	S.E. by S.	1,070	7,950	S.W. by W.	262	1,873	N.W. by N.	66	277
E.N.E. ..	217	1,520	S.S.E. ..	415	3,449	W.S.W. ..	265	2,063	N.N.W. ..	65	419
E. by N. ..	217	1,341	S. by E. ..	200	1,597	W. by S...	468	4,026	N. by W...	105	938

There were 273 calm hours during the year. The resultant corresponding to the above numbers is represented by a S.E. wind, blowing with a uniform daily velocity of 32 miles.

Appendix VIII.

Madras Observatory.—Number of hours of wind from each point in the year 1904.

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	..	22	50	175	196	153	44	30	42	15	..	..	..	..	..	..	..	..	.	..	..	..	..	..	..	..	..	..	..	3	5	..	9
February	..	..	1	9	141	77	38	51	83	65	36	40	41	45	5	5	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	57
March	..	..	..	..	..	..	..	..	2	23	27	149	166	257	49	20	3	14	10	6	1	..	..	..	..	..	..	..	..	..	..	..	17
April	..	..	..	..	..	..	..	..	..	..	..	24	31	367	166	42	16	25	25	12	1	3	1	..	..	..	..	..	..	..	..	..	7
May	..	..	..	3	1	3	20	22	6	3	24	9	61	241	97	28	16	25	47	26	15	25	18	11	3	3	..	..	..	..	4	9	24
June	..	..	..	1	1	..	1	..	1	13	14	5	1	2	8	17	8	13	13	25	26	57	82	182	96	80	29	24	5	6	3	1	6
July	..	..	..	1	1	1	4	4	1	6	12	17	17	32	24	23	23	40	40	51	35	55	74	100	57	37	25	18	21	13	3	4	5
August	1	1	..	..	1	..	..	..	5	19	18	40	32	40	28	36	40	39	23	58	27	45	52	93	43	50	15	16	7	5	3	..	7
September	2	3	9	1	..	6	3	19	7	22	17	60	31	56	29	18	6	23	19	39	15	57	28	66	46	45	26	15	6	8	2	2	34
October	2	43	26	69	42	25	29	51	35	75	19	7	2	30	9	11	2	2	8	13	10	20	10	16	9	5	16	7	4	21	12	13	101
November	27	71	103	136	131	63	52	23	9	8	..	..	.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	10	28	50	6
December	22	51	80	214	129	153	26	17	12	9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.	5	26	..
Annual ..	54	191	269	609	643	481	217	217	208	258	167	351	382	1070	415	200	115	182	185	230	130	262	265	468	254	220	111	82	44	66	65	105	273

Appendix IX.

MADRAS OBSERVATORY.—Number of miles of wind from each point in the year 1904.

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	..	98	374	1314	1236	1131	301	214	226	82	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	13	8	..	4997
February	..	..	12	95	728	361	274	300	370	290	131	202	161	245	48	42	6	7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3272
March	..	..	..	..	..	..	..	..	17	90	107	634	838	1543	333	170	27	114	77	50	4	..	..	..	..	..	..	..	..	..	..	..	4004
April	..	..	..	..	..	..	..	..	..	..	..	108	130	2945	1597	408	169	248	260	108	8	23	9	..	..	..	..	..	..	..	..	..	6013
May	..	..	..	24	13	45	120	126	37	36	100	82	483	2191	793	197	142	213	268	194	109	183	105	88	13	29	..	..	..	..	39	27	5657
June	..	..	..	9	9	..	7	..	8	77	73	41	13	26	49	85	56	83	93	139	227	556	807	1774	1113	761	287	245	40	22	15	11	6626
July	..	..	..	8	10	7	33	29	10	37	101	117	113	231	208	220	161	248	251	344	320	473	615	866	505	240	181	139	116	55	21	10	5699
August	7	6	..	..	8	..	..	..	49	138	141	281	235	270	188	259	293	219	132	307	175	254	286	675	342	374	110	121	52	33	22	..	4976
September	24	13	23	3	..	16	22	62	38	110	100	423	213	367	184	129	38	170	118	211	96	310	171	545	432	370	240	120	45	35	10	10	4618
October	24	189	155	382	339	184	89	282	163	342	120	33	8	132	49	87	22	12	69	65	27	74	40	78	38	33	75	25	27	66	59	59	3347
November	280	415	632	871	867	502	366	163	38	75	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	11	5	53	185	470	4933
December	165	440	642	1838	1221	1493	308	165	44	32	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	60	346	6754
Annual ..	500	1160	1838	4544	4431	3739	1520	1341	1000	1309	873	1921	2194	7950	3449	1597	914	1314	1268	1418	966	1873	2063	4026	2443	1807	893	661	285	277	419	933	60926

Appendix X.

Madras Observatory.—Number of inches of rain from each point in the year 1904.

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	..	0·54	..	0·19	0·11	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·14	..	..
February	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
March	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
April	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
May	..	..	..	..	..	..	0·06	..	..	0·04	..	..	0·12	..	0·01	..	0·02	..	0·01	..	..	0·02	..	..	..	..	..	..	..	..	0·24	0·05	0·35
June	..	..	..	..	..	..	..	..	..	..	0·04	..	..	..	..	..	..	..	..	..	..	0·19	..	0·01	..	0·05	0·01	0·20	..	..	0·11	..	..
July	..	..	..	..	..	..	..	0·06	0·03	..	0·89	0·01	0·36	..	1·19	0·07	0·04	0·13	0·05	..	0·51	0·19	0·32	0·67	..	0·80	..	0·28	0·46	0·12	..	..	..
August	..	..	..	..	..	..	..	..	..	..	0·01	0·06	..	..	..	..	0·01	0·27	0·49	0·38	0·16	0·48	0·01	0·31	0·02	0·21	0·11	0·03	..	..	..	..	..
September	1·27	0·03	..	..	..	0·06	..	..	0·22	0·05	0·24	0·01	..	..	..	0·07	..	0·35	0·02	0·04	..	0·25	..	0·18	..	..	..	0·62	..	0·09	..	0·01	..
October	..	0·17	..	0·06	..	0·03	0·15	0·02	0·04	0·25	..	0·16	..	0·46	0·01	0·12	..	..	0·02	..	0·01	0·09	0·06	0·14	0·04	..	..	..	..	0·04	0·31	0·15	..
November	..	..	0·01	..	..	..	0·01	..	..	0·05	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·13	..
December	0·15	0·31	0·60	0·83	0·03	0·04	0·09	0·07	0·90	0·11	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·21	..
Annual ..	1·42	0·51	0·61	0·91	0·03	0·67	0·31	0·34	1·30	0·50	1·18	0·24	0·48	0·46	1·21	0·26	0·07	0·75	0·59	0·42	0·68	1·22	0·39	1·31	0·06	1·06	0·12	1·13	0·46	0·25	0·80	0·55	0·35

Appendix XI.

MADRAS OBSERVATORY.—Wind, cloud and bright sunshine.

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.
1904.	MILES.							HOURS.	
January	134	N.E.	3·7	4·6	4·5	3·1	4·0	6·7	8·5
February	92	E. by N.	2·3	3·3	1·8	0·8	2·1	8·6	10·1
March	120	S.E. by S.	0·9	2·2	0·7	0·6	1·2	8·7	10·2
April	190	S.S.E.	3·2	2·8	1·8	0·6	2·1	8·1	9 7
May	140	S.S.E.	4·2	4·3	4·1	2·9	4·0	6·4	8·6
June	133	W. by S.	6·6	5·8	7·5	7·4	6·9	3·9	7·6
July	115	S.W. by W.	6·7	5·7	6·9	6·6	6·5	4·4	8·2
August	85	S.W. by S.	5·6	4·9	7·1	5·5	5·8	5·3	9·0
September	66	S.W. by S.	4·8	4·4	5·7	5·7	5·2	6·0	9·2
October	47	E.N.E.	5·1	5·8	5·7	4·3	5·2	6·0	10·2
November	145	N.E. by N.	3·1	3·7	3·3	2·5	3·2	7·9	9·9
December	203	N.E. by N.	5·6	6·1	5·3	4·8	5·5	5·6	8·4
Annual ..	32	S.E.	4·3	4·5	4·5	3·7	4·3	6·5	..

Appendix XII.

Mean monthly and annual meteorological results at the Madras Observatory in 1904.

	Barometer.		Dry bulb thermometer.				Wet bulb.	Tension of vapour.	Relative humidity.	Sun Max. in vacuo.	Min. on grass.	Wind.			Rain.		Cloudy sky.	Bright sunshine.	Dew point.
	Reduced to 32°.	Daily range.	Mean.	Max.	Min.	Range.	Mean.	By Blandford's tables.				Daily velocity.	Mean direction.		Amount.	Days.			
	Inches.	Inches.	°	°	°	°	°	Inches.	Cents.	°	°	Miles.	Points.		Inches.	No.	Cents.	Hours.	
January	29·995	0·111	75·8	83·0	69·2	13·8	71·0	0·694	75	131·6	65·6	161	4	NE	1·03	3	40	209·2	67·5
February	·970	·116	75·7	84·4	66·7	17·7	70·4	·675	76	131·5	62·6	113	8	E	..	..	21	249·8	66·6
March	·893	·126	79·2	88·2	70·0	18·2	73·6	·755	76	144·9	66·4	129	12	SE	..	..	12	271·2	69·7
April	·781	·141	84·6	91·4	77·8	16·6	78·9	·914	77	140·0	75·8	200	14	SSE	..	..	21	242·5	75·1
May	·734	·122	85·9	95·9	79·4	16·5	78·7	·886	71	138·0	78·1	183	14	SSE	0·92	4	40	197·2	74·0
June	·703	·128	88·5	99·8	82·0	17·8	76·2	·710	55	141·8	80·7	221	22	WSW	0·61	10	69	117·8	68·4
July	·716	·116	84·5	96·0	77·9	18·1	76·3	·799	67	134·7	76·3	184	20	SW	6·18	18	65	136·7	70·9
August	·747	·134	85·0	96·0	78·3	17·7	76·7	·806	67	137·8	76·1	161	19	SW by S	2·55	7	58	163·8	71·2
September	·796	·132	84·5	95·7	77·2	18·5	76·2	·734	67	143·5	75·7	155	18	SSW	3·51	10	52	180·2	70·7
October	·847	·128	81·7	90·2	74·7	15·5	76·3	·838	78	135·8	72·6	108	4	NE	2·33	15	52	186·2	72·7
November	·974	·108	79·0	89·4	69·3	20·1	71·1	·660	66	139·0	66·4	161	3	NE by N	* 0·20	3	32	238·0	66·6
December	30·012	·111	76·1	83·7	69·6	14·1	69·8	·646	72	130·9	67·6	218	3	NE by N	3·31	9	55	173·2	66·4
Annual ..	29·847	·123	81·7	91·4	74·3	17·1	74·6	·767	71	136·6	72·0	166	12	SE	20·64	79	43	2,365·8	69·8

Extreme monthly meteorological records at the Madras Observatory in 1904.

	Barometer.					Dry bulb thermometer.				Humidity.		Sun Th. in vacuo.		Grass therm.		Wind.				Rain.	
	Highest.		Lowest.		Range.	Highest.		Lowest.		Lowest.		Highest.		Lowest.		Highest.		Lowest.		Greatest fall.	
	Inches.	Day.	Inches.	Day.	Inches.	°	Day.	°	Day.	Cents.	Day.	°	Day.	°	Day.	Miles.	Day.	Miles.	Day.	Inches.	Day.
January	30·135	8	29·879	28	0·256	84·8	27	61·8	31	57	29	138·1	12	56·5	31	300	8	60	28	0·35	2
February	·098	7	·850	27, 28	·248	87·0	29	61·2	1	55	7, 8	138·7	9	56·4	1	162	10	55	14	..	..
March	·038	9	·772	31	·266	93·3	20	67·7	10	49	26	143·0	24	63·8	20	167	19	94	24, 25	..	..
April	29·919	12	·559	6	·360	100·4	23	74·2	4	49	19, 23, 25	145·6	12	71·2	3	265	8	100	2	..	..
May	·882	8	·605	25	·277	102·7	14	74·6	24	41	7	147·6	7	71·6	1	253	5	77	25	0·58	25
June	·806	29	·522	19	·284	103·5	3	79·1	28	31	13	156·5	12	76·3	16	289	12	146	28	0·11	6
July	·862	26	·569	2	·293	101·0	7	73·3	25	35	7	144·6	4	72·0	25	271	1	116	28	1·54	25
August	·872	31	·588	1	·284	101·4	28	75·3	4	37	20	146·9	30, 31	74·1	4	211	14	112	29	1·60	3
September	·992	26	·571	12	·421	100·5	18	72·6	2	33	12	161·2	12	70·7	27	286	12	65	30	1·64	20
October	·965	27	·657	15	·308	94·5	4	67·3	29	44	28	146·5	7	63·9	29	184	16	43	9	0·57	19
November	30·107	19	·809	5	·298	93·4	5	64·1	24, 29	27	5	146·8	9	60·7	5	280	20	91	7	0·09	10
December	·212	31	·850	19	·362	87·7	1	62·7	27	46	1	141·2	29	59·7	27	365	20	128	27	0·85	20

* Lowest ever recorded in November (since 1813).

Appendix XIII.

Madras Observatory.—Abnormals from monthly means for the year 1904.

Abnormals of	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Reduced atmospheric pressure	— 0·002	+ 0·006	— 0·012	— 0·045	— 0·001	Same as	— 0·011	— 0·003	+ 0·018	+ 0·005	+ 0·051	+ 0·034	+ 0·004
Temperature of air	+ 0·7	— 1·0	— 0·8	+ 0·6	— 0·8	+ 2·1	Same as	+ 1·7	+ 1·5	+ 1·1	+ 1·5	+ 0·6	+ 0·6
Do. of evaporation	+ 1·8	— 0·4	— 0·3	+ 1·3	+ 0·4	— 0·4	+ 0·4	+ 0·7	— 0·1	+ 0·7	— 1·8	— 0·8	+ 0·1
Percentage of humidity	+ 5	+ 3	+ 2	+ 3	+ 4	— 7	+ 2	— 3	— 5	Same as	— 13	— 5	— 1
Greatest solar heat in vacuo	— 6·8	— 8·2	— 5·6	— 1·7	— 5·0	+ 1·3	— 4·0	— 2·2	+ 2·2	— 3·3	+ 1·6	— 4·9	— 3·1
Maximum in shade	— 1·6	— 2·2	— 1·0	+ 1·5	— 1·9	+ 1·5	+ 0·4	+ 2·3	+ 2·5	+ 1·2	+ 4·4	+ 0·1	+ 0·6
Minimum in shade	+ 1·7	— 1·3	— 2·1	+ 0·6	— 1·4	+ 1·7	— 0·6	+ 1·0	+ 0·1	— 0·5	— 3·0	— 0·2	— 0·4
Do. on grass	+ 2·5	— 1·2	— 2·2	+ 1·1	— 0·8	+ 2·1	— 0·3	+ 0·7	+ 0·7	— 0·2	— 3·1	+ 1·2	+ 0·1
Rainfall in inches	+ 0·11	— 0·28	— 0·39	— 0·62	— 1·20	— 1·50	+ 2·31	— 2·01	— 1·18	— 8·67	— 13·01	— 1·94	..
Do. since January	.	— 0·17	— 0·56	— 1·18	— 2·38	— 3·88	— 1·57	— 3·58	— 4·76	— 13·43	— 26·44	— 28·38	— 28·38
General direction of wind	1 point E.	Same as	Same as	1 point S.	1 point E.	3 points W.	Same as	Same as	Same as	3 points N.	1 point E.	1 point E.	Same as
Daily velocity in miles	+ 17	— 9	— 23	+ 9	— 44	+ 1	— 14	— 13	— 1	— 15	— 1	+ 35	— 5
Percentage of cloudy sky	+ 3	— 3	— 12	— 7	+ 2	+ 5	— 6	— 9	— 10	— 7	— 27	+ 3	— 6
Do. of bright sunshine	— 14·8	— 8·4	— 5·9	— 7·3	— 16·2	— 16·0	+ 2·1	+ 1·3	+ 5·6	— 1·1	+ 17·1	— 7·7	— 4·9

+ means *above* normal, — *below*.