# ANNUAL REPORT

OF THE

# DIRECTOR

# KODAIKANAL AND MADRAS

# OBSERVATORIES

## FOR 1916

MADRAS:
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1917

# KODAIKANAL AND MADRAS OBSERVATORIES.

## REPORT FOR THE YEAR 1916.

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# KODAIKANAL AND MADRAS OBSERVATORIES.

## I.—REPORT OF THE KODAIKANAL OBSERVATORY FOR THE YEAR 1916.

*Staff.*—The staff of the Observatory on December 31, 1916, was as follows:—

| | |
|---|---|
| Director ... ... ... ... ... | J. Evershed, F.R.S. |
| Assistant Director ... ... .. ... | T. Royds, D.Sc. |
| First Assistant ... ... ... ... | S. Sitarama Ayyar, B.A. |
| Second Assistant ... ... ... ... | G. Nagaraja Ayyar. |
| Third Assistant ... ... ... ... | A. A. Narayana Ayyar, B.A. |
| Fourth Assistant ... ... ... ... | S. Balasundaram Ayyar. |
| Writer ... ... ... ... ... | L. N. Krishnaswami Ayyar. |
| Photographic Assistant ... ... ... | R. Krishna Ayyar. |

MAGNETIC SECTION—

| | |
|---|---|
| Magnetic Observer ... ... .. ... | S. S. Ramaswami Ayyangar, B.A. |
| Magnetic Recorder ... ... ... ... | S. S. Ranga Acharya. |

The Director was on special duty in Kashmir until November 23. The Assistant Director was granted a month's privilege leave from December 4, 1916. The First Assistant was on privilege leave from April 26 to May 20, the Second Assistant from December 6, 1915 to January 15, 1916, the Writer from May 15 to June 15, and the Photographic Assistant from June 13 to August 13. The Book-binder retired on September 10 after a service of 15 years in this observatory.

The Magnetic Observatory which was working under the Survey of India Department since 1904 was transferred to the Meteorological Department on August 1, 1916.

The First Assistant and Photographic Assistant returned from special duty in Kashmir on March 28.

The subordinate staff consists of a book-binder, an assistant book-binder, a mechanic, six peons (including the peon of the Magnetic Observatory recently transferred from the Survey of India to the Meteorological Department), a boy peon for the dark room and two lascars.

2. *Distribution of work.*—The special distribution of work arranged in the latter half of last year continued till the end of March 1916. The Assistant Director had charge of the two spectroheliographs and of the grating spectrograph until December when the Director took charge of these instruments. The First, Second and Third Assistants were in charge of the work with the Cooke and the Lerebour and Secretan equatorials and also of all astronomical computing, the preparation of the observations for the press and the measurement of spectrum plates. The Third Assistant had charge of the seismometer and clock comparisons, and the meteorological work was done by the Fourth Assistant and the Writer. The Writer was responsible for the accounts, correspondence and all office

records. The Photographic Assistant had charge of the photographic developing, printing, etc.

3. *Buildings and grounds.*—The buildings and grounds and fire lines have been kept in good order. The lathe room was re-roofed during the year.

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

Six-inch Cooke equatorial.

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

Spectrograph I.—This with the 11-inch polar siderostat has been dismounted.

Spectrograph II—consisting of a collimator of 7 feet focus and camera of 14 feet focus placed at an angle of 60° with the former. Plane gratings of 3¼ inches or 5 inches ruled surface are used, and the slit is provided with various devices for the direct comparison of spectra from different sources, and for rotating the solar image.

Spectroheliograph—with 18-inch siderostat and 12-inch Cooke photo-visual lens of 20 feet focus, by the Cambridge Scientific Instrument Company.

An auxiliary spectroheliograph attached to the above, made in the observatory workshop.

Six-inch transit instrument and barrel chronograph, formerly the property of the Survey of India.

Theodolite, 6-inch—Cooke.

Sextant.

Evershed spectroscope with three prisms, for prominence and sunspot work, by Hilger.

Mean time clock, Kullberg 6326.

Do. Shelton.

Mean time chronometer, Kullberg 6299.

Sidereal chronometer, Kullberg 6134.

Tape chronograph, Fuess.

Two micrometers for measuring spectrum photographs, Hilger.

Hartmann photometer.

Dividing engine, Cambridge Scientific Instrument Company, Limited.

Milne horizontal pendulum seismograph.

Induction coil with necessary adjuncts.

Small polar siderostat.

Universal instrument.

Complete set of meteorological instruments, including a Richard thermograph and barograph and a nephoscope.

A high class screw cutting turning lathe, by Messrs. Cooke & Sons.

Angström pyrheliometer.

An 18-inch concave mirror by Henry of Paris belonging to the Director is mounted in the spectroheliograph room for general spectrum work.

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

Twenty-inch reflecting telescope, by Common.

Six-inch Cooke photo-visual telescope with equatorial mounting.

Two prisms of 6 inches aperture for use with the above.

Twelve-inch Cooke siderostat.

Eight-inch horizontal telescope.

Large grating spectroscope, by Hilger.

An ultra-violet spectrograph, by Grubb.

Sidereal clock, Cooke.

Mean time chronometer, Frodsham No. 3476.

One micrometer for measuring spectrum photographs, Hilger.

The Observatory is greatly indebted to His Highness the Nizam's Government and to the Director of the Nizamiah Observatory for the loan of the following lenses received in January 1915 :—

A 15-inch lens, a 12-inch lens, a 7-inch lens, all by Grubb, and a 4-inch photo-visual lens by Cooke.

The large spectroheliograph for photographing solar images up to 4½ inches diameter erected at Srinagar in 1915 was dismantled in October and the optical parts returned to Kodaikanal.

## OBSERVATIONS.

### (*a*) Solar Physics.

5. *Summary of solar observations.*—The following table gives the number of observations made at Kodaikanal during each month of the year :—

| — | January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November. | December. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 31 | 28 | 31 | 30 | 30 | 24 | 30 | 30 | 26 | 26 | 28 | 28 | 342 |
| B | 3 | 2 | 3 | 2 | 6 | ... | 1 | . . | ... | ... | 1 | 3 | 21 |
| C | 31 | 27 | 31 | 28 | 29 | 18 | 26 | 26 | 23 | 23 | 26 | 27 | 315 |
| D | ... | | ... | ... | .. | ... | .. | ... | ... | ... | ... | .. | ... |
| E | 31 | 27 | 31 | 29 | 29 | 20 | 28 | 28 | 25 | 26 | 28 | 27 | 329 |

A = spots and faculae observed. B = spot spectrum observed. C = visual spectroscopic observations made. D = photoheliograms taken. E = spectroheliograms taken.

The year was rather more favourable than usual for spectroscopic observations and prominence records.

At Srinagar 725 Spectroheliograms were obtained on 223 days from January 1st to October 25th, when the instruments were dismantled. The conditions here were extremely favourable from the beginning of May to the end of October. (See section 11).

6. *Photoheliograph.*—This was dismantled in 1915 for work in Kashmir and no direct solar photographs were obtained at Kodaikanal in 1916. The series of daily photographs on a scale of 8 inches to the sun's diameter will be resumed in 1917. At Srinagar 8-inch photographs were obtained on 72 days between January 1 and May 5. After that date the instrument was modified to give a much larger scale, and during the succeeding months special regions of the sun's disc including sunspots were photographed on a scale of 15 inches to the sun's diameter. These plates were obtained on 47 days.

7. *Cambridge spectroheliograph.*—Very satisfactory photographs were obtained with this instrument throughout the year when the definition was good. This is commonly the case between 7-30 and 8-30 a.m. but later in the day good results can very seldom be obtained. Photographs of the sun's disc in "K" light were taken on 329 days and prominence plates on 310 days. Duplicates of the disc plates have been sent to the Cambridge Observatory for measurement.

8. *Grating spectroheliograph.*—Photographs of the sun in H$\alpha$ light were obtained on 258 days. The plates for this work are now sensitized at the observatory by the Photographic Assistant and are superior to the commercial red sensitive plates. A special apparatus has been constructed for drying the plates after sensitizing. The number of absorption markings due to dense prominences on the sun's disc has increased largely and some very remarkable forms were photographed in April.

9. *Grating spectrograph.*—Dr. Royds has employed this instrument for studying the solar displacements, at the centre of the disc and at the limb, of the nickel and titanium lines, using these metals in the electric arc for comparison with the solar lines. The plates obtained have all been measured and reduced and the results were ready for publication at the close of the year. In general these results confirm those obtained with iron, and indicate a low pressure in the reversing layer, and a descending movement of the gases at the centre of the disc. Spectrum plates were also obtained in continuation of the research on the displacements in the sun of lines which are greatly shifted at the negative pole of the arc.

During December the spectrograph was modified for the purpose of photographing the spectrum of Venus. In this work the 15-inch Hyderabad lens after its return from Kashmir, was used to great advantage, and spectra were secured of the planet having a dispersion of 1·4 A per millimeter. Measures of the plates by the positive on negative method will probably yield a fair value of the solar parallax, but the main purpose is the determination of the wave-lengths of some of the solar lines on the side of the sun turned 90 degrees or more from the direction of the earth.

The research on the change of wave-length of the iron lines between the centre of the sun's disc and the limb has been completed and published (Kodaikanal Observatory Bulletin No. XLIX), and the sunspot radial motion plates obtained in 1915 have been measured and the results published in Kodaikanal Observatory Bulletin No. LI.

A number of measures of solar and arc spectra has also been accomplished for the purpose of testing the anomalous dispersion theory. The results show fairly conclusively that anomalous dispersion is not an effective agent in displacing solar lines ('Observatory' Vol. XXXIX, 432).

10. *Six-inch Cooke equatorial and spectroscope.*—This has been employed exclusively for spectrum observations, attention being concentrated on phenomena which cannot readily be photographed, such as metallic prominences, temporary eruptions, and displacements of the hydrogen lines both on the sun's disc and at the limb. The position angles of a few definitely marked prominences are also determined for the purpose of checking the correctness of the angles measured on the photographs; these depend on a fundamental angle computed from the hour angle of the sun at the time a photograph is taken, and errors which would otherwise pass unnoticed may arise in the computation or in the entry of the time.

11. *Kashmir expedition.*—The purpose of this expedition not having been fully accomplished by March 1916 owing to very abnormal weather conditions, the Government of India sanctioned an extension of the work for a further period of seven months at the request of Dr. Walker. The two assistants Messrs. Sitarama Ayyar and Krishna Ayyar who had rendered excellent service during the earlier period returned to Kodaikanal in March, and the Director and Mrs. Evershed continued the work at Srinagar until November 1.

The results obtained during the summer of 1916 amply confirm the original estimates of the general excellence of the climate for solar work. Clear and brilliant skies are the rule during the summer months and the clearness is maintained throughout the day in a large proportion of days, in strong contrast to the conditions prevailing at mountain stations. In more cloudy weather there is a distinct tendency to clear sky along the central axis of the valley while the surrounding hills are thickly covered by clouds.

As regards the winter months the results anticipated in Kodaikanal Observatory Bulletin No. XLII, page 104, were not realized, and during the six months November to April inclusive the conditions as to definition do not appear to differ materially from those found in other localities, that is to say, the definition generally is good in the morning and evening and poor near midday. The four months December to March inclusive must be considered to be considerably less favourable in Kashmir than at Kodaikanal because of the greater prevalence of cloud in Kashmir at that season.

In the month of May in Kashmir a marked improvement occurs in the midday seeing. This appears to coincide with the flooding of the paddy fields, and may also be connected with the growth of crops which then cover the fields and protect the soil from the heating effects of the sun. In the summer months good definition throughout the day is the rule, and superlative definition is of quite frequent occurrence. Very beautiful solar photographs were secured in July and in August under temperature conditions ranging from 80° to 90° in the shade, and good results were also the rule in September and October.

Considerable difficulty was experienced in adapting the instrumental outfit to the high temperature conditions, which produced distortion of the heliostat mirror and large and rapid changes of focus in the lenses. In addition to this, irregular refraction in the horizontal beam of light between the lenses and the spectroheliograph caused bad definition of the photographs when long exposures were necessary. These troubles were very largely overcome by erecting a movable wet shield over the mirror and a tube of white calico open along the top to protect the beam of light from irregular air currents. This tube was itself protected from the direct sun by a high screen of the same material.

The two principal factors which it is believed conduce to the good definition in Kashmir are the absence of disturbing winds, excluded by the surrounding wall of high mountains; and the very large areas of wet cultivation which in summer greatly reduce the heating effect of the sun on the soil.

*Summary of Sunspot and Prominence Observations.*

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

| — | January | February. | March. | April. | May | June. | July. | August. | September. | October. | November. | December. | Year. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New groups ... ... | 20 | 26 | 25 | 23 | 22 | 22 | 20 | 19 | 24 | 24 | 22 | 31 | 278 |
| Daily numbers . ... | 3·4 | 4 4 | 3·9 | 3·9 | 4 8 | 3·8 | 4·0 | 2·3 | 2·8 | 3 6 | 4·8 | 5·0 | 3·9 |
| North ... .. ... | 12 | 11 | 14 | 10 | 11 | 12 | 14 | 15 | 16 | 15 | 12 | 16 | 158 |
| South .. ... ... | 8 | 15 | 11 | 13 | 11 | 10 | 6 | 4 | 8 | 9 | 10 | 15 | 120 |
| Equator ... ... | ... | ... | ... | | ... | | | .. | ... | ... | ... | ... | ... |

The increase in the number of new groups amounts to 40 per cent compared with the previous year but the rate of increase has diminished.

There were ten days in 1915 and five in 1916 on which no spots were recorded.

There was a preponderance of spots in the northern hemisphere as in 1915, and the mean latitude was 16°·0 for northern spots and 18°·4 for southern.

Disturbances in the spot spectrum have been recorded in a large number of cases, as was to be expected in this part of the solar cycle. There were in the whole year 489 cases of C reversals, 51 of $D_3$ darkenings and 145 displacements of the C line.

13. *Prominences.*—The mean daily areas of prominences in square minutes of arc, derived from photographic records made at Kodaikanal and at Srinagar, are as follows :—

| — | North. | South. | Total. |
|---|---|---|---|
| 1916—January to June | 2·06 | 1·77 | 3·83 |
| July to December | 1·98 | 1·65 | 3 58 |

The corresponding totals for the year 1915 were, for the first six months 5·27, and for the second six months 5·29. A reduction of area amounting to about 30 per cent is thus shown.

The mean daily number of prominences recorded during the year is 18·9, a reduction compared with 1915 of under 1 per cent.

The distribution east and west of the sun's axis is interesting as indicating a return to the condition of eastern preponderance. There is only a slight excess of east over west in prominence areas and numbers, the percentage east being 50·6 and 50·5 respectively derived from a total of 6129 prominences. Prominences projected on the disc as absorption markings give percentages east of the central meridian as 52·2 for areas and 51·5 for numbers, derived from 2618 prominence markings. $D_3$ darkenings also preponderate east of the central meridian and of 489 bright reversals of H$\alpha$ on the disc 54·3 per cent were east. Only fifty-eight metallic prominences were recorded during the year and these were more frequent on the west limb than on the east. 438 displacements of H$\alpha$ were observed in the chromosphere and prominences and of these 55 per cent were on the east limb.

On May 26 a very complete record was obtained at Kodaikanal and at Srinagar of an eruptive prominence which rose to the extraordinary height of over 18′, or about half a million miles above the sun—a description of this prominence will be given in Bulletin No. LV.

14. *Solar radiation.*—Observations with the Angstrom pyrheliometer were made near noon in February and March whenever the conditions appeared favourable.

(*b*) Other Observations.

15. *Time.*—The error of the standard clock is usually determined by reference to the 16-hour signal from the Madras Observatory. This is rendered possible by the courtesy of the Telegraph Department which permits the Madras wire to be joined through to this Observatory. The signal is received with accurac yon most days and all failures are at once reported to the officer in charge of the Trichinopoly division.

16. *Meteorology.*—Eye observations are made at $8^h$, $10^h$ and $16^h$ local mean time as in former years. The Richard thermograph (wet and dry bulb) and barograph, the Beckley anemograph and the sunshine recorder also continue in use. The hourly readings from the barographs, thermographs, and sunshine records are now tabulated at the Calcutta Meteorological Office and the anemograms at the Madras Observatory which also prepares the $8^h$ registers from readings taken here. The preparation of the $10^h$ and $16^h$ registers is done in the Calcutta Meteorological Office. The wind velocity and direction are observed at $8^h$, $10^h$ and $16^h$ as usual from the Robinson anemometer and a wind vane.

Cloud observations with the nephoscope have been made three times a day and the results transmitted monthly to the Agra Aerological Observatory.

*Pressure.*—There was a slight excess of pressure in the months of January, March and April and a defect in all other months, compared with the average for the 11 years 1900—1910. The mean pressure for June was nearly 0·05 inch below the average for that month and for September it was 0·04 inch below normal.

*Temperature.*—The mean temperature for the year was 2° above normal, and an excess over normal is shown in the means for each month. The greatest excess was in March with a mean temperature 3°·2 above normal. The mean sun maximum for the year is also above normal.

*Humidity.*—The mean annual humidity was 70 per cent against a normal of 74 per cent. The greatest defect was in January when the humidity was 44 per cent, the normal value for that month being 64 per cent.

*Rainfall.*—There was a large deficiency in rainfall in the months January to April inclusive and in December. In July there was a very large excess amounting to 7·33 inches, but the year as a whole was in defect by 4·13 inches.

*Wind.*—The average wind velocity for the year was in defect of normal, the mean daily movement being 36 miles less than normal. The defect was found in every month except in May and June when there was a very slight excess. The greatest defect was in July in which month the daily movement was 226 miles against a normal of 427 miles. The greatest deviation from normal in wind direction was in December when the mean direction was south-east by east the normal being north-east.

*Transparency of the atmosphere.*—The transparency of the lower atmosphere as judged by the visibility of the Nilgiris, about 100 miles distant was slightly above normal. The Nilgiris were more or less visible on 112 days.

*Cloud and sunshine.*—The mean amount of clear sky was not very different from the normal except in January when it was 85 per cent against a normal of 64 per cent. There was a large excess in the number of hours of bright sunshine and the excess occurred in every month except June when there was a slight defect. Even in July when the rainfall was unusually heavy there was an excess of 61·6 hours.

17. *Seismology.*—Eighty-one earthquakes were recorded on the Milne horizontal pendulum, as against seventy-two last year. Details of the records are given in Appendix I.

18. *Library.*—One hundred and twenty-four volumes were bound during the year.

19. *Publications.*—Four Bulletins, with the following titles were published during the year :—

No. XLIX.—On the change of wave-length of the iron lines in passing from the centre of the sun's disc to the limb, by J. Evershed, F.R.S., and T. Royds, D.Sc.

No. L.—Summary of prominence observations for the second half of the year 1915, by T. Royds, D.Sc.

No. LI.—New measures of radial motion in sunspots, by J. Evershed, F.R.S.

No. LII.—Summary of prominence observations for the first half of the year 1916, by T. Royds, D.Sc.

In addition the following contributions were made to "The Observatory" by the Director :—

| | | |
|---|---|---|
| Anomalous dispersion in the sun | | XXXIX. 59. |
| Do. | do. | XXXIX. 432. |
| Large prominences | | XXXIX. 392. |

THE OBSERVATORY, KODAIKANAL,
*6th February 1917.*

J. EVERSHED,
*Director, Kodaikanal and Madras Observatories.*

## II.—REPORT OF THE MADRAS OBSERVATORY FOR THE YEAR 1916.

*Staff.*—The staff at the Observatory on December 31, 1916, was as follows:—

| | |
|---|---|
| Deputy Director .. ... ... ... | R. Ll. Jones. |
| Computer ... ... ... ... ... | S. Solomon Pillai. |
| First Assistant ... ... ... ... ... | C. Chengalvaraya Mudaliyar. |
| Second Assistant ... ... ... ... | E. Ramanujam Pillai. |

Mr. R. Ll. Jones was absent on leave from 22nd May to 26th June 1916, and Mr. James Angus of the Madras Christian College acted for him during his absence. Mr. S. Solomon Pillai was absent on privilege leave from 15th August to 28th October 1916 during which period Mr. C. Chengalvaraya Mudaliyar acted as Computer and Mr. R. K. Sangameswara Ayyar as First Assistant.

2. *Time service.*—The time gun at Fort St. George failed on 30 occasions out of 732, giving a percentage of success of 96. Owing to the shifting of the instruments from the old Port Office to the new Signal Station the dropping of the Semaphore was suspended from 1st January to 22nd February. During the remaining part of the year the Semaphore failed on thirteen occasions; on ten of these it was dropped correctly at 2 P.M. The 4 P.M. roll of signals was sent and received at the Central Telegraph Office, for distribution over India, correctly on every day.

3. *Meteorological observations.*—Meteorological observations were carried on as in former years, and the registers are kept posted up to date. Extra observations were taken for storm warning purposes and telegrams sent to Calcutta on 37 occasions.

4. *Buildings.*—Repairs to the office and quarters were carried out during the year. The construction of the subsoil drain round the Observatory which was undertaken at the end of the previous year was completed during the earlier part of the year. It is too early as yet to say how far it will be effective in stopping the variations in level; but the changes this year have not been so large as in previous years.

5. *Instruments.*—The following is a list of the instruments at the Observatory on 31st December 1916:—

(a) *Astronomical.*

Eight-inch Equatorial Telescope—Troughton & Simms.
Sidereal clock—Haswall.
Do. Dent, No. 1408.
Do. S. Riefler, No. 61.
Mean Time clock—J. H. Agar Baugh, No. 105.
Do. with galvanometer—Shepherd & Sons.
Meridian circle—Troughton & Simms.
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.
Do. Thermograph—No. 29637, L. Casella.
Peander's Self-recording Rain-gauge—No. 116, Lawrence & Mayo.
Beckley's Anemograph—Adie.
Sunshine Recorder—No. 149, L. Casella.
Nephoscope—Mons Jules Duboscq & Ph. Pellin.

Barometer, Fortin's—No. 1771, L. Casella.
Do. do. No. 725, L. Casella (spare).
Do. do. No. 1420, L. Casella.
Dry bulb thermometer—No. 94221, L. Casella.
Do. do. No. 38037, Negretti and Zambra (spare).
Wet do. No. 94219, L. Casella.
Do. do. No. 38037, Negretti and Zambra (spare).
Dry Maximum thermometer—No. 8581, Negretti and Zambra.
Dry Minimum thermometer—No. 69017, L. Casella.
Wet do. No. 91753, Negretti and Zambra.
Sun Maximum thermometer—No. 127618, Negretti and Zambra.
Grass Minimum thermometer—No. 3377, Negretti and Zambra.
Rain-gauge (8″ diameter) -No. 1042, Negretti and Zambra.
Measure glass for above.
Rain-gauge (5″ diameter).
Measure glass for above.
Stop watch—No. A-3.

The Mean Time Clock by Shepherd & Sons and the Sidereal clock by Haswall were cleaned. The Riefler clock was overhauled and cleaned during the year.

6. *Weather summary.*—The following is a summary of the meteorological conditions at Madras during 1916 :—

*Pressure.*—Pressure was below normal in all other months of the year except in January when the excess was 0·024 inch and the greatest defect was 0·086 inch in September. The highest pressure recorded was 30·149 inches on January 11 and the lowest 29·436 inches on June 13.

*Temperature.*—The mean temperature of the air was above normal throughout the year except in July. The maximum shade temperature was normal in October, below normal in May, July and November and above in all other months. The minimum in shade was below normal in January, March, May, July and December and above normal in the remaining months. The highest shade temperature recorded was 104°·5 on June 7 and the lowest 62°·6 on January 19. The highest sun maximum was 169°·4 on October 3 and the lowest on grass was 58°·4 on January 19.

*Humidity.*—The percentage of humidity was above normal in all months except January, June and December. In these months it was almost normal.

*Wind.*—The wind velocity was in defect almost throughout the year. The highest wind velocity was 369 miles on November 22. The wind direction was nearly normal in all months except October when it was 10 points towards west.

*Cloud.*—The percentage of cloud was above normal in June and below in all other months.

*Sunshine.*—The percentage of bright sunshine was below normal in June, August, September, October and November and above normal in the remaining months. The total number of hours of sunshine during the year was 2,372·1 against 2,444·9 in the previous year.

*Rainfall.*—The rainfall in the year was above normal in June, October and November, and below in all the other months. The greatest excess was 4·30 inches in October and the greatest defect was 2·36 inches in August. The total fall for the year was 46·47 inches on 92 days against an average of 49·02 inches. The greatest fall in the year was 5·09 inches on October 15. The monsoon rainfall from October 15 to the end of the year was 31·62 inches against an average of 26·00 inches.

*Storm.*—A storm of great severity formed in or entered the south-east of the Bay on November 19th and moving slowly westwards crossed the Coromandel Coast to the south of Madras early on the morning of the 23rd. It caused great loss in life and property in the South Arcot District and Pondicherry.

THE OBSERVATORY, MADRAS,
*4th February 1917.*

R. LL. JONES,
*Deputy Director.*

# APPENDIX I.

## STATION—KODAIKANAL OBSERVATORY.

### SEISMIC RECORDS.

$\phi = 10° 13' 50''$ $\lambda = 77° 28' 00''$ $h = 2{,}343$ metres. *Subsoil*—Rock.
*Apparatus*—Milne's Horizontal Pendulum Seismograph.

| 1916. | $T_o$ | $\frac{r}{T_o^2}$ | 1916. | $T_o$ | $\frac{r}{T_o^2}$ |
|---|---|---|---|---|---|
| January ... ... | 17·9 | 2·3 | July ... ... | 18·2 | 2·5 |
| February ... ... | 17·8 | 2·5 | August .. ... | 18·0 | 2·4 |
| March ... ... | 17·9 | 2·4 | September ... ... | 18·0 | 2·6 |
| April .. ... | 18·2 | 2·6 | October ... ... | 18·0 | 2·6 |
| May .. ... | 17·9 | 2·5 | November .. | 17·8 | 2·5 |
| June .. ... | 18·1 | 2·4 | December ... | 18·0 | 2·5 |

| No. | Date. | Phase. | Time G.M.T. | | | Period. (Sec.) | Amplitude ($u$). | | | Distance $\Delta$ (Km.) | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | An. | Ae. | Az. | | |
| | 1916. | | H. | M. | S. | | | | | | |
| 1 | January* 1 ... | ... | | ... | | ... | ... | ... | ... | ... | No P. Ts. |
| | | iL | 13 | 32 | 36 | ... | ... | | ... | ... | |
| | | M | 14 | 13 | 12 | ... | ... | 830 | ... | .. | |
| | | F | 17 | 26 | 00 | ... | ... | ... | ... | ... | |
| 2 | 13 ... | eP | 6 | 27 | 48 | ... | ... | ... | ... | .. | |
| | | iL | 6 | 48 | 06 | ... | ... | ... | ... | ... | |
| | | M | 6 | 49 | 42 | ... | ... | 50 | .. | .. | |
| | | F | | ? | | .. | ... | | | ... | |
| 3 | 13 ... | iP | 8 | 30 | 48 | ... | ... | .. | ... | .. | Overlapping. |
| | | iL | 8 | 38 | 42 | ... | ... | ... | . | ... | |
| | | M | 8 | 55 | 00 | .. | .. | 65 | ... | ... | |
| | | F | 12 | 21 | 48 | ... | ... | . | ... | ... | |
| 4 | 19 ... | eP | 19 | 18 | 42 | ... | ... | . | .. | ... | Widening of line. |
| | | F | 20 | 29 | 30 | ... | ... | . | ... | ... | |
| 5 | 24 ... | iP | 7 | 09 | 36 | ... | | ... | ... | ... | |
| | | iL | 7 | 13 | 48 | ... | . | .. | . | ... | |
| | | M | 7 | 35 | 54 | .. | ... | 490 | ... | ... | |
| | | F | 8 | 55 | 30 | ... | .. | ... | ... | ... | |
| 6 | 26 ... | eP | 8 | 13 | 18 | ... | ... | ... | . . | ... | Widening of line. |
| | | F | 8 | 38 | 12 | ... | ... | ... | ... | ... | |
| 7 | 26 .. | eP | 13 | 23 | 00 | . | ... | ... | ... | ... | Widening of line. |
| | | F | 14 | 00 | 54 | ... | ... | .. | ... | ... | |
| 8 | 30 ... | eP | 21 | 39 | 48 | .. | .. | | .. | | Widening of line. |
| | | F | 22 | 04 | 00 | ... | ... | . | ... | | |
| 9 | 31 .. | eP | 18 | 40 | 18 | . . | ... | ... | ... | ... | |
| | | L | | ... | | | ... | . | ... | | |
| | | M | 19 | 29 | 12 | . | . | 50 | ... | ... | |
| | | F | 20 | 10 | 54 | ... | ... | .. | ... | ... | |
| 10 | February 1 . | eP | 7 | 46 | 12 | ... | .. | ... | ... | .. | |
| | | iL | 7 | 57 | 48 | ... | ... | ... | . | . | |
| | | M | 8 | 12 | 48 | ... | ... | 650 | ... | ... | |
| | | F | 10 | 45 | 24 | ... | ... | ... | ... | ... | |
| 11 | 6 ... | iP | 22 | 15 | 48 | ... | . | | .. | .. | |
| | | iL | 22 | 43 | 06 | | .. | .. | | ... | |
| | | M | 22 | 51 | 54 | ... | .. | 250 | ... | .. | |
| | | F | 23 | 38 | 48 | | ... | ... | ... | ... | |
| 12 | 10 ... | eP | 2 | 15 | 36 | .. | ... | | ... | .. | |
| | | iL | 2 | 18 | 24 | ... | .. | | ... | ... | |
| | | M | 2 | 21 | 48 | | ... | 40 | ... | ... | |
| | | F | 2 | 36 | 24 | . | . | . . | | ... | |
| 13 | 14 ... | iP | 10 | 17 | 54 | . | ... | . . | ... | ... | |
| | | eL | 10 | 20 | 00 | ... | | ... | ... | ... | |
| | | M | 10 | 24 | 06 | .. | ... | 50 | ... | ... | |
| | | F | 11 | 13 | 18 | ... | ... | ... | ... | ... | |
| 14 | 14 ... | eP | 17 | 49 | 48 | ... | ... | ... | ... | ... | |
| | | iL | 17 | 54 | 48 | ... | ... | .. | | ... | |
| | | M | 17 | 57 | 18 | ... | ... | 150 | ... | . | |
| | | F | 18 | 29 | 36 | ... | ... | . | ... | ... | |
| 15 | 15 ... | eP | 12 | 31 | 48 | ... | . | ... | ... | ... | |
| | | iL | 12 | 39 | 00 | ... | ... | ... | . . | ... | |
| | | M | 12 | 41 | 06 | ... | ... | 80 | ... | .. | |
| | | F | 13 | 13 | 00 | ... | . | ... | | ... | |

* The instrument was not working satisfactorily during the month. From January 13th to February 5th it was under repairs and during this period record was obtained only on January 17th.

Kodaikanal Observatory, Seismic Records—*cont.*

| No. | Date. | | Phase. | Time G.M.T. | | | Period (Sec.). | Amplitude (u). | | | Distance △ (Km.). | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | H. | M. | S. | | An. | Ae. | Az. | | |
| | 1916. | | | | | | | | | | | |
| 16 | February | 20 . | iP | 18 | 12 | 24 | . | .. | . | ... | ... | |
| | | | iL | 18 | 44 | 24 | .. | ... | ... | | | |
| | | | M | 18 | 53 | 42 | | ... | 160 | ... | ... | |
| | | | F | 20 | 38 | 00 | .. | .. | .. | | . | |
| 17 | | 21 ... | iP | 14 | 02 | 36 | | ... | . | ... | ... | Widening of line. |
| | | | F | 14 | 19 | 42 | ... | ... | ... | ... | ... | |
| 18 | | 28 ... | eP | 20 | 45 | 24 | .. | . | ... | ... | ... | |
| | | | iL | 21 | 44 | 42 | .. | ... | . | | .. | |
| | | | M | 22 | 01 | 42 | .. | .. | 350 | .. | ... | |
| | | | F | 23 | 20 | 30 | .. | | .. | .. | ... | |
| 19 | March | 4 ... | eP | 7 | 48 | 30 | . | ... | ... | .. | | Widening of line. |
| | | | F | 8 | 39 | 48 | | | ... | | ... | |
| 20 | | 26 ... | eP | 0 | 08 | 00 | . | .. | .. | .. | | Widening of line. |
| | | | F | 0 | 46 | 24 | .. | . | ... | ... | ... | |
| 21 | | 26 ... | P | | ... | | | .. | .. | | .. | |
| | | | iL | 2 | 19 | 24 | . | ... | | .. | | |
| | | | M | 2 | 20 | 30 | ... | | 50 | | ... | |
| | | | F | 2 | 28 | 12 | | . | | ... | | |
| 22 | April | 5 ... | eP | 21 | 20 | 30 | .. | ... | .. | . | ... | |
| | | | eL | 21 | 25 | 36 | . | | ... | .. | .. | |
| | | | M | 21 | 31 | 30 | .. | ... | 50 | .. | .. | |
| | | | F | 21 | 51 | 00 | .. | | | | .. | |
| 23 | | 7 .. | iP | 9 | 41 | 36 | ... | . | | ... | ... | |
| | | | iL | 9 | 41 | 48 | | . | ... | .. | | |
| | | | M | 9 | 51 | 36 | ... | . | 1,120 | ... | .. | |
| | | | F | 11 | 53 | 36 | ... | ... | ... | .. | .. | |
| 24 | | 7 ... | eP | 14 | 48 | 12 | ... | ... | ... | .. | | |
| | | | eL | 14 | 56 | 54 | ... | . | .. | . | ... | |
| | | | M | 14 | 58 | 42 | ... | | 40 | ... | ... | |
| | | | F | 15 | 06 | 54 | | | ... | | .. | |
| 25 | | 14 ... | eP | 17 | 50 | 00 | ... | ... | .. | .. | .. | Widening of line. |
| | | | F | 18 | 06 | 24 | ... | ... | .. | .. | .. | |
| 26 | | 15 | P | | ? | | ... | ... | ... | ... | . | Beginning lost in hour mark at $9^h$ $30^m$. |
| | | | eL | 9 | 34 | 36 | ... | ... | ... | ... | ... | |
| | | | M | 9 | 35 | 30 | ... | .. | 60 | .. | ... | |
| | | | F | 9 | 56 | 48 | ... | ... | ... | ... | ... | |
| 27 | | 15 .. | eP | 12 | 38 | 30 | ... | | ... | ... | ... | |
| | | | iL | 12 | 42 | 24 | ... | | ... | ... | ... | |
| | | | M | 12 | 47 | 30 | ... | ... | 420 | ... | ... | |
| | | | F | 14 | 23 | 36 | ... | | | ... | . | |
| 28 | | 15 ... | eP | 15 | 08 | 36 | ... | ... | ... | ... | ... | |
| | | | iL | 15 | 19 | 24 | ... | .. | ... | .. | ... | |
| | | | M | 15 | 20 | 00 | ... | ... | 60 | .. | .. | |
| | | | F | 15 | 52 | 42 | ... | | ... | ... | .. | |
| 29 | | 18 | eP | 4 | 25 | 06 | ... | .. | | ... | .. | |
| | | | iL | 4 | 26 | 42 | ... | .. | ... | . | .. | |
| | | | M | 4 | 27 | 24 | ... | .. | 50 | ... | ... | |
| | | | F | 5 | 37 | 12 | ... | .. | ... | ... | . | |
| 30 | | 21 ... | eP | 11 | 44 | 48 | ... | . | ... | ... | .. | |
| | | | iL | 11 | 46 | 30 | ... | ... | ... | ... | | |
| | | | M | 11 | 47 | 30 | ... | ... | 100 | ... | .. | |
| | | | F | 13 | 09 | 54 | | | .. | . | .. | |
| 31 | | 21 ... | eP | 14 | 05 | 54 | .. | | .. | | .. | |
| | | | iL | 14 | 11 | 00 | ... | ... | .. | ... | ... | |
| | | | M | 14 | 12 | 18 | .. | ... | 50 | ... | ... | |
| | | | F | 14 | 37 | 42 | ... | ... | ... | ... | .. | |
| 32 | | 24 ... | eP | 8 | 25 | 24 | ... | ... | ... | ... | ... | |
| | | | iL | 8 | 47 | 00 | ... | ... | ... | ... | ... | |
| | | | M | 8 | 47 | 30 | . | ... | 50 | ... | ... | |
| | | | F | | ? | | ... | .. | ... | ... | ... | |
| 33 | | 24 ... | P | | ? | | ... | ... | ... | | .. | Overlapping. |
| | | | iL | 9 | 36 | 42 | ... | ... | | ... | ... | |
| | | | M | 9 | 41 | 30 | ... | ... | 200 | .. | ... | |
| | | | F | 10 | 35 | 24 | .. | ... | .. | ... | .. | |
| 34 | | 26 ... | P | | ? | | ... | ... | ... | | ... | Instrument examined at $3^h$ $38^m$. |
| | | | L | | ? | | ... | ... | .. | ... | ... | |
| | | | M | 4 | 01 | 24 | .. | ... | 120 | ... | ... | |
| | | | F | 4 | 35 | 42 | ... | . | ... | ... | .. | |
| 35 | May | 9 .. | P | | ... | | .. | ... | ... | ... | ... | No P. Ts. |
| | | | iL | 14 | 40 | 18 | .. | ... | ... | ... | . | |
| | | | M | 14 | 48 | 18 | ... | ... | 580 | ... | ... | |
| | | | F | 15 | 22 | 18 | ... | ... | ... | ... | ... | |
| 36 | | 15 ... | eP | 22 | 38 | 48 | ... | ... | ... | ... | ... | Widening of line. |
| | | | F | 22 | 47 | 30 | .. | ... | ... | ... | ... | |

Kodaikanal Observatory, Seismic Records—*cont.*

| No. | Date. | Phase. | Time G.M.T. H. | M. | S. | Period (Sec.). | Amplitude (μ). An. | Ae. | Az. | Distance Δ (Km.). | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1916. | | | | | | | | | | |
| 37 | May 23 ... | eP | 22 | 54 | 36 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 23 | 06 | 54 | ... | ... | .. | . | ... | |
| 38 | June 14 ... | eP | 14 | 19 | 24 | ... | ... | ... | .. | ... | |
| | | eL | 14 | 20 | 12 | ... | ... | ... | . | ... | |
| | | M | 14 | 21 | 12 | ... | ... | 50 | ... | ... | |
| | | F | 14 | 39 | 18 | ... | ... | ... | ... | .. | |
| 39 | 15 ... | eP | 11 | 32 | 00 | ... | . | ... | ... | ... | |
| | | eL | 11 | 39 | 48 | .. | ... | .. | . | . | |
| | | M | 11 | 43 | 54 | ... | ... | 110 | ... | ... | |
| | | F | 12 | 40 | 00 | .. | ... | ... | ... | ... | |
| 40 | 21 ... | eP | 20 | 09 | 36 | ... | ... | ... | | ... | |
| | | iL | 20 | 09 | 48 | ... | ... | .. | . | ... | |
| | | M | 20 | 10 | 36 | ... | ... | 110 | . | . | |
| | | F | 20 | 23 | 36 | . | ... | . | .. | ... | |
| 41 | 21 ... | eP | 21 | 58 | 36 | .. | | ... | ... | .. | |
| | | eL | 22 | 03 | 48 | | .. | ... | . | ... | |
| | | M | 22 | 10 | 00 | .. | .. | 50 | ... | ... | |
| | | F | 23 | 57 | 42 | ... | ... | ... | ... | ... | |
| 42 | 30 ... | eP | 4 | 20 | 12? | .. | .. | . | ... | .. | Confused by air tremors. |
| | | eL | 4 | 32 | 48 | .. | ... | ... | ... | ... | |
| | | M | 4 | 33 | 48 | ... | ... | 120 | ... | ... | |
| | | F | 5 | 22 | 48? | ... | ... | ... | ... | ... | |
| 43 | July 13 ... | eP | 15 | 26 | 12 | . | ... | ... | ... | ... | Widening of line. |
| | | F | 15 | 42 | 42 | .. | ... | ... | ... | .. | |
| 44 | 27 ... | eP | 11 | 57 | 06 | ... | ... | ... | ... | ... | |
| | | iL | 11 | 58 | 06 | ... | ... | ... | ... | ... | |
| | | M | 12 | 07 | 00 | ... | ... | 80 | ... | ... | |
| | | F | 12 | 24 | 06 | ... | .. | ... | ... | ... | |
| 45 | August 8 .. | eP | 1 | 42 | 06 | ... | ... | ... | ... | ... | |
| | | iL | 1 | 51 | 00 | ... | ... | .. | ... | ... | |
| | | M | 1 | 52 | 12 | ... | ... | 100 | ... | ... | |
| | | F | 2 | 55 | 42 | ... | ... | .. | ... | ... | |
| 46 | 8 ... | eP | 5 | 04 | 36 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 5 | 20 | 18 | ... | ... | ... | ... | ... | |
| 47 | 25 ... | eP | 10 | 15 | 30 | ... | ... | ... | ... | ... | |
| | | eL | 11 | 02 | 18 | ... | ... | ... | ... | ... | |
| | | M | 11 | 13 | 18 | .. | ... | 110 | ... | ... | |
| | | F | 11 | 55 | 06 | ... | ... | | ... | ... | |
| 48 | 28 ... | iP | 6 | 44 | 36 | ... | ... | ... | ... | ... | |
| | | iL | 6 | 47 | 36 | ... | ... | ... | ... | ... | |
| | | M | 6 | 52 | 00 | | ... | 900 | ... | ... | |
| | | F | | ... | | ... | ... | .. | ... | ... | |
| 49 | 28 ... | P | | ... | | ... | | | ... | ... | |
| | | iL | 7 | 55 | 48 | | . | ... | ... | ... | |
| | | M | 7 | 57 | 18 | ... | ... | 220 | ... | ... | |
| | | F | 8 | 52 | 00 | ... | ... | ... | ... | ... | |
| 50 | September 11 ... | eP | 9 | 38 | 06 | ... | ... | ... | ... | . | |
| | | iL | 9 | 44 | 00 | ... | ... | ... | .. | ... | |
| | | M | 9 | 45 | 06 | ... | ... | 100 | . | ... | |
| | | F | 11 | 07 | 00 | ... | ... | ... | ... | ... | |
| 51 | 15 ... | eP | 7 | 12 | 00 | ... | ... | ... | . | ... | |
| | | iL | 7 | 20 | 00 | . | ... | ... | .. | ... | |
| | | M | 7 | 21 | 48 | .. | ... | 50 | ... | ... | |
| | | F | 8 | 19 | 42 | ... | ... | ... | ... | ... | |
| 52 | 29 ... | eP | 20 | 24 | 06 | ... | ... | ... | .. | ... | Widening of line. |
| | | F | 20 | 41 | 30 | . | .. | ... | ... | ... | |
| 53 | October 3 ... | eP | 1 | 49 | 54 | ... | ... | | . | ... | |
| | | eL | 1 | 59 | 36 | ... | ... | ... | | ... | |
| | | M | 2 | 12 | 12 | | ... | 50 | ... | ... | |
| | | F | | ... | | ... | .. | ... | ... | | |
| 54 | 3 ... | P | | ... | | | ... | ... | . | ... | Overlapping. |
| | | iL | 2 | 48 | 36 | ... | .. | ... | ... | ... | |
| | | M | 2 | 54 | 18 | . | ... | 150 | | ... | |
| | | F | 3 | 49 | 00? | ... | ... | ... | ... | ... | |
| 55 | 14 ... | P | | .. | | ... | | ... | . | ... | No P. Ts. |
| | | iL | 19 | 57 | 36 | ... | ... | ... | ... | ... | |
| | | M | 19 | 58 | 18 | ... | ... | 200 | ... | ... | |
| | | F | 20 | 18 | 30 | .. | ... | .. | ... | ... | |
| 56 | 20 ... | eP | 17 | 24 | 54 | ... | ... | ... | . | ... | Widening of line. |
| | | F | 19 | 40 | 12 | ... | ... | ... | ... | ... | |
| 57 | 21 ... | eP | 19 | 30 | 00? | ... | ... | ... | ... | ... | Hour mark at $19^h$ $30^m$. |
| | | iL | 19 | 34 | 36 | ... | .. | ... | ... | | |
| | | M | 19 | 36 | 54 | ... | ... | 190 | ... | .. | |
| | | F | 20 | 18 | 48 | ... | ... | ... | ... | ... | |

Kodaikanal Observatory, Seismic Records—*cont.*

| No. | Date | | Phase. | Time G.M.T. | | | Period (Sec.). | Amplitude ($u$). | | | Distance △ (Km.). | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | An. | Ae. | Az. | | |
| | 1916. | | | H. | M. | S. | | | | | | |
| 58 | October | 31 | eP | 1 | 09 | 42 | ... | .. | ... | .. | ... | |
| | | | eL | 1 | 15 | 48 | ... | | ... | | | |
| | | | M | 1 | 18 | 00 | | | 50 | .. | ... | |
| | | | F | 1 | 35 | 36 | ... | .. | .. | ... | ... | |
| 59 | | 31 | eP | 15 | 43 | 18 | ... | | | ... | . | |
| | | | iL | 15 | 52 | 42 | ... | ... | .. | ... | ... | |
| | | | M | 16 | 18 | 48 | | ... | 270 | | .. | |
| | | | F | 18 | 26 | 12 | ... | .. | .. | ... | .. | |
| 60 | November | 4 | eP | 2 | 36 | 09 | .. | ... | ... | | . | |
| | | | eL | 2 | 40 | 00 | ... | .. | ... | ... | .. | |
| | | | M | 2 | 43 | 00 | ... | .. | 40 | ... | . | |
| | | | F | 2 | 50 | 02 | ... | | .. | | .. | |
| 61 | | 11 | eP | 14 | 16 | 05 | ... | ... | . | . | | |
| | | | eL | 14 | 20 | 00 | ... | ... | .. | | .. | |
| | | | M | 14 | 23 | 06 | .. | ... | 80 | ... | .. | |
| | | | F | 14 | 36 | 09 | ... | .. | ... | | ... | |
| 62 | | 11 | eP | 16 | 03 | 07 | .. | ... | .. | ... | ... | |
| | | | eL | 16 | 07 | 03 | ... | ... | | ... | ... | |
| | | | M | 16 | 11 | 09 | ... | ... | 70 | ... | ... | |
| | | | F | 16 | 24 | 01 | ... | ... | ... | ... | ... | |
| 63 | | 13 | eP | 12 | 44 | 54 | ... | ... | . | ... | .. | Widening of line. |
| | | | F | 12 | 55 | 36 | ... | ... | .. | . | ... | |
| 64 | | 14 | eP | 22 | 51 | 12 | ... | ... | . | ... | ... | |
| | | | eL | 22 | 59 | 24 | ... | ... | ... | ... | ... | |
| | | | M | 23 | 00 | 54 | | ... | 80 | ... | ... | |
| | | | F | 23 | 16 | 30 | ... | ... | ... | ... | .. | |
| 65 | | 18 | eP | 12 | 40 | 30 | ... | ... | | | ... | Widening of line. |
| | | | F | 12 | 56 | 36 | ... | ... | ... | ... | ... | |
| 66 | | 21 | eP | 7 | 53 | 12 | ... | ... | ... | .. | ... | |
| | | | eL | 8 | 04 | 42 | ... | ... | | ... | ... | |
| | | | M | 8 | 18 | 48 | ... | . | 50 | ... | .. | |
| | | | F | 8 | 26 | 24 | ... | ... | .. | .. | ... | |
| 67 | | 22 | eP | 20 | 03 | 18 | ... | ... | ... | ... | ... | |
| | | | eL | 20 | 06 | 54 | ... | | .. | ... | ... | |
| | | | M | 20 | 09 | 12 | ... | | 40 | | | |
| | | | F | 20 | 20 | 48 | ... | ... | ... | .. | ... | |
| 68 | | 24 | eP | 4 | 47 | 36 | ... | | | . | . | Widening of line. |
| | | | F | 4 | 49 | 42 | ... | ... | .. | .. | ... | |
| 69 | | 24 | eP | 12 | 57 | 30 | .. | ... | | ... | ... | Widening of line. |
| | | | F | 13 | 08 | 36 | .. | ... | ... | ... | ... | |
| 70 | | 30 | eP | 4 | 40 | 18 | ... | . | ... | .. | ... | Widening of line. |
| | | | F | 5 | 09 | 30 | .. | ... | ... | ... | ... | |
| 71 | December | 1 | eP | 21 | 46 | 00 | ... | ... | ... | ... | ... | Widening of line. |
| | | | F | 21 | 57 | 24 | ... | ... | .. | | ... | |
| 72 | | 2 | eP | 13 | 11 | 54 | .. | ... | ... | ... | ... | |
| | | | eL | 13 | 14 | 24 | .. | .. | ... | ... | ... | |
| | | | M | 13 | 17 | 30 | ... | ... | 30 | ... | .. | |
| | | | F | 13 | 24 | 06 | .. | ... | ... | ... | ... | |
| 73 | | 3 | P | | ... | | . | .. | ... | ... | ... | |
| | | | iL | 8 | 47 | 24 | ... | ... | .. | | ... | |
| | | | M | 8 | 47 | 24 | ... | ... | 40 | ... | ... | |
| | | | F | 8 | 51 | 30 | ... | | | .. | ... | |
| 74 | | 5 | eP | 21 | 44 | 30 | ... | .. | . | . | ... | Widening of line. |
| | | | F | 21 | 56 | 24 | ... | | | ... | ... | |
| 75 | | 9 | eP | 0 | 44 | 30 | ... | | ... | .. | ... | Widening of line. |
| | | | F | 0 | 48 | 36 | ... | ... | . | . | ... | |
| 76 | | 14 | eP | 17 | 41 | 00 | ... | .. | .. | ... | ... | Widening of line. |
| | | | F | 18 | 08 | 00 | ... | ... | | ... | ... | |
| 77 | | 23 | eP | 10 | 05 | 42 | ... | ... | . | | ... | |
| | | | eL | 10 | 43 | 00 | ... | ... | ... | ... | ... | |
| | | | M | 10 | 55 | 42 | ... | ... | 60 | ... | .. | |
| | | | F | 11 | 29 | 30 | ... | .. | ... | ... | .. | |
| 78 | | 24 | P | | .. | | | | | | | |
| | | | eL | 8 | 03 | 24 | ... | ... | ... | ... | ... | |
| | | | M | 8 | 04 | 54 | ... | ... | 50 | ... | ... | |
| | | | F | 8 | 12 | 24 | ... | .. | ... | .. | ... | |
| 79 | | 26 | eP | 4 | 08 | 06 | ... | ... | .. | ... | ... | Widening of line. |
| | | | F | 4 | 38 | 06 | ... | | ... | ... | ... | |
| 80 | | 26 | eP | 20 | 34 | 18 | ... | ... | ... | ... | ... | Widening of line. |
| | | | F | 21 | 05 | 06 | ... | ... | ... | ... | ... | |
| 81 | | 27 | eP | 22 | 08 | 36 | ... | ... | ... | ... | ... | Widening of line. |
| | | | F | 22 | 29 | 00 | ... | .. | ... | ... | ... | |

# APPENDIX II.

Latitude 10° 13′ 50″ N.

Longitude $5^h$ $9^m$ $52^s$ E.

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

MEAN Monthly and Annual Meteorological Results at the Kodaikanal Observatory in 1916.

| 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 Simpson's Tables. | | | | Daily Velocity. | Mean Direction. | | Amount. | Days. | | |
| | Inches. | Inches. | ° | ° | ° | ° | ° | ° | Inches. | Cents. | ° | ° | Miles. | Points. | Points. | Inches. | No. | Cents. | Hours. |
| January | 22·864 | 0·064 | 56·5 | 67·5 | 45·5 | 22 0 | 45·0 | 36·6 | 0·192 | 44 | 125·4 | 34·8 | 292 | 3 | N.E. by N. | ... | ... | 85 | 318·0 |
| February | ·835 | ·069 | 57·2 | 66 6 | 47·7 | 18 9 | 47·6 | 41·2 | ·250 | 57 | 128·0 | 36·6 | 249 | 6 | E.N.E. | 0·06 | . | 68 | 245·1 |
| March | ·859 | ·058 | 61·0 | 70·9 | 51·0 | 19·9 | 49·5 | 43·6 | ·246 | 49 | 136·3 | 41·3 | 299 | 3 | N.E. by N. | 0·72 | 1 | 76 | 293·9 |
| April | ·843 | ·062 | 62·8 | 71·8 | 53·9 | 17·9 | 53·3 | 48 0 | ·323 | 60 | 132·0 | 46·0 | 273 | 5 | N.E. by E. | 1·86 | 5 | 59 | 272·3 |
| May | ·793 | .059 | 62·4 | 70·1 | 54 6 | 15 5 | 55·5 | 50·2 | ·381 | 70 | 135·3 | 48·4 | 259 | 5 | N.E. by E. | 7·41 | 11 | 53 | 251·8 |
| June | ·720 | ·052 | 58·2 | 63·3 | 53·0 | 10·8 | 53·9 | 49·8 | ·381 | 81 | 119 4 | 49·2 | 376 | 23 | W. by S. | 2·30 | 7 | 19 | 107·6 |
| July | ·738 | ·054 | 59·1 | 65·2 | 53·1 | 12·1 | 55·1 | 50·8 | ·404 | 83 | 128·6 | 48·5 | 226 | 22 | W.S.W. | 11 52 | 16 | 28 | 164·2 |
| August | ·769 | ·061 | 58·1 | 63·9 | 52·2 | 11·7 | 54·3 | 49·7 | .391 | 83 | 126·0 | 48.4 | 284 | 21 | S.W. by W. | 8·53 | 14 | 26 | 158·2 |
| September | ·745 | ·071 | 57·9 | 63·4 | 52·5 | 10·9 | 54·2 | 49·7 | ·392 | 83 | 123·9 | 48 7 | 293 | 23 | W. by S. | 8 35 | 9 | 25 | 136·1 |
| October | ·777 | ·069 | 57·4 | 63·0 | 51 7 | 11·3 | 53·7 | 49·3 | ·383 | 83 | 119·0 | 47·5 | 208 | 27 | N.W. by W. | 6·97 | 11 | 26 | 145·1 |
| November | .804 | ·062 | 56·2 | 63·3 | 49·2 | 14·1 | 51·9 | 45·9 | ·354 | 79 | 121·2 | 44 5 | 233 | 4 | N.E. | 6·48 | 10 | 38 | 188·7 |
| December | ·798 | ·058 | 53·4 | 61·4 | 45·4 | 16·0 | 47·7 | 41·0 | 286 | 71 | 117·2 | 45·2 | 246 | 11 | S.E. by E. | 1·22 | 4 | 52 | 220·2 |
| Annual | 22·795 | 0·062 | 58·4 | 65·9 | 50·8 | 15·0 | 51·8 | 46·3 | 0·332 | 70 | 126 0 | 44·9 | 270 | 31 | N. by W. | 55·42 | 88 | 46 | 2,501·2 |

EXTREME Monthly Meteorological Records at the Kodaikanal Observatory in 1916.

| 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 | 22·940 | 15 | 22·790 | 7 | 0·150 | **76·3** | **25** | 40·4 | 11 | 32·5 | 29 | **5** | **26** | 132·4 | 25 | **24 1** | **20** | 502 | 18 | 178 | 9 | ... | ... |
| February | ·926 | 29 | ·745 | 8 | ·181 | 72·8 | 1,23 | 41·6 | 4 | **31·3** | **5** | 16 | 2 | 140·7 | 18 | 26·4 | 5 | 544 | 26 | **71** | **6** | 0·04 | 16 |
| March | **.941** | **17** | ·789 | 11 | ·152 | 75·4 | 29 | 44·7 | 10 | 35·2 | 11 | 11 | 11 | 146 9 | 20 | 34·1 | 3 | 445 | 24 | 165 | 12 | 0·71 | 26 |
| April | ·927 | 7 | ·766 | 21 | ·161 | 75·6 | 24 | 50·5 | 14 | 40·3 | 2 | 20 | 2 | 145·9 | 17 | 36·5 | 2 | 344 | 24 | 185 | 7 | 0·94 | 5 |
| May | ·903 | 7 | ·669 | 22 | ·234 | 73·8 | 1 | 52·0 | 19 | 43 4 | 12 | 34 | 12 | 143·9 | 12 | 41·0 | 6 | 393 | 20 | 150 | 28 | 1·82 | 23 |
| June | ·842 | 30 | **·616** | **13** | ·226 | 67·9 | 30 | 50·7 | 25 | 44·9 | 29 | 37 | 30 | 141·5 | 17 | 43·1 | 30 | 548 | 8 | 81 | 30 | 0·43 | 4 |
| July | ·828 | 14 | ·635 | 21 | ·193 | 68·0 | 5 | 50·0 | 1,2 | 42·1 | 1 | 39 | 2 | 141·6 | 5 | 35·8 | 2 | 497 | 31 | 96 | 2 | **2·37** | **17** |
| August | ·858 | 9 | ·683 | 1 | ·175 | 68·2 | 25 | 50·8 | 5,15 | 45 6 | 17 | 61 | 8,17 | **150 0** | **24** | 44·2 | 17 | 584 | 2 | 93 | 10 | 1 81 | 24 |
| September | ·809 | 5,23 | ·654 | 10 | ·155 | 67·1 | 26 | 48·7 | 29 | 40·7 | 29 | 48 | 28 | 141·0 | 25 | 39 0 | 29 | **606** | **20** | 130 | 15 | 2·27 | 2 |
| October | ·874 | 10 | ·651 | 17 | ·223 | 68 2 | 4 | 47·6 | 22 | 41·6 | 22 | 36 | 30 | 139 0 | 1 | 39·1 | 1 | 369 | 16 | 97 | 5 | 1·57 | 26 |
| November | ·906 | 14 | ·679 | 2 | ·227 | 67·7 | 8 | 44·2 | 27 | 36·1 | 22 | 21 | 22 | 137·9 | 5 | 38·1 | 21 | 480 | 22 | 102 | 5 | 1·72 | 15 |
| December | ·860 | 14 | ·724 | 27 | ·186 | 69·6 | 18 | **40 3** | **23** | 33·5 | 21 | 17 | 18 | 140·9 | 5 | 27·1 | 22 | 416 | 15 | 97 | 22 | 0·67 | 9 |

# APPENDIX III.

KODAIKANAL mean hourly wind velocity for the year 1916.

| 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 | 14 | 15 | 14 | 14 | 13 | 13 | 15 | 14 | 14 | 12 | 12 | 10 | 9 | 7 | 8 | 11 | 12 | 13 | 14 | 14 | 15 |
| February | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 13 | 16 | 15 | 14 | 13 | 11 | 10 | 9 | 7 | 6 | 6 | 6 | 7 | 8 | 9 | 10 |
| March | 12 | 13 | 13 | 13 | 13 | 13 | 13 | 14 | 16 | 19 | 16 | 15 | 16 | 13 | 11 | 11 | 9 | 8 | 7 | 8 | 8 | 9 | 11 | 12 |
| April | 10 | 11 | 11 | 11 | 11 | 11 | 12 | 11 | 13 | 15 | 15 | 13 | 13 | 12 | 11 | 10 | 10 | 9 | 10 | 11 | 11 | 10 | 10 | 10 |
| May | 11 | 10 | 11 | 11 | 10 | 10 | 9 | 10 | 11 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 9 | 9 | 11 | 11 | 12 | 12 | 11 |
| June | 19 | 18 | 18 | 17 | 17 | 17 | 17 | 16 | 14 | 13 | 15 | 13 | 14 | 13 | 13 | 14 | 15 | 16 | 17 | 16 | 16 | 16 | 16 | 15 |
| July | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 9 | 9 | 10 | 10 | 9 | 9 | 8 | 9 | 8 | 8 | 9 | 9 | 10 | 9 | 9 | 10 |
| August | 13 | 13 | 15 | 14 | 14 | 13 | 16 | 12 | 11 | 11 | 10 | 11 | 10 | 10 | 10 | 11 | 10 | 10 | 11 | 11 | 10 | 12 | 12 | 9 |
| September | 14 | 14 | 14 | 15 | 14 | 14 | 14 | 13 | 12 | 12 | 12 | 12 | 12 | 11 | 10 | 10 | 9 | 11 | 11 | 12 | 11 | 11 | 13 | 13 |
| October | 9 | 10 | 10 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 9 | 9 | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 9 | 9 |
| November | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 8 | 8 | 9 | 10 | 8 | 10 | 10 | 10 |
| December | 12 | 12 | 12 | 13 | 12 | 11 | 11 | 11 | 10 | 13 | 12 | 10 | 10 | 12 | 8 | 8 | 8 | 7 | 9 | 10 | 10 | 10 | 10 | 12 |
| Annual | 12 | 12 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 13 | 12 | 12 | 12 | 11 | 10 | 10 | 9 | 9 | 10 | 10 | 10 | 11 | 11 | 11 |

## APPENDIX IV.

KODAIKANAL mean hourly bright sunshine for the year 1916.

| 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 |
| January | 0·39 | 0·95 | 0·97 | 0·97 | 0·98 | 0·99 | 0·99 | 0·99 | 0·96 | 0·96 | 0·85 | 0·27 |
| February | ·50 | ·91 | ·93 | ·90 | ·89 | ·84 | ·79 | ·65 | ·61 | ·59 | ·51 | ·32 |
| March | ·24 | ·89 | ·93 | ·97 | ·97 | ·97 | ·91 | ·82 | ·75 | ·75 | 75 | ·87 |
| April | 1·00 | ·85 | ·92 | ·93 | ·92 | ·93 | ·93 | ·83 | ·63 | ·54 | ·39 | ·23 |
| May | 0·38 | ·70 | ·79 | ·87 | ·88 | ·84 | ·86 | ·79 | ·72 | ·64 | ·46 | ·18 |
| June | ·14 | ·36 | ·45 | ·44 | ·48 | 47 | ·38 | ·28 | ·16 | ·21 | ·15 | ·07 |
| July | ·24 | ·49 | ·70 | ·73 | ·72 | 64 | ·54 | ·36 | ·23 | ·29 | 25 | ·13 |
| August | ·24 | ·52 | ·68 | ·68 | ·62 | ·54 | ·46 | ·37 | ·28 | ·27 | ·25 | ·10 |
| September | ·29 | ·55 | ·58 | ·59 | ·64 | ·58 | ·46 | ·27 | ·21 | ·20 | ·12 | ·07 |
| October | ·24 | ·55 | ·60 | ·51 | ·61 | ·50 | ·43 | ·45 | ·27 | ·21 | ·18 | ·02 |
| November | ·32 | ·65 | ·75 | ·76 | ·76 | ·72 | ·61 | ·49 | ·44 | ·40 | ·31 | ·09 |
| December | ·31 | ·72 | ·82 | ·82 | ·77 | ·77 | ·64 | ·62 | ·58 | ·51 | ·41 | ·14 |
| Mean | 0·37 | 0·71 | 0·79 | 0·80 | 0·80 | 0·75 | 0·69 | 0·59 | 0·50 | 0·48 | 0·39 | 0·17 |

## APPENDIX V.

NUMBER of days in each month on which the Nilgiris were visible in 1916.

| Month. | Very clear. | Visible. | Just visible. | Tops only visible. | Total. |
|---|---|---|---|---|---|
| January | ... | 7 | 5 | 2 | 14 |
| February | ... | 1 | 1 | 1 | 3 |
| March | ... | 1 | ... | .. | 1 |
| April | . | 1 | ... | ... | 1 |
| May | 1 | 1 | .. | ... | 2 |
| June | ... | 3 | ... | .. | 3 |
| July | 16 | 8 | ... | ... | 24 |
| August | 2 | 2 | 1 | 1 | 6 |
| September | 2 | 12 | 2 | ... | 16 |
| October | 3 | 12 | ... | ... | 15 |
| November | 1 | 9 | 4 | ... | 14 |
| December | ... | 9 | 4 | ... | 13 |
| Total | 25 | 66 | 17 | 4 | 112 |

# APPENDIX VI.

MADRAS OBSERVATORY—Abnormals from monthly means for the year 1916.

| Abnormals of | January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November. | December. | Annual. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reduced atmospheric pressure ... ... .. | + 0·024 | − 0·048 | − 0·015 | − 0·012 | − 0·004 | − 0·062 | − 0·014 | − 0·006 | − 0·086 | − 0·072 | − 0·045 | − 0·035 | − 0·028 |
| Temperature of air ... ... ... ... | + 0·5 | + 1·5 | + 0·3 | + 1·1 | + 0·8 | + 0·8 | − 0·9 | + 0·8 | + 1·5 | + 1·0 | + 1·3 | + 0·6 | + 0·8 |
| Do. of evaporation ... ... ... | Same as | + 1·3 | + 0·7 | + 1·2 | + 1·9 | + 0·1 | + 2·3 | + 1·8 | + 2·0 | + 1·7 | + 2·4 | + 0·2 | + 1·3 |
| Percentage of humidity ... ... ... ... | − 2 | + 1 | + 2 | + 1 | + 5 | − 1 | + 12 | + 3 | + 3 | + 4 | + 5 | − 1 | + 3 |
| Greatest solar heat in vacuo ... ... ... | + 10·1 | + 12·6 | + 13·2 | + 12·6 | + 6·9 | + 11·9 | + 3·5 | + 8·1 | + 13·9 | + 6·9 | + 6·7 | + 13·5 | + 10·0 |
| Maximum in shade ... ... ... ... .. | + 0·5 | + 1·7 | + 0·8 | + 1·2 | − 1·0 | + 1·5 | − 2·8 | + 0·4 | + 0·4 | Same as | − 0·4 | + 0·1 | + 0·3 |
| Minimum in shade ... ... ... ... ... | − 1·1 | + 1·1 | − 1·4 | + 0·9 | − 0·1 | + 0·2 | − 0·9 | + 0·6 | + 0·9 | + 1·1 | + 1·4 | − 0·1 | + 0·2 |
| Do. on grass ... ... ... .. ... | − 0·1 | + 2·6 | − 0·7 | + 1·8 | + 0·2 | + 1·2 | + 0·2 | + 1·6 | + 1·8 | + 2·3 | + 2·8 | + 0·7 | + 1·0 |
| Rainfall in inches ... ... ... ... ... | − 0·85 | − 0·28 | − 0·39 | − 0·60 | − 1·28 | + 1·30 | − 0·21 | − 2·36 | − 1·77 | + 4·30 | + 0·96 | − 1·37 | ... |
| Do. since January 1st ... ... ... ... | ... | − 1·13 | − 1·52 | − 2·12 | − 3·40 | − 2·10 | − 2·31 | − 4·67 | − 6·44 | − 2·14 | − 1·18 | − 2·55 | − 2·55 |
| General direction of wind ... ... ... ... | 1 point E. | 3 points E. | 1 point E. | 1 point S. | 2 points E. | 1 point W. | 5 points S. | 1 point S. | 1 point W. | 10 points W. | 5 points E. | 1 point E. | 1 point S. |
| Daily velocity in miles ... ... ... ... | − 32 | − 2 | − 15 | − 9 | − 50 | − 21 | − 66 | − 27 | − 19 | Same as | − 26 | − 32 | − 25 |
| Percentage of cloudy sky ... ... ... ... | − 16 | − 9 | − 15 | − 6 | − 14 | + 3 | − 10 | − 6 | − 5 | − 1 | − 10 | − 11 | − 9 |
| Do. of bright sunshine ... ... ... | + 1·9 | + 0·1 | + 0·7 | + 1·9 | + 2·6 | − 9·0 | + 5·0 | − 0·3 | − 18·5 | − 8·5 | − 2·7 | + 1·5 | − 4·6 |

+ means above normal; — means below normal.

## APPENDIX VII.

ABSTRACT of the Mean Meteorological Condition of Madras in the year 1916 compared with the average of past years.

| Mean values of | 1916. | Difference from | Average. |
|---|---|---|---|
| Reduced atmospheric pressure ... ... ... ... ... | 29·836 | 0·028 below. | 29·864 |
| Temperature of air ... .. ... ... ... ... ... | 81·9 | 0·8 above. | 81·1 |
| Do. of evaporation ... ... .. ... ... | 75·8 | 1·3 „ | 74·5 |
| Percentage of humidity .. .. . ... ... .. | 75 | 3 „ | 72 |
| Greatest solar heat in vacuo ... ... ... ... ... | 149·7 | 10·0 „ | 139·7 |
| Maximum in shade ... ... ... ... ... ... . | 91·1 | 0·3 „ | 90·8 |
| Minimum in shade ... ... ... .. ... .. ... | 74·9 | 0·2 „ | 74·7 |
| Do. on grass ... .. ... ... . ... .. | 72·9 | 1·0 „ | 71·9 |
| Rainfall in inches since January 1st on 92 days ... | 46·47 | 2·55 below. | 49·02 |
| General direction of wind .. ... ... ... .. .. | S.E. by S. | 1 point S. | S.E. |
| Daily velocity in miles ... ... ... ... ... ... | 146 | 25 below | 171 |
| Percentage of cloudy sky ... ... ... ... ... ... | 40 | 9 „ | 49 |
| Do. of bright sunshine ... ... ... ... ... | 53·8 | 4·6 „ | 58·4 |

DURATION and Quantity of the Wind from different Points.

| From | Hours. | Miles. | From | Hours. | Miles. | From | Hours. | Miles. | From | Hours. | Miles. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 153 | 1,062 | East ... | 305 | 1,494 | South . | 187 | 1,112 | West ... | 300 | 2,880 |
| N. by E. | 163 | 928 | E. by S. | 366 | 1,800 | S. by W. | 210 | 1,293 | W. by N. | 133 | 1,051 |
| N. N. E. | 362 | 2,096 | E. S. E.... | 384 | 1,561 | S.S. W. ... | 242 | 1,381 | W. N. W. | 95 | 604 |
| N.E. by N. | 443 | 2,819 | S.E. by E. | 484 | 2,748 | S.W. by S. | 210 | 1,362 | N.W. by W. | 76 | 362 |
| N. E. | 213 | 1,518 | S. E. ... | 566 | 3,774 | S.W. ... | 191 | 1,180 | N. W. ... | 41 | 267 |
| N.E. by E. | 135 | 702 | S.E. by S. | 1,119 | 7,800 | S.W. by W. | 220 | 1,305 | N.W. by N. | 64 | 340 |
| E. N. E. | 228 | 1,054 | S. S. E. ... | 475 | 3,416 | W.S.W. .. | 250 | 1,737 | N.N.W. ... | 60 | 391 |
| E. by N. | 258 | 1,044 | S. by E. | 280 | 1,683 | W. by S. | 393 | 2,907 | N. by W. | 55 | 368 |

There were 186 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 20 miles.

# APPENDIX VIII.

MADRAS OBSERVATORY—Number of hours of wind from each point in the year 1916.

| 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 | .. | 9 | 88 | 94 | 86 | 51 | 103 | 78 | 60 | 64 | 57 | 37 | .. | ... | .. | ... | ... | .. | .. | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 17 |
| February | ... | ... | ... | ... | ... | 16 | 9 | 38 | 27 | 57 | 107 | 131 | 88 | 140 | 3 | 4 | 13 | 9 | 10 | 14 | 8 | 1 | ... | ... | ... | ... | ... | ... | ... | ... | . | ... | 21 |
| March | ... | 2 | 14 | 1 | 1 | 1 | 16 | 43 | 68 | 63 | 50 | 90 | 45 | 193 | 89 | 14 | 7 | 14 | 11 | 9 | ... | ... | .. | ... | ... | ... | ... | .. | ... | .. | ... | ... | 13 |
| April | .. | ... | ... | ... | ... | | ... | ... | ... | ... | ... | 20 | 119 | 363 | 105 | 21 | 12 | 17 | 17 | 20 | 6 | 1 | ... | 1 | 1 | ... | ... | ... | ... | ... | ... | ... | 17 |
| May | ... | . | 1 | ... | 1 | 2 | 1 | 1 | 5 | 40 | 33 | 52 | 172 | 182 | 107 | 21 | 20 | 27 | 24 | 14 | 7 | 2 | 6 | ... | 3 | 2 | .. | ... | 1 | 1 | 1 | ... | 18 |
| June | ... | 3 | 1 | ... | 1 | ... | 1 | 3 | ... | 2 | 13 | 4 | 4 | 33 | 28 | 53 | 34 | 9 | 14 | 39 | 44 | 57 | 77 | 150 | 91 | 28 | 15 | 7 | 4 | 1 | 10 | ... | 4 |
| July | 7 | 14 | .. | ... | 1 | 5 | 2 | 5 | 19 | 33 | 29 | 28 | 59 | 78 | 50 | 40 | 28 | 45 | 52 | 31 | 15 | 42 | 42 | 33 | 20 | 13 | 8 | 13 | 4 | 8 | 1 | ... | 19 |
| August | 6 | 3 | 5 | 1 | 1 | ... | ... | 5 | 18 | 12 | 12 | 37 | 27 | 31 | 26 | 47 | 18 | 10 | 63 | 47 | 31 | 45 | 35 | 72 | 84 | 37 | 20 | 14 | 8 | 8 | 5 | 4 | 12 |
| September | ... | 1 | ... | 2 | 11 | 1 | 4 | 4 | 16 | 30 | 17 | 20 | 10 | 40 | 15 | 19 | 14 | 19 | 19 | 24 | 50 | 45 | 63 | 67 | 72 | 42 | 39 | 24 | 10 | 14 | 10 | 3 | 15 |
| October | 14 | 18 | 16 | 6 | 3 | 3 | 32 | 16 | 34 | 44 | 7 | 19 | 27 | 43 | 26 | 30 | 27 | 24 | 28 | 14 | 26 | 25 | 23 | 64 | 28 | 11 | 13 | 18 | 10 | 29 | 29 | 15 | 22 |
| November | 57 | 46 | 58 | 64 | 58 | 42 | 37 | 41 | 36 | 9 | 1 | 46 | 15 | 6 | 26 | 31 | 14 | 36 | 4 | 8 | 4 | 2 | 4 | 6 | 1 | .. | .. | ... | 4 | 3 | 4 | 33 | 24 |
| December | 69 | 64 | 179 | 275 | 50 | 14 | 28 | 24 | 22 | 12 | 8 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4 |
| Annual total. | 153 | 160 | 362 | 443 | 213 | 185 | 228 | 258 | 305 | 366 | 334 | 484 | 566 | 1,119 | 475 | 280 | 187 | 210 | 242 | 210 | 191 | 220 | 250 | 393 | 300 | 133 | 95 | 76 | 41 | 64 | 60 | 55 | 186 |

# APPENDIX IX.

MADRAS OBSERVATORY—Number of miles of wind from each point in the year 1916.

| 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 | ... | 47 | 324 | 495 | 704 | 196 | 491 | 347 | 280 | 257 | 175 | 151 | ... | ... | ... | ... | ... | | ... | ... | ... | ... | ... | . | ... | ... | .. | ... | .. | ... | ... | ... | 3,467 |
| February | ... | ... | ... | ... | ... | 60 | 71 | 178 | 154 | 306 | 513 | 630 | 541 | 595 | 25 | 29 | 83 | 60 | 68 | 99 | 57 | 6 | ... | ... | ... | ... | ... | | ... | ... | ... | ... | 3,475 |
| March | ... | 4 | 39 | 11 | 9 | 2 | 52 | 144 | 298 | 311 | 182 | 558 | 280 | 1,814 | 570 | 104 | 57 | 154 | 84 | 78 | ... | ... | ... | ... | ... | ... | . | ... | . | ... | ... | ... | 4,251 |
| April | ... | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... | 157 | 855 | 2,799 | 837 | 146 | 92 | 170 | 150 | 185 | 43 | 5 | ... | 6 | 4 | ... | ... | ... | ... | ... | ... | ... | 5,449 |
| May | ... | ... | 10 | ... | 9 | 25 | 11 | 9 | 48 | 327 | 290 | 418 | 1,259 | 1,561 | 715 | 181 | 132 | 160 | 183 | 104 | 35 | 11 | 43 | .. | 14 | 16 | ... | ... | 7 | 8 | 7 | .. | 5,483 |
| June | ... | 15 | 5 | ... | 6 | ... | 9 | 4 | ... | 16 | 45 | 37 | 40 | 303 | 253 | 371 | 226 | 63 | 82 | 213 | 331 | 402 | 666 | 1,399 | 991 | 292 | 108 | 17 | 35 | 3 | 37 | ... | 5,969 |
| July | 29 | 37 | ... | ... | 9 | 28 | 11 | 25 | 149 | 199 | 103 | 151 | 376 | 604 | 387 | 215 | 146 | 233 | 229 | 12[illegible] | 93 | 181 | 231 | 189 | 94 | 64 | 44 | 67 | 24 | 54 | 4 | ... | 4,104 |
| August | 29 | 15 | 7 | 5 | 3 | .. | ... | 31 | 58 | 76 | 76 | 224 | 148 | 148 | 170 | 184 | 121 | 55 | 303 | 331 | 236 | 284 | 270 | 463 | 697 | 274 | 147 | 74 | 55 | 46 | 24 | 16 | 4,570 |
| September | ... | 16 | ... | 10 | 75 | 3 | 45 | 23 | 82 | 123 | 65 | 137 | 65 | 230 | 112 | 101 | 77 | 95 | 110 | 115 | 243 | 266 | 375 | 461 | 440 | 321 | 227 | 78 | 66 | 58 | 51 | 22 | 4,098 |
| October | 68 | 124 | 83 | 75 | 19 | 25 | 134 | 70 | 171 | 165 | 55 | 110 | 143 | 166 | 126 | 148 | 91 | 128 | 145 | 71 | 123 | 142 | 127 | 350 | 145 | 88 | 78 | 126 | 60 | 162 | 209 | 92 | 3.814 |
| November | 434 | 276 | 422 | 500 | 297 | 271 | 130 | 119 | 181 | 47 | 9 | 175 | 67 | 74 | 221 | 204 | 87 | 175 | 27 | 37 | 19 | 8 | 25 | 39 | 3 | ... | ... | ... | 20 | 9 | 59 | 238 | 4,173 |
| December | 502 | 394 | 1,206 | 1,728 | 387 | 92 | 100 | 94 | 73 | 74 | 48 | ... | ... | ... | .. | ... | ... | ... | ... | ... | . | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4,693 |
| Annual. | 1,062 | 923 | 2,096 | 2,819 | 1,518 | 702 | 1,054 | 1,044 | 1,494 | 1,800 | 1,561 | 2,748 | 3,774 | 7,800 | 3,416 | 1,683 | 1,112 | 1,293 | 1,381 | 1,362 | 1,180 | 1,305 | 1,737 | 2,907 | 2,388 | 1,050 | 604 | 362 | 267 | 340 | 391 | 368 | 53,546 |

# APPENDIX X.

MADRAS OBSERVATORY—Number of inches of rain from each point in the year 1916.

| 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 | ... | ... | ... | ... | ... | ... | ... | ... | 0·04 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| February | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| March | ... | ... | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| April | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·02 | ... | ... | ... | ... | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| May | ... | ... | ... | ... | ... | ... | ... | .. | 0·02 | .. | 0·01 | ... | . | ... | ... | ... | 0·08 | 0·01 | ... | 0·71 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·01 |
| June | ... | ... | ... | ... | 0·47 | ... | ... | .. | ... | 0·02 | 0·17 | ... | 0·08 | | 0·08 | 0·05 | 0·02 | 0·14 | 0·50 | 0·03 | 0·06 | 0·05 | 0·31 | 0·69 | ... | 0·03 | 0·08 | ... | ... | ... | 0·68 | ... | ... |
| July | ... | ... | ... | ... | ... | 0·04 | 0·01 | ... | ... | 0·20 | ... | 0·24 | 0·04 | ... | 0·08 | ... | 0·76 | 0·24 | ... | ... | ... | 0·05 | ... | ... | ... | 0·81 | 0·06 | ... | 0·60 | 0·53 | ... | ... | ... |
| August | 0·08 | ... | ... | 0·08 | 0·02 | ... | ... | 0·13 | ... | ... | ... | 0·05 | 0·02 | 0·02 | .. | ... | ... | ... | 0·07 | ... | 0·02 | 0·09 | ... | 0·48 | ... | 0·72 | 0·24 | ... | 0·15 | 0·01 | ... | 0·05 | 0·02 |
| September | ... | 0·46 | ... | ... | .. | ... | ... | .. | ... | 0·14 | ... | 0·28 | ... | 0·02 | 0·06 | ... | 0·35 | 0·14 | 0·64 | 0·02 | 0·06 | 0·07 | 0·16 | ... | 0·23 | 0·02 | 0·03 | 0·18 | ... | 0·03 | 0·02 | 0·01 | ... |
| October | 3·74 | 1·27 | ... | 0·19 | 0·22 | 0·06 | 0·35 | ... | ... | 0·99 | 0·05 | 0·02 | 0·02 | ... | 0·03 | ... | 0·51 | 0·27 | 0·22 | 1·28 | 0·37 | 0·16 | 0·02 | 0·28 | 0·61 | 0·40 | 0·16 | 0·59 | 0·03 | 1·79 | 1·31 | 0·75 | 0·11 |
| November | 1·17 | 0·77 | 0·73 | 1·10 | 0·95 | 0·26 | 1·30 | 1·10 | 0·97 | 0·03 | ... | 0·34 | 0·23 | 0·22 | 0·51 | 1·78 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·21 | 0·10 | 0·55 | 1·82 | 0·03 |
| December | 0·70 | 0·07 | 0·63 | 0·30 | 0·01 | 0·38 | 0·08 | 1·64 | 0·01 | 0·14 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | . | ... | ... | ... | ... | ... | ... |
| Annua | 5·64 | 2·57 | 1·36 | 1·67 | 1·67 | 0·74 | 1·69 | 2·87 | 1·04 | 1·52 | 0·23 | 0·93 | 0·34 | 0·28 | 0·76 | 1·83 | 1·22 | 0·80 | 1·43 | 2·04 | 0·51 | 0·42 | 0·49 | 1·45 | 0·84 | 1·98 | 0·57 | 0·77 | 0·99 | 2·46 | 2·56 | 2·63 | 0·17 |

# APPENDIX XI.

Madras Observatory—Wind, cloud and bright sunshine, 1916.

| Month. | Wind resultant. | | Cloud (0—10). | | | | | Bright sunshine. | |
|---|---|---|---|---|---|---|---|---|---|
| | Velocity. | Direction. | 8 H. | 10 H. | 16 H. | 20 H. | Mean. | Average per day. | Greatest number of hours in a day. |
| | MILES. | POINTS. | | | | | | HOURS. | HOURS. |
| January | 97 | E.N.E. | 2·3 | 2·7 | 2·1 | 1·2 | 2·1 | 8·0 | 9·2 |
| February | 101 | S.E. by E. | 1·1 | 2·0 | 1·7 | 1·2 | 1·5 | 9·0 | 10·8 |
| March | 117 | S.E. | 0·9 | 1·5 | 0·8 | 0·5 | 0·9 | 8·9 | 10·7 |
| April | 171 | S.S.E. | 2·5 | 2·3 | 2·3 | 1·4 | 2·2 | 8·8 | 10·7 |
| May | 155 | S.E. by S. | 3·1 | 2·5 | 1·7 | 2·1 | 2·4 | 8·0 | 10·5 |
| June | 111 | S.W. by W. | 5·8 | 5·3 | 8·2 | 7·5 | 6·7 | 3·9 | 7·4 |
| July | 69 | S. by E. | 6·7 | 6·2 | 5·7 | 5·6 | 6·1 | 4·6 | 9·0 |
| August | 97 | S.W. | 5·4 | 6·0 | 7·2 | 5·6 | 6·1 | 4·9 | 10·8 |
| September | 70 | S.W. by W. | 5·8 | 5·6 | 6·1 | 5·1 | 5·7 | 5·3 | 11·5 |
| October | 115 | S.W. | 5·7 | 5·9 | 6·5 | 4·9 | 5·8 | 4·9 | 10·3 |
| November | 66 | N.E. | 4·6 | 5·7 | 5·8 | 3·5 | 4·9 | 5·2 | 9·7 |
| December | 128 | N.E. by N. | 4·0 | 4·8 | 3·9 | 3·6 | 4·1 | 6·2 | 8·6 |
| Annual | 20 | S.E. | 4·0 | 4·2 | 4·3 | 3·5 | 4·0 | 6·5 | ... |

# APPENDIX XII.

## MEAN Monthly and Annual Meteorological Results at the Madras Observatory in 1916.

| Month. | Barometer. | | Dry Bulb Thermometer. | | | | Wet Bulb. | | Tension of Vapour. | Relative Humidity. | Sun Max in Vac. | Min. on Grass. | Wind. | | | Rain. | | Cloudy 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. | | Inches. | No. | Cents. | Hours. |
| January | 30·021 | 0·116 | 75·6 | 85·1 | 66·4 | 18·7 | 69·2 | 64·9 | 0·626 | 71 | 148·5 | 63·0 | 112 | 6 | E.N.E | 0·04 | 1 | 21 | 247·1 |
| February | 29·917 | ·129 | 78·2 | 88·3 | 69·1 | 19 2 | 72·1 | 68·2 | ·707 | 74 | 152·3 | 63·4 | 120 | 11 | S.E. by E | ... | ... | 15 | 261·5 |
| March | ·890 | ·132 | 80·3 | 90·0 | 70·7 | 19·3 | 74·6 | 70·3 | ·782 | 76 | 153·7 | 67·9 | 137 | 11 | S.E. by E. | ... | ... | 9 | 277·3 |
| April | ·814 | ·133 | 85·1 | 94·1 | 78·1 | 16 0 | 78·8 | 76 3 | ·898 | 75 | 154·3 | 76·5 | 182 | 14 | S.S.E. | 0·02 | 1 | 22 | 265·6 |
| May | ·731 | ·120 | 87 5 | 96·8 | 80 7 | 16·1 | 80·2 | 77·5 | ·932 | 72 | 149·9 | 79·1 | 177 | 13 | S.E. by S. | 0·84 | 3 | 24 | 247·9 |
| June | ·642 | ·134 | 87·2 | 99·8 | 80·5 | 19·3 | 76·7 | 73·7 | ·777 | 61 | 152·4 | 79·8 | 199 | 20 | S.W. | 3·41 | 11 | 67 | 118·1 |
| July | ·706 | ·109 | 83·6 | 92·8 | 77·6 | 15·2 | 78·2 | 75·2 | ·890 | 77 | 142·2 | 76·8 | 132 | 15 | S. by E. | 3·66 | 11 | 61 | 143·6 |
| August | ·743 | ·123 | 84·4 | 94·1 | 77·9 | 16·2 | 77·8 | 74·9 | ·861 | 73 | 148·1 | 77·0 | 147 | 18 | S.S.W. | 2·20 | 10 | 61 | 153·0 |
| September | ·712 | ·125 | 84·5 | 93·6 | 78·0 | 15·6 | 78·3 | 74·9 | ·881 | 75 | 155·2 | 76·8 | 137 | 19 | S.W. by S. | 2·92 | 14 | 57 | 160·2 |
| October | ·778 | ·121 | 81·6 | 89·0 | 76 3 | 12·7 | 77·3 | 74·8 | ·876 | 82 | 146·0 | 75·1 | 123 | 17 | S. by W. | 15·30 | 15 | 58 | 151·9 |
| November | ·879 | ·110 | 78·8 | 85·5 | 73·7 | 11·8 | 75·3 | 72·5 | ·831 | 84 | 144·1 | 72·3 | 139 | 7 | E. by N. | 14·17 | 18 | 49 | 155·0 |
| December | 944 | ·108 | 76·1 | 83·7 | 69·7 | 14·0 | 70·8 | 68·0 | ·683 | 76 | 149·3 | 67·1 | 151 | 3 | N.E. by N. | 3·91 | 8 | 41 | 190·9 |
| Annual ... | 29·815 | 0·122 | 81·9 | 91·1 | 74·9 | 16·2 | 75·8 | 72·6 | 0·812 | 75 | 149·7 | 72·9 | 146 | 13 | S.E. by S. | 46·47 | 92 | 40 | 2,372·1 |

## EXTREME Monthly Meteorological Records at the Madras Observatory in 1916.

| 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 | **30·149** | **11** | 29·887 | 31 | 0·262 | 86·5 | 30 | **62·6** | **19** | **60·9** | **19** | 47 | 12 | 152·3 | 29 | **58·4** | **19** | 257 | 12 | 65 | 26 | 0·04 | 9 |
| February | ·064 | 12 | ·791 | 22 | 273 | 97·3 | 29 | 62·7 | 5 | 61·9 | 5 | 31 | 3 | 160·2 | 29 | 58·7 | 5 | 154 | 22 | 70 | 2 | ... | ... |
| March | ·009 | 27 | ·690 | 30 | 319 | 96·1 | 30 | 65·9 | 8, 9, 10 | 65·5 | 10 | 49 | 30 | 159·6 | 13 | 62·4 | 8 | 201 | 30 | 84 | 11 | ... | ... |
| April | 29·963 | 5 | ·636 | 21 | ·327 | 101·2 | 24 | 74·7 | 3 | 74·2 | 28 | 44 | 24 | 161·6 | 6 | 72·0 | 3 | 220 | 26, 19 | 140 | 22 | 0 02 | 1 |
| May | ·888 | 10 | ·585 | 15 | ·303 | 103·4 | 4 | 74·7 | 31 | 71·9 | 31 | 34 | 29 | 155·6 | 9 | 74·7 | 31 | 249 | 26 | 125 | 21 | 0·81 | 31 |
| June | ·838 | 30 | **·436** | **13** | **·402** | **104·5** | **7** | 74·6 | 1 | 71·7 | 1 | **29** | **13** | 165·9 | 16 | 74·5 | 29 | 259 | 21 | 130 | 30 | 0·96 | 18 |
| July | ·868 | 14 | ·581 | 25 | ·287 | 99·4 | 1 | 73·1 | 4, 5 | 71·8 | 11 | 47 | 2 | 157·0 | 19 | 73·2 | 27 | 274 | 18 | 63 | 23 | 1·53 | 4 |
| August | ·902 | 10 | ·567 | 1 | ·335 | 100·2 | 14 | 75·6 | 25 | 72·7 | 13, 14 | 38 | 14 | 161·3 | 24 | 74·3 | 16 | 217 | 13 | 99 | 29 | 0·63 | 23 |
| September | ·845 | 2 | ·571 | 10 | ·274 | 99·4 | 4 | 74·5 | 6 | 72·9 | 26 | 42 | 24 | 167·9 | 23 | 73·7 | 24 | 192 | 23 | 181 | 7 | 0 98 | 11 |
| October | ·909 | 10 | ·628 | 1 | ·281 | 98·4 | 3 | 72·5 | 21 | 71·3 | 23 | 53 | 1 | **169·4** | **3** | 70·2 | 21 | 217 | 22 | 66 | 18 | **5·09** | **15** |
| November | 30·040 | 19 | ·679 | 22 | ·361 | 92·8 | 3 | 68·8 | 22 | 68·1 | 23 | 45 | 2 | 164·3 | 8 | 68·3 | 26 | **369** | **22** | **33** | **7** | 2·95 | 22 |
| December | ·036 | 15 | ·837 | 27 | ·199 | 85·8 | 2 | 64·1 | 25 | 63·5 | 25 | 49 | 24 | 155·5 | 26 | 60·3 | 25 | 247 | 8 | 95 | 19, 30 | 1·37 | 3 |