# ANNUAL REPORT

OF THE

# DIRECTOR

# KODAIKANAL AND MADRAS

# OBSERVATORIES

## FOR 1915.

MADRAS:
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

1916.

# KODAIKANAL AND MADRAS OBSERVATORIES.

## REPORT FOR THE YEAR 1915.

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# KODAIKANAL AND MADRAS OBSERVATORIES.

## I.—REPORT OF THE KODAIKANAL OBSERVATORY FOR THE YEAR 1915.

*Staff.*—The staff of the observatory on December 31, 1915, 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. |

The Director-General of Observatories, Dr. Gilbert T. Walker, represented to Government the desirability of a second expedition to Kashmir with a larger and more complete instrumental equipment than had been taken in 1914. His efforts and the representations made by Professor H. H. Turner of Oxford University Observatory resulted in sanction being accorded to the proposal, and a sum of Rs. 5,600 was granted to defray expenses.

The Director accompanied by the First Assistant and the Photographic Assistant left Kodaikanal on July 6 for Kashmir and arrived at Srinagar on July 15. A preliminary account of the work of the expedition up to the end of the year is given in section 10.

The Assistant Director returned from combined leave on May 30.

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

2. *Distribution of work.*—Until the departure of the Kashmir Expedition the distribution of work was as follows. The Director and the Assistant Director had charge of the two spectroheliographs and the large grating spectrograph. The First, Second and Third Assistants were in charge of the work with the Cooke equatorial (spectroscopic), the Lerebour and Secretan equatorial (visual and photographic) and the transit instrument. They had also to do the 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. The meteorological work was done by the Fourth Assistant and the Writer. The Fourth Assistant also assisted in the preparation of observations for the press. The Writer was responsible for the accounts, correspondence and all office records. The Photographic Assistant had charge of the photographic developing, printing, etc.

When the Kashmir Expedition left in July the work had to be redistributed among the assistants remaining in Kodaikanal. The Assistant Director took charge of the spectroheliograph and the large grating spectrograph. The Second and Third Assistants had the First Assistant's duties divided between them. The visual and photographic work with the Lerebour and Secretan equatorial was discontinued for the duration of the Kashmir Expedition. The Fourth Assistant took a portion of the Photographic Assistant's work being relieved by the Writer of some of his meteorological duties. The staff at Kodaikanal have undertaken these extra duties with commendable loyalty.

3. *Buildings and grounds.*—The buildings and grounds and fire lines have been kept in good order. A small grass fire originating within the grounds occurred on December 23, but no damage was done except one pine tree burnt.

Estimates for reroofing the spectroheliograph building and the glazed verandah are in preparation.

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 and a new spectrograph fed by the 12-inch Foucault siderostat from Poona is under construction.

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 3½ 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:—

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

A large spectroheliograph for photographing solar images up to 4½ inches diameter was partly constructed in the Observatory workshop and afterwards erected and completed at Srinagar, Kashmir.

## OBSERVATIONS.

### (a) Solar Physics.

5. 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 | 30 | 28 | 31 | 30 | 31 | 25 | 22 | 30 | 29 | 31 | 28 | 23 | 338 |
| B | 4 | 11 | 8 | 4 | 3 | 1 | 4 | 0 | 0 | 2 | 0 | 0 | 37 |
| C | 29 | 25 | 31 | 30 | 31 | 19 | 14 | 21 | 19 | 26 | 18 | 21 | 284 |
| D | 29 | 28 | 31 | 27 | 30 | 18 | ... | ... | ... | ... | ... | .. | 163 |
| E | 30 | 28 | 31 | 30 | 31 | 26 | 20 | 26 | 25 | 30 | 25 | 23 | 325 |

A = disc examined. B = spot spectrum observed. C = prominences photographed.
D = photoheliograms taken. E = spectroheliograms taken.

Although more observations than in normal years were made in October, the year on the whole was not more favourable than previous years.

6. *Photoheliograph.*—Photographs were obtained at Kodaikanal on 163 days up to June 19. The photoheliograph was dismounted on that date, the photo-visual object glass and other optical parts being required for work in Kashmir.

7. *Spectroheliograph.*—Monochromatic photographs of the sun's disc in "K" light were taken on 325 days and prominence plates on 284 days. The autocollimating spectroheliograph was in use with the Michelson grating throughout the year and photographs of H$\alpha$ markings were obtained on 208 days.

Duplicates of the disc photographs in "K" light have been sent to the Cambridge Observatory for measurement.

8. *Grating Spectrograph.*—An exceptionally fine series of spot spectra was obtained, using the new Anderson grating. In these the exposure times were reduced to from two to fifteen seconds only, and the limits of the penumbrae and other details are well shown. New and interesting features in the radial motion displacement are shown, and some of the plates give evidence of motion at right angles to the radial movement, perhaps indicating rotation of the spot.

A series of fourth order solar spectra in the H and K region was secured for study of the change of wave-length of certain iron lines between the centre of the disc and the limb. A beautiful series of third order spectra in the green region, of limbs and centre of the disc, was secured for study of limb shifts and solar rotation shifts. A series of spectra of general sunlight with iron arc comparison was also photographed for the purpose of comparing the shifts obtained with those observed at the centre of the sun's disc. This last is of importance in connection with a proposed research of the wave-lengths of the solar lines reflected from Venus when the planet receives light from a hemisphere of the sun turned 90° or more from the earth. If the general shift of the solar lines all over the disc is due to a movement of recession from the earth, this shift would not be observed in the Venus spectrum, after allowing for the effect of the orbital motion of the planet, and there would be a difference of wave-length in the lines of ordinary day light and light derived from another face of the sun. If this difference does not exist, the shift of the solar lines towards red must be ascribed to some cause other than motion in the line of sight.

The measurement of the various series of spectra obtained has not been completed, owing to the pressure of work in connection with the Kashmir expedition, except in the case of the fourth order H and K spectra, and the investigation of the change of wave-length in passing from the centre of the sun's disc to the limb was being prepared for the press at the close of the year.

The spectrograph has also been employed by the Assistant Director who has determined the displacements at the centre of the sun's disc and at the limb of the lines of nickel and titanium; the results of this work will shortly be ready for the press. He has also continued experiments with the electric arc to elucidate the density effect: the result of these is to show that the displacements observed are not a pole effect, but that a source of light where the density is under better control than in the arc is necessary for the effective study of the phenomenon.

9. *6-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.

10. *Observations in Kashmir.*—The months of July, August and September were mainly occupied in erecting and adjusting the large spectroheliograph, the siderostat, and moving object-glasses. In addition a 6-inch Cooke equatorial telescope was erected, and a small grating spectroscope was constructed for attachment to the equatorial for the observation of prominences. The adjustment of the equatorial was completed, and spectroscopic observations were begun, on August 8. The spectroheliograph was practically completed early in September, the first photograph being taken on September 9. From this date until the end of the year, H or K spectroheliograms were taken on all clear days, viz., on 20 days in September, 26 days in October, 29 days in November, and 18 days in December. The photographs in December were interrupted for many days by smoke from extensive forest fires, induced by the excessive drought.

The weather throughout the summer and the early autumn had been exceedingly dry: October had less than half the normal rainfall, and November and December were rainless, excepting a light fall of snow on December 15. These conditions are very abnormal in the valley, and resulted in great desiccation of the soil, grass and other vegetation being completely withered up. This parched condition of the valley and the surrounding hills, and the great heat developed by the sun on the ground, appear to have affected the seeing unfavourably. The quality of the solar definition was however good during July, August and September; in October and November the increasing dryness and the decreasing altitude of the sun had a marked effect detrimental to the quality of the spectroheliograms. It may be noted that in the earlier months the best results were obtained in the afternoon, which agrees with our experience during the spring expedition of 1914; later, in November and December, the best photographs were obtained early in the day.

On the whole, the results are less good than had been anticipated from the previous experience. It is however of interest to learn that abundant moisture in the valley is a most important factor in producing good solar definition.

The visual observations of the prominences bear out in general the conclusions derived from the spectroheliograms. During the three months August-September-October, the conditions for this work were almost ideal: there was excellent contrast in the H$\alpha$ line, due to the purity of the sky, and the definition was good at all hours of the day. During November the conditions were somewhat less good, although still superior to the average at Kodaikanal. In December there was much cloud, and the seeing was generally less good than in November. The first assistant, S. Sitarama Ayyar, had charge of these observations, and he was able to secure a very complete set of prominence drawings. In the four months August 8 to December 13 only four days were missed, owing to cloud; after December 13 observations were interrupted by a snow-storm and thick clouds, yet the record for December, owing to his zeal, is 20 days' observation. Sitarama Ayyar's work has been incorporated with the Kodaikanal prominence observations for the half-year ending December 31.

Independent observations of the definition of an 8-inch solar image were made daily by Mrs. Evershed, from the date of arrival at Srinagar. Her report shows a general mean of $3\frac{1}{4}$ on a scale in which 5 represents no appreciable tremor in the 8-inch image. The definition during the first half of the period shows slightly better (3·4), and the last half slightly worse (3·1) than the mean. Also in the earlier months the midday and afternoon seeing was slightly better than the morning, but later the earlier hours were best. The uniformity of the seeing is the most remarkable feature: it was very rarely of the best quality, and never of the worst, and there was but little change at different hours of the day.

It should be mentioned that in the photographic work Mr. Krishna Ayyar rendered excellent service throughout. In the long series of difficulties and disappointments incidental to the initial working of the spectroheliograph, Krishna Ayyar maintained a cheerful optimism. Only those who have had experience of this instrument can appreciate the disheartening nature of these difficulties.

*Summary of Sunspot and Prominence Observations.*

11. *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 ... ... | 18 | 18 | 18 | 18 | 14 | 18 | 14 | 17 | 12 | 17 | 19 | 15 | 198 |
| Daily number ... ... | 2·4 | 3·3 | 3·7 | 3·1 | 3·2 | 3·0 | 3·5 | 3·1 | 3·0 | 3·2 | 3·2 | 3·1 | 3·2 |
| North ... ... ... | 15 | 10 | 12 | 7 | 10 | 8 | 6 | 10 | 5 | 13 | 12 | 6 | 114 |
| South .. ... .. | 3 | 8 | 6 | 11 | 4 | 10 | 8 | 7 | 7 | 4 | 7 | 9 | 84 |
| Equator ... ... | ... | ... | ... | | ... | ... | ... | ... | ... | ... | ... | ... | ... |

There is again a marked increase in spot activity compared with last year in accordance with the usual progress of a new spot cycle. The daily number of spots in each month has been fairly constant since January.

For the first time since 1906 there has been a preponderance of spots in the northern hemisphere.

12. *Prominences.*—The increase in solar activity during 1915 is more marked in prominence areas than in sunspots. The mean areas obtained from the photographs for 1915 and those of 1914 for comparison are given in the table below :—

*Mean daily Profile areas of Prominences in square minutes of arc.*

| — | 1914. | 1915. |
|---|---|---|
| North ... ... ... | 1·50 | 2·60 |
| South ... ... ... | 1·60 | 2·68 |
| Total ... | 3·10 | 5·28 |

There is only a slight preponderance in the southern hemisphere. The zone of greatest activity is again between latitudes 45° and 60°.

Metallic prominences have also been more frequently observed than in 1914; forty-five were recorded as against seventeen last year.

There has also been an increase, on the whole, in the number of displacements in prominences at the limb though fewer than would have been expected were seen in the second half of the year.

13. *Solar Radiation.*—Observations with the Ångström pyrheliometer were made near noon when the meteorological conditions were favourable.

### (b) OTHER OBSERVATIONS.

14. *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 accuracy on most days and all failures are at once reported to the officer in charge of the Trichinopoly division.

15. *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 barograms, thermograms, 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.*—The average pressure for the year was in excess of the normal by 0·012 inch. The mean monthly pressure was in excess in all the months except in September, October, and November. The greatest excess was in March by 0·049 inch and the greatest defect was in November by 0·020 inch.

*Temperature.*—The monthly mean temperature as well as the mean maximum was above normal in all the months. The annual mean temperature was in excess by 3°·0 and the annual mean maximum by 2°·0. The monthly mean minimum temperature was also in excess in all the months except in April and in December. The greatest deviation was an excess of 2°·8 over normal in November. The mean sun maximum was in excess throughout the year.

*Humidity.*—The annual mean humidity was in defect of the normal by only one per cent. The greatest deviations were an excess of 6 per cent in November and a defect of 10 per cent in May.

*Rainfall.*—The total rainfall for the year was 5·85 inches below normal and the number of rainy days was less by six. The month of October which normally has the heaviest rainfall was in defect by 6·36 inches, owing to the lateness of the North-East Monsoon.

*Wind.*—The wind velocity was in defect throughout the year and the average daily velocity was less than the normal by 53 miles. The mean wind direction for the year differed from the normal by two points to the west, mostly due to the south by west wind prevailing in October.

*Transparency of the atmosphere.*—The transparency of the lower atmosphere as judged by the visibility of the Nilgiris, about 100 miles distant was greater than either in 1913 or 1914. There were 129 days when the Nilgiris were visible as against 93 days in 1913 and 95 days in 1914.

*Cloud and Sunshine.*—The mean amount of clear sky was only one per cent less than normal; but curiously there was an excess of 374 hours, or 18 per cent of bright sunshine.

16. *Seismology.*—Seventy-two earthquakes were recorded on the Milne horizontal pendulum, as against sixty last year. Details of the records are given in Appendix I.

17. *Library.*—One hundred and thirty volumes were bound during the year.

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

No. XLV.—Summary of prominence observations for the second half of 1914, by J. Evershed, F.R.S.

No. XLVI.—The displacements of the enhanced lines of iron at the Centre of the Sun's Disc, by J. Evershed, F.R.S., and A. A. Narayana Ayyar, B.A.

No. XLVII.—Summary of prominence observations for the first half of 1915, by T. Royds, D.Sc.

XLVIII.—Anomalous dispersion in the Sun, by T. Royds, D.Sc.

The following contribution was made in addition to the above :—

"Note on the atmospheric conditions required for astronomical observations," by J. Evershed, F.R.S. Publications of the Astronomical Society of the Pacific, Volume 27, page 179, 1915.

19. *General.*—The Director-General of Observatories inspected the Kodaikanal Observatory in January.

THE OBSERVATORY, KODAIKANAL,
*28th January 1916.*

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

## II.—REPORT OF THE MADRAS OBSERVATORY FOR THE YEAR 1915.

*Staff.*—The staff at the Observatory on December 31, 1915, was as follows :—

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

Mr. C. Chengalvaraya Mudaliyar was absent on privilege leave for two months from 8th June 1915, when Mr. V. Duraiswami Ayyar of the Meteorological Office acted for him. Mr. E. Ramanujam Pillai was absent on privilege leave for two months from 1st September 1915, when Mr. P. R. Chidambaram Ayyar of the Meteorological Office acted for him.

2. *Time Service.*—No change was made during the year. The time gun at Fort St. George failed on 22 occasions out of 730, giving a percentage of success of 97. The semaphore at the Port Office failed on five occasions. On two of these days it was correctly dropped at 2 P.M. It was dropped correctly at 1 P.M. on all other days. None of the failures were due to faults at the Observatory. 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 70 occasions.

4. *Buildings.*—Repairs to the office and quarters were carried out during the year. The construction of the subsoil drain round the observatory sanctioned in the previous year was commenced towards the end of the year and is nearing completion. The construction was undertaken too late in the year for us to see if it will be effective in stopping the large variations in level which have been referred to in previous reports.

5. *Instruments.*—The following is a list of the instruments at the Observatory on 31st December 1915 :—

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

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 cord of the Mean Time Clock by Agar Baugh was renewed and Chronometer by V. Kullberg No. 5394 was cleaned. The gun-firing apparatus at the Fort was repaired during the year.

The level of the transit instrument went through a series of large changes very similar to those observed in the previous five years. The recovery during the rains was not complete, so that some permanent alteration in level is left at the end of the year.

6. *Weather Summary.*—The following is a summary of the meteorological conditions at Madras during 1915 :—

*Pressure.*—Except in January, March, July and December when there was an excess, pressure was below normal throughout the year; the greatest excess was 0·052 inch in March and the greatest defect was 0·073 inch in November. The highest pressure recorded was 30·140 inches on January 18 and the lowest 29·498 inches on May 9.

*Temperature.*—The mean temperature of the air was above normal throughout the year. The maximum temperature in shade was normal in June, below normal in January, July and September, and above in the other months. The minimum in the shade and solar heat in *vacuo* were above normal throughout the year. The highest shade temperature recorded was 107°·3 F. on May 12, 20, 21 and 23, and the lowest 63°·8 F. on December 5. The highest sun maximum was 165°·7 F. on August 23 and the lowest on grass was 60°·5 F. on December 5.

*Humidity.*—The percentage of humidity was normal in October, below normal in May and December and above in the remaining months.

*Wind.*—The wind velocity was in defect in all other months except in January, when it was almost normal. This is largely due to change of exposure as explained in previous reports. The highest velocity was 314 miles on November 21. The wind direction was normal or nearly normal in all months except in June, September, October and November, the most noticeable deviation being 8 points south in October owing to the late arrival of the North-East Monsoon.

*Cloud.*—The percentage of cloud was normal in November, above normal in January and February, and below in the remaining months.

*Sunshine.*—Except in January, February and November when there was defect, the percentage of bright sunshine was in excess over the normal throughout the year. The total number of hours of sunshine during the year was 2444·9.

*Rainfall.*—The rainfall in the year was above normal in January, July, September and November, nearly normal from February to April and below normal during the other months. The greatest excess was 8·72 inches in January and the greatest defect 8·36 inches in October. The total fall for the year was 56·61 inches on 92 days against an average of 49·02 inches. The most noticeable rainfall was 9·61 inches in January. Most of this rain fell during the 14th and 15th of the month and was due to a depression which formed in the south-west of the Bay during the 13th and 14th. This fall of 9·61 inches is the highest ever recorded in January at Madras since 1813. The monsoon rainfall from October 15 to the end of the year was 21·60 inches against an average of 26·00 inches. The greatest fall on any day was 6·69 inches on January 15.

THE OBSERVATORY, MADRAS,
22*nd January* 1916.

R. LL. JONES,
*Deputy Director.*

# APPENDIX I.

## STATION—KODAIKANAL OBSERVATORY.

### SEISMIC RECORDS.

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

| 1915. | $T_o$ | $\frac{r}{T_o^2}$ | 1915. | $T_o$ | $\frac{r}{T_o^2}$ |
|---|---|---|---|---|---|
| January ... ... | 15·6 | 3·4 | July ... ... | 18·6 | 2·4 |
| February ... ... | 18 1 | 2·7 | August ... ... | 18·7 | 2·5 |
| March ... .. | 18·0 | 2·5 | September ... ... | 18·9 | 2·4 |
| April ... ... | ı7 9 | 2·5 | October ... ... | 18 6 | 2·5 |
| May ... ... | 18·0 | 2·5 | November ... ... | 18·1 | 2 6 |
| June ... ... | 18·3 | 2·6 | December ... ... | 17·9 | 2·4 |

| No. | Date. | Phase. | Time G.M.T. | | | Period. (Sec.) | Amplitude (u). | | | Distance $\Delta$ (Km.) | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | An. | Ae. | Az. | | |
| | 1915. | | H. | M. | S. | | | | | | |
| 1 | January* 4 ... | eP | 0 | 07 | 12 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 0 | 13 | 24 | ... | ... | ... | ... | ... | |
| 2 | 4 ... | eP | 0 | 16 | 00 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 0 | 21 | 42 | ... | ... | ... | ... | ... | |
| 3 | 4 ... | eP | 0 | 30 | 30 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 0 | 34 | 42 | ... | ... | ... | ... | ... | |
| 4 | 5 ... | eP | 14 | 48 | 00 | ... | ... | ... | ... | ... | |
| | | eL | 14 | 55 | 36 | ... | ... | | ... | ... | |
| | | M | 15 | 04 | 54 | ... | ... | 50 | ... | ... | |
| | | F | 15 | 56 | 24 | ... | ... | ... | ... | ... | |
| 5 | 5—6 ... | eP | 23 | 35 | 54 | ... | ... | ... | | | |
| | | iL | 23 | 41 | 18 | ... | ... | ... | ... | ... | |
| | | M | 0 | 00 | 18 | ... | ... | 100 | ... | ... | |
| | | F | 0 | 50 | 30 | ... | ... | ... | ... | ... | |
| 6 | 8 ... | eP | 9 | 56 | 42 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 10 | 13 | 06 | ... | ... | ... | ... | ... | |
| 7 | 10 ... | eP | 1 | 09 | 12 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 1 | 15 | 42 | ... | ... | ... | ... | ... | |
| 8 | 11 ... | eP | 9 | 04 | 36 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 9 | 08 | 00 | | ... | ... | ... | ... | |
| 9 | 17 ... | eP | 4 | 01 | 48 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 4 | 04 | 54 | ... | ... | ... | ... | ... | |
| 10 | February 21 ... | eP | 5 | 45 | 48 | ... | ... | ... | ... | | Widening of line. |
| | | F | 5 | 51 | 42 | ... | ... | ... | ... | ... | |
| 11 | 21 ... | P | | ... | | | ... | ... | ... | ... | |
| | | iL | 15 | 07 | 06 | ... | ... | ... | ... | ... | |
| | | M | 15 | 07 | 36 | ... | ... | 70 | ... | ... | |
| | | F | 15 | 27 | 12 | ... | ... | ... | ... | ... | |
| 12 | 25 ... | eP | 20 | 58 | 42 | ... | ... | ... | ... | ... | L.W not very different in intensity from P.Ts. |
| | | eL | 21 | 31 | 30 | ... | ... | ... | ... | ... | |
| | | M | 21 | 36 | 54 | | ... | 40 | ... | ... | |
| | | F | 22 | 55 | 06 | ... | ... | ... | ... | ... | |
| 13 | 28 ... | eP | | ... | | | ... | ... | ... | ... | |
| | | iL | 19 | 14 | 54 | ... | ... | ... | ... | ... | |
| | | M | 19 | 32 | 18 | ... | ... | 200 | ... | ... | |
| | | F | 20 | 38 | 12 | | ... | ... | ... | ... | |
| 14 | March 8 ... | eP | 16 | 09 | 42 | ... | ... | ... | | ... | Widening of line. |
| | | F | 16 | 23 | 36 | ... | ... | ... | ... | ... | |
| 15 | 10 ... | eP | 1 | 16 | 24 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 1 | 27 | 12 | ... | ... | ... | ... | ... | |
| 16 | 12 ... | eP | 15 | 03 | 12 | ... | ... | ... | ... | ... | |
| | | eL | 15 | 07 | 06 | ... | ... | ... | ... | ... | |
| | | M | 15 | 15 | 48 | ... | ... | 100 | | ... | |
| | | F | 16 | 05 | 48 | ... | ... | ... | ... | ... | |
| 17 | 17 ... | iP | 19 | 02 | 54 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 19 | 13 | 00 | ... | ... | | ... | ... | |
| 18 | 18 ... | eP | 2 | 03 | 00 | ... | ... | ... | ... | ... | Hour mark broad. Probably a W.L. superposed on it. |

* 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 Δ (Km.). | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | An. | Ae. | Az. | | |
| | 1915. | | | H. | M. | S. | | | | | | |
| 19 | March | 18 .. | P | | .. | | ... | .. | . | ... | ... | |
| | | | iL | 21 | 14 | 12 | ... | ... | ... | ... | ... | |
| | | | M | 21 | 22 | 48 | ... | ... | 50 | ... | ... | |
| | | | F | 21 | 38 | 48 | ... | ... | | | ... | |
| 20 | | 26 ... | eP | 5 | 26 | 06 | | ... | . | ... | ... | Widening of line. |
| | | | F | 5 | 28 | 42 | ... | ... | ... | ... | ... | |
| 21 | | 30 ... | eP | 9 | 30 | 00? | ... | ... | ... | ... | ... | P.Ts. merged in hour mark. |
| | | | eL | 9 | 33 | 06 | ... | ... | ... | ... | ... | |
| | | | M | 9 | 36 | 42 | ... | ... | 60 | ... | ... | |
| | | | F | 9 | 52 | 54 | .. | ... | ... | ... | ... | |
| 22 | April | 3 ... | eP | 13 | 48 | 06 | ... | ... | ... | ... | ... | |
| | | | eL | 13 | 51 | 24 | ... | | ... | ... | ... | |
| | | | M | 13 | 57 | 06 | ... | ... | 120 | ... | .. | |
| | | | F | 14 | 28 | 12 | ... | ... | ... | ... | ... | |
| 23 | | 3 ... | eP | 21 | 20 | 30 | . | ... | ... | ... | ... | |
| | | | eL | 21 | 24 | 36 | .. | ... | .. | .. | ... | |
| | | | M | 21 | 28 | 42 | ... | .. | 40 | | ... | |
| | | | F | 22 | 25 | 06 | ... | .. | ... | ... | ... | |
| 24 | | 16 ... | eP | | ... | | ... | ... | ... | ... | ... | No P. Ts. |
| | | | eL | 16 | 06 | 00 | | .. | ... | ... | ... | |
| | | | M | 14 | 07 | 30 | ... | ... | 20 | ... | ... | |
| | | | F | 14 | 19 | 36 | .. | ... | ... | .. | ... | |
| 25 | | 17 ... | eP | 9 | 48 | 36 | ... | ... | ... | ... | ... | Widening of line. |
| | | | F | 9 | 51 | 12 | | ... | ... | ... | ... | |
| 26 | | 22 ... | eP | 19 | 01 | 00 | ... | ... | .. | ... | .. | |
| | | | eL | 19 | 03 | 36 | ... | ... | ... | ... | ... | |
| | | | M | 19 | 07 | 06 | ... | ... | 70 | ... | .. | |
| | | | F | 19 | 39 | 12 | ... | ... | ... | . | ... | Widening of line. |
| 27 | | 23 ... | eP | 16 | 09 | 30 | ... | .. | ... | ... | ... | |
| | | | F | 16 | 16 | 24 | .. | ... | ... | ... | ... | |
| 28 | | 28 ... | eP | 3 | 33 | 42 | ... | ... | ... | ... | ... | |
| | | | eL | 3 | 36 | 48 | ... | ... | ... | .. | ... | |
| | | | M | 3 | 39 | 36 | ... | ... | 40 | ... | .. | |
| | | | F | 4 | 03 | 36 | ... | ... | ... | ... | ... | |
| 29 | | 30 .. | eP | 2 | 04 | 54 | ... | ... | ... | ... | ... | |
| | | | iL | 2 | 05 | 48 | ... | ... | .. | ... | ... | |
| | | | M | 2 | 07 | 18 | ... | ... | 50 | ... | ... | |
| | | | F | 2 | 18 | 12 | ... | . | ... | ... | ... | |
| 30 | May | 1 ... | iP | 5 | 11 | 54 | .. | ... | ... | ... | ... | |
| | | | iL | 5 | 21 | 36 | ... | . | .. | ... | ... | |
| | | | M | 5 | 44 | 48 | ... | ... | 710 | ... | ... | |
| | | | | 5 | 48 | 06 | ... | ... | 1,010 | ... | ... | |
| | | | | 5 | 53 | 00 | ... | ... | 1,020 | ... | ... | |
| | | | | 5 | 58 | 06 | ... | ... | 850 | ... | ... | |
| | | | | 6 | 02 | 30 | . | ... | 920 | ... | ... | |
| | | | F | 10 | 03 | 54 | ... | ... | ... | ... | ... | |
| 31 | | 2 ... | eP | 4 | 44 | 36 | ... | ... | ... | ... | ... | |
| | | | eL | 4 | 46 | 06 | ... | ... | ... | ... | ... | |
| | | | M | 4 | 47 | 54 | ... | ... | ... | ... | ... | |
| | | | F | 5 | 04 | 18 | ... | ... | ... | ... | ... | |
| 32 | | 3 ... | eP | 3 | 41 | 18 | ... | ... | ... | ... | ... | |
| | | | eL | 4 | 02 | 12 | ... | ... | ... | .. | ... | |
| | | | M | 4 | 04 | 00 | ... | .. | 30 | ... | ... | |
| | | | F | 5 | 39 | 36 | ... | ... | ... | ... | ... | |
| 33 | | 3 ... | eP | 22 | 27 | 24 | ... | ... | ... | ... | ... | Widening of line. |
| | | | F | 22 | 29 | 00 | ... | ... | ... | ... | ... | |
| 34 | | 5 ... | eP | 11 | 27 | 24 | ... | ... | ... | ... | ... | |
| | | | eL | 11 | 48 | 1[illegible] | ... | ... | ... | ... | ... | |
| | | | M | 11 | 50 | 36 | ... | ... | 30 | ... | ... | |
| | | | F | 12 | 07 | 36 | ... | ... | ... | ... | ... | |
| 35 | | 5 ... | eP | 15 | 25 | 36 | ... | ... | ... | .. | .. | |
| | | | eL | 15 | 27 | 54 | ... | ... | ... | ... | ... | |
| | | | M | 15 | 28 | 30 | ... | ... | 30 | ... | ... | |
| | | | F | 15 | 46 | 12 | ... | ... | ... | ... | ... | |
| 36 | | 8 ... | eP | 14 | 00 | 06 | ... | ... | ... | ... | ... | |
| | | | eL | 14 | 08 | 54 | ... | ... | ... | ... | | |
| | | | M | 14 | 13 | 18 | ... | ... | 60 | ... | ... | |
| | | | F | 14 | 33 | 12 | ... | .. | .. | ... | ... | |
| 37 | | 12 ... | oP | 11 | 01 | 00 | ... | ... | ... | ... | ... | |
| | | | eL | 11 | 10 | 48 | ... | ... | .. | ... | ... | |
| | | | M | 11 | 27 | 24 | ... | ... | 290 | ... | ... | |
| | | | F | 12 | 19 | 12 | . | ... | ... | ... | ... | |
| 38 | | 14 ... | eP | 7 | 27 | 42 | ... | ... | ... | ... | ... | Widening of line. Hour mark superposed. |
| | | | F | 7 | 48 | 36 | .. | ... | ... | ... | .. | |

Kodaikanal Observatory Seismic Records—*cont.*

| No. | Date. | | Phase. | Time G.M.T. | | | Period (Sec.). | Amplitude (μ) | | | Distance Δ (Km.). | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | An. | Ae. | Az. | | |
| | 1915. | | | H. | M. | S. | | | | | | |
| 39 | May | 19 ... | eP | 5 | 16 | 36 | ... | ... | ... | ... | ... | Widening of line |
| | | | F | 5 | 20 | 36 | ... | ... | ... | ... | ... | |
| 40 | | 21 ... | eP | 8 | 38 | 12 | ... | ... | ... | ... | ... | |
| | | | eL | 3 | 43 | 18 | ... | ... | ... | ... | ... | |
| | | | M | 8 | 48 | 00 | ... | ... | 100 | ... | ... | |
| | | | F | 4 | 21 | 18 | ... | ... | ... | ... | ... | |
| 41 | June | 1 ... | eP | 15 | 17 | 00 | ... | ... | ... | ... | ... | |
| | | | eL | 15 | 29 | 12 | ... | ... | ... | ... | ... | |
| | | | M | 15 | 32 | 30 | ... | ... | 80 | ... | ... | |
| | | | F | 16 | 20 | 00 | ... | ... | ... | ... | ... | |
| 42 | | 6—7 ... | iP | 21 | 48 | 54 | ... | ... | ... | ... | ... | Air tremors due to high wind were frequent during 2nd half of June. |
| | | | iL | 21 | 59 | 06 | ... | ... | ... | | ... | |
| | | | M | 22 | 53 | 12 | ... | ... | 340 | ... | ... | |
| | | | F | 0 | 13 | 54 | ... | ... | ... | ... | ... | |
| 43 | July | 31 ... | eP | 1 | 42 | 54 | ... | | ... | ... | ... | |
| | | | iL | 2 | 12 | 36 | ... | ... | | ... | ... | |
| | | | M | 2 | 19 | 48 | ... | ... | 340 | ... | ... | |
| | | | F | 5 | 09 | 06 | ... | ... | ... | ... | ... | |
| 44 | August | 3 ... | eP | 13 | 14 | 30 | ... | ... | ... | ... | ... | |
| | | | iL | 13 | 22 | 00 | ... | ... | ... | ... | ... | |
| | | | M | 13 | 31 | 06 | ... | ... | 60 | ... | ... | |
| | | | F | 14 | 41 | 36 | ... | ... | ... | ... | ... | |
| 45 | | 6 ... | eP | 13 | 32 | 54 | ... | ... | ... | ... | ... | |
| | | | eL | 13 | 57 | 42 | ... | ... | ... | ... | ... | |
| | | | M | 13 | 58 | 42 | ... | ... | 50 | ... | ... | |
| | | | F | 14 | 46 | 42 | ... | ... | ... | ... | ... | |
| 46 | | 11 ... | eP | 9 | 37 | 12 | ... | ... | ... | ... | ... | |
| | | | eL | 9 | 41 | 54 | ... | ... | ... | ... | ... | |
| | | | M | 9 | 48 | 30 | ... | ... | 40 | ... | ... | |
| | | | F | 10 | 04 | 30 | ... | ... | ... | ... | ... | |
| 47 | | 12 ... | eP | 7 | 47 | 24 | ... | ... | ... | ... | ... | |
| | | | iL | 7 | 58 | 54 | ... | ... | ... | ... | ... | |
| | | | M | 8 | 03 | 42 | ... | ... | 140 | ... | ... | |
| | | | F | 8 | 33 | 06 | ... | ... | ... | ... | ... | |
| 48 | | 12 ... | iP | 9 | 22 | 48 | ... | ... | ... | ... | ... | |
| | | | iL | 9 | 23 | 06 | ... | ... | ... | ... | ... | |
| | | | M | 9 | 26 | 42 | ... | ... | 320 | ... | ... | |
| | | | F | 9 | 58 | 06 | ... | ... | ... | ... | ... | |
| 49 | | 12 ... | eP | 13 | 50 | 00 | ... | ... | ... | ... | ... | |
| | | | eL | 13 | 53 | 36 | ... | ... | ... | ... | ... | |
| | | | M | 13 | 54 | 54 | ... | ... | 50 | ... | ... | |
| | | | F | 14 | 12 | 00 | ... | ... | ... | ... | ... | |
| 50 | | 13 ... | P | | ... | | ... | ... | | ... | ... | |
| | | | eL | 22 | 23 | 48 | ... | ... | ... | ... | ... | |
| | | | M | 22 | 24 | 48 | ... | ... | 6 | ... | ... | |
| | | | F | 22 | 30 | 00 | ... | ... | ... | ... | ... | |
| 51 | | 16 ... | eP | 1 | 22 | 18 | | ... | ... | ... | ... | Widening of line. |
| | | | F | 2 | 19 | 00 | ... | ... | ... | ... | ... | |
| 52 | | 19 ... | eP | 0 | 52 | 30 | ... | ... | ... | ... | ... | Widening of line. |
| | | | F | 1 | 14 | 54 | ... | ... | ... | ... | ... | |
| 53 | | 31 ... | eP | 20 | 50 | 48 | ... | ... | ... | ... | ... | |
| | | | eL | 21 | 05 | 36 | ... | ... | ... | | ... | |
| | | | M | 21 | 10 | 30 | ... | ... | 60 | | ... | |
| | | | F | 21 | 39 | 42 | ... | ... | ... | ... | ... | |
| 54 | September | 1 ... | iP | 1 | 10 | 00 | ... | ... | ... | ... | ... | |
| | | | iL | 1 | 10 | 06 | ... | ... | ... | ... | ... | |
| | | | M | 1 | 12 | 00 | ... | ... | 290 | ... | ... | |
| | | | F | 1 | 37 | 12 | ... | ... | ... | | ... | |
| 55 | | 1 ... | eP | 2 | 05 | 54 | ... | ... | ... | ... | ... | |
| | | | iL | 2 | 06 | 24 | ... | ... | ... | ... | | |
| | | | M | 2 | 07 | 24 | ... | ... | 100 | ... | ... | |
| | | | F | 2 | 16 | 36 | | ... | ... | ... | ... | |
| 56 | | 6 ... | eP | 18 | 02 | 00 | ... | ... | ... | ... | ... | Widening of line. |
| | | | F | 18 | 50 | 42 | ... | ... | ... | | ... | |
| 57 | | 7 ... | * eP | 1 | 41 | 00 | ... | ... | ... | ... | ... | |
| | | | iL | 2 | 03 | 48 | ... | ... | ... | ... | ... | |
| | | | M | 2 | 56 | 00 | ... | | 520 | ... | ... | |
| | | | F | 3 | 36 | 00 | ... | ... | ... | ... | ... | |
| 58 | | 12 ... | eP | 0 | 09 | 30 | ... | ... | ... | ... | ... | |
| | | | eL | 0 | 16 | 42 | ... | ... | ... | | ... | |
| | | | M | 0 | 17 | 18 | ... | ... | 40 | ... | ... | |
| | | | F | 0 | 33 | 06 | ... | ... | ... | ... | ... | |
| 59 | | 12 ... | eP | 21 | 42 | 48 | ... | ... | | ... | | Widening of line. |
| | | | F | 22 | 15 | 36 | ... | ... | ... | ... | ... | |
| 60 | September | 23 ... | eP | 8 | 29 | 00 | ... | ... | ... | ... | ... | Widening of line. |
| | | | F | 8 | 49 | 24 | ... | ... | ... | ... | ... | |

## Kodaikanal Observatory Seismic Records—*cont.*

| No. | Date. | Phase. | Time G.M.T. H. | M. | S. | Period (Sec.). | Amplitude (u) AN. | AE. | AZ. | Distance Δ (Km.). | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1915. | | | | | | | | | | |
| 61 | October 3 ... | eP | 7 | 24 | 00 | ... | ... | ... | ... | ... | |
| | | iL | 7 | 57 | 30 | ... | ... | ... | ... | ... | |
| | | M | 8 | 15 | 48 | ... | ... | 350 | ... | ... | |
| | | F | 9 | 48 | 48 | ... | ... | ... | ... | ... | |
| 62 | 5 ... | eP | 14 | 08 | 06 | ... | | | ... | ... | Widening of line. |
| | | F | 14 | 58 | 30 | ... | ... | ... | ... | ... | |
| 63 | 11 ... | eP | 20 | 52 | 48 | ... | ... | ... | ... | ... | Widening of line. |
| | | F | 21 | 48 | 18 | ... | ... | ... | ... | ... | |
| 64 | November 1 ... | eP | 7 | 35 | 06 | ... | ... | ... | ... | ... | |
| | | iL | 7 | 55 | 36 | ... | ... | ... | ... | ... | |
| | | M | 8 | 08 | 54 | ... | ... | 290 | ... | ... | |
| | | F | 10 | 55 | 24 | ... | ... | ... | ... | ... | |
| 65 | 18 ... | eP | 4 | 21 | 30 | ... | ... | ... | ... | ... | |
| | | eL | 4 | 41 | 18 | ... | ... | ... | ... | ... | |
| | | M | 4 | 45 | 54 | ... | ... | 60 | ... | ... | |
| | | F | 5 | 17 | 12 | ... | ... | ... | ... | ... | |
| 66 | 18 ... | eP | 20 | 34 | 06? | ... | ... | ... | ... | ... | |
| | | eL | 20 | 40 | 30 | ... | ... | ... | ... | ... | |
| | | M | 20 | 45 | 24 | ... | ... | 50 | ... | ... | |
| | | F | 21 | 06 | 00 | ... | ... | ... | ... | ... | |
| 67 | 20 ... | eP | 15 | 58 | 36 | ... | ... | ... | ... | ... | |
| | | eL | 15 | 55 | 54 | ... | ... | ... | ... | ... | |
| | | M | 15 | 59 | 30 | ... | ... | 50 | ... | ... | |
| | | F | 16 | 13 | 36 | ... | ... | ... | ... | ... | |
| 68 | 21 ... | eP | 1 | 19 | 12 | ... | ... | ... | ... | ... | |
| | | eL | 1 | 35 | 36 | ... | ... | ... | ... | ... | |
| | | M | 1 | 39 | 42 | ... | ... | 190 | ... | ... | |
| | | F | 2 | 39 | 42 | ... | ... | ... | ... | ... | |
| 69 | December 3 ... | eP | 2 | 45 | 06 | ... | ... | | ... | ... | |
| | | iL | 2 | 49 | 30 | ... | ... | ... | ... | ... | |
| | | M | 2 | 54 | 06 | ... | ... | 190 | ... | ... | |
| | | F | 3 | 27 | 24 | ... | ... | ... | ... | ... | |
| 70 | 17 ... | eP | 7 | 16 | 36 | ... | ... | ... | ... | ... | |
| | | iL | 7 | 22 | 00 | ... | ... | ... | ... | ... | |
| | | M | 7 | 25 | 54 | ... | ... | 60 | ... | ... | |
| | | F | 7 | 52 | 42 | ... | ... | ... | ... | ... | |
| 71 | 18 ... | eP | 19 | 13 | 24 | ... | ... | ... | ... | ... | |
| | | F | 19 | 28 | 48 | ... | ... | ... | ... | ... | Widening of line. |
| 72 | 19 ... | eP | 20 | 21 | 18 | ... | ... | ... | ... | ... | |
| | | iL | 20 | 24 | 48 | ... | ... | ... | ... | ... | |
| | | M | 20 | 27 | 12 | ... | ... | 110 | ... | ... | |
| | | F | 20 | 55 | 12 | ... | ... | ... | ... | ... | |

## 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 1915.

| Month | Barometer. | | Dry Bulb Thermometer. | | | | Wet Bulb. | | Tension of Vapour. | Relative Humidity. | Sun Max. in *Vac.* | Min. on Grass. | Wind. | | | Rain. | | Clear Sky. | Bright Sun-shine. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reduced to 32°. | Daily Range. | Mean. | Max. | Min. | Range. | Mean. | Min. | By Simpson's Tables. | | | | Daily Velocity. | Mean Direction. | | Amount. | Days. | | |
| | Inches. | Inches. | ° | ° | ° | ° | ° | ° | Inches. | Cents. | ° | ° | Miles. | Points. | | Inches. | No. | Cents. | Hours. |
| January ... | 22·877 | 0·060 | 57·5 | 66·0 | 48·9 | 17·1 | 48·3 | 41·4 | 0·262 | 57 | 124·8 | 41·7 | 262 | 5 | N.E. by E. | 1·79 | 4 | 56 | 248·3 |
| February .. | ·867 | ·066 | 58·5 | 67·6 | 49·5 | 18·1 | 49·6 | 43·3 | ·278 | 59 | 131·4 | 41·6 | 223 | 1 | N. by E. | 0·52 | 2 | 59 | 238·9 |
| March ... ... | ·905 | ·067 | 60·3 | 69·5 | 51·0 | 18·5 | 52·0 | 44·9 | ·318 | 62 | 136·2 | 43·0 | 232 | 9 | E. by S. | 3·47 | 7 | 65 | 274·3 |
| April .. ... | ·865 | ·061 | 62 4 | 71·4 | 53·5 | 17·9 | 54·1 | 48·1 | ·346 | 63 | 139·9 | 46·6 | 258 | 6 | E.N.E. | 3·92 | 4 | 69 | 277·0 |
| May ... ... | ·819 | ·060 | 64·0 | 72·3 | 55·6 | 16·7 | 55·3 | 49·7 | ·362 | 63 | 138·2 | 48·9 | 247 | 29 | N.W. by N. | 1·28 | 4 | 59 | 278·7 |
| June ... ... | ·769 | ·065 | 61·1 | 67·7 | 54·6 | 13·1 | 56·1 | 51·7 | ·410 | 79 | 130 5 | 51·3 | 351 | 26 | W.N.W. | 6·05 | 12 | 30 | 157·2 |
| July ... ... | ·777 | ·056 | 58·9 | 64·1 | 53·7 | 10·4 | 55·5 | 51·8 | ·414 | 86 | 121·7 | 49·9 | 289 | 22 | W.S.W. | 6·22 | 14 | 19 | 109·4 |
| August ... ... | ·785 | ·061 | 58·7 | 64·1 | 53·2 | 10·9 | 55·6 | 51·3 | ·418 | 86 | 125·2 | 49·5 | 231 | 26 | W.N.W. | 6·79 | 15 | 24 | 184·4 |
| September ... | ·785 | ·077 | 59·7 | 65·7 | 53·7 | 12 0 | 55·4 | 51·2 | ·408 | 83 | 129·8 | 49·6 | 265 | 25 | W. by N. | 6·07 | 12 | 19 | 153·9 |
| October ... | ·806 | ·068 | 59·0 | 66·1 | 51 8 | 14·3 | 54·4 | 49·0 | ·387 | 79 | 131·6 | 42 9 | 203 | 17 | S. by W. | 4·24 | 9 | 43 | 203·8 |
| November ... | ·809 | ·073 | 56·7 | 61·8 | 51·7 | 10·1 | 53 9 | 50·1 | ·399 | 96 | 117·5 | 48·3 | 214 | 29 | N.W. by W. | 8·03 | 16 | 16 | 115·8 |
| December ... | ·842 | ·064 | 54·3 | 62·5 | 46·2 | 16·3 | 48·6 | 41·6 | ·294 | 70 | 115·9 | 36·4 | 260 | 6 | E.N.E. | 5·32 | 8 | 54 | 215·5 |
| Annual ... | 22·825 | 0·065 | 59·3 | 66·6 | 51·9 | 14·6 | 53·2 | 47·8 | 0·358 | 73 | 128·6 | 45·8 | 253 | 30 | N.N.W. | 53·70 | 107 | 43 | 2402·2 |

### EXTREME Monthly Meteorological Records at the Kodaikanal Observatory in 1915.

| 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 ... | 22 980 | 18 | 22·814 | 31 | 0·166 | 73·7 | 8 | 42·3 | 12 | 34·6 | 27 | 10 | 3 | 139·9 | 6 | 30·4 | 12 | 495 | 1 | 110 | 18 | 0·47 | 19 |
| February ... | ·920 | 9 | ·800 | 4 | ·120 | 74·6 | 18 | 43·9 | 1 | 35·2 | 26 | 16 | 15 | 142·1 | 28 | 35·1 | 1 | 343 | 11 | 84 | 7 | 0·21 | 7 |
| March . .. | ·968 | 18, 19 | ·835 | 1 | ·131 | 73·4 | 25 | 46 1 | 7 | 38 7 | 21 | 29 | 21 | 145·5 | 31 | 33 2 | 9 | 430 | 20 | 116 | 10 | 0·93 | 1 |
| April ... ... | ·943 | 6 | ·759 | 19 | ·184 | 75·0 | 8 | 49·2 | 8 | 39·2 | 8 | 24 | 13 | 146·4 | 8 | 39·1 | 8 | 418 | 14 | 128 | 18 | 2·99 | 16 |
| May ... ... | ·895 | 20 | ·697 | 9 | ·198 | 77·2 | 24, 29 | 52·8 | 22 | 43·1 | 23 | 29 | 22 | 156·0 | 1 | 42·8 | 21 | 449 | 10 | 98 | 15 | 0·37 | 6 |
| June ... ... | ·850 | 30 | 660 | 23 | ·190 | 74·5 | 11 | 52·3 | 28, 29 | 49·3 | 30 | 46 | 1 | 144 8 | 12 | 47·7 | 5 | 659 | 17 | 84 | 13 | 1·31 | 14 |
| July . ... | ·874 | 11 | ·615 | 20 | ·259 | 70·0 | 5 | 51·9 | 12 | 46·4 | 4 | 43 | 3 | 147 9 | 5 | 41·2 | 4 | 529 | 29 | 102 | 7 | 1·04 | 6 |
| August ... | ·886 | 31 | ·706 | 22 | ·180 | 68·2 | 10 | 50·6 | 19 | 47·1 | 19 | 69 | 11 | 143·9 | 8 | 43·4 | 29 | 587 | 2 | 89 | 16 | 1·16 | 22 |
| September .. | ·888 | 2 | ·686 | 10 | ·202 | 70·6 | 27 | 51·6 | 2 | 44 7 | 3 | 44 | 3 | 152·3 | 27 | 44·4 | 1, 2 | 450 | 12 | 92 | 15 | 0·99 | 20 |
| October ... ... | ·870 | 13 | ·709 | 10 | ·161 | 69·5 | 11, 15 | 48 2 | 15 | 42·3 | 8 | 42 | 3 | 147·3 | 9 | 38 4 | 14 | 523 | 2 | 109 | 10 | 1·14 | 20 |
| November .. | ·898 | 29 | ·662 | 5 | ·236 | 67·1 | 9 | 47·9 | 30 | 45·8 | 6 | 54 | 6 | 127·9 | 25 | 44·0 | 30 | 347 | 5 | 69 | 26 | 1·22 | 27 |
| December ... | ·914 | 11 | ·754 | 6 | ·160 | 72·4 | 6 | 39·6 | 15 | 32 6 | 7 | 20 | 11 | 132·9 | 4 | 20·2 | 15 | 464 | 25 | 112 | 9 | 1·24 | 26 |

# APPENDIX III.

Kodaikanal mean hourly wind velocity for the year 1915.

| Month. | Hours. | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| January ... | 11 | 13 | 12 | 12 | 13 | 11 | 13 | 12 | 12 | 15 | 13 | 13 | 12 | 10 | 9 | 9 | 7 | 7 | 8 | 9 | 9 | 10 | 10 | 10 |
| February ... | 10 | 11 | 10 | 10 | 10 | 10 | 9 | 10 | 9 | 12 | 11 | 11 | 11 | 11 | 10 | 8 | 6 | 6 | 6 | 6 | 7 | 8 | 9 | 10 |
| March ... | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 10 | 11 | 11 | 12 | 13 | 11 | 10 | 11 | 13 | 7 | 7 | 8 | 10 | 10 | 10 | 9 | 9 |
| April ... | 11 | 11 | 12 | 12 | 11 | 11 | 12 | 12 | 12 | 14 | 15 | 14 | 12 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 9 | 10 |
| May ... | 10 | 12 | 10 | 10 | 10 | 10 | 9 | 9 | 11 | 11 | 12 | 12 | 11 | 11 | 11 | 12 | 9 | 9 | 8 | 10 | 9 | 10 | 9 | 10 |
| June ... | 15 | 17 | 15 | 15 | 15 | 15 | 14 | 14 | 15 | 13 | 14 | 14 | 13 | 14 | 14 | 13 | 12 | 13 | 14 | 15 | 15 | 16 | 17 | 17 |
| July ... | 14 | 13 | 14 | 14 | 12 | 13 | 12 | 13 | 11 | 11 | 11 | 11 | 10 | 11 | 11 | 11 | 10 | 11 | 11 | 12 | 12 | 14 | 13 | 13 |
| August ... | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 9 | 7 | 9 | 10 | 10 | 9 | 8 | 9 | 9 | 9 | 9 | 9 | 10 | 10 | 10 | 12 | 12 |
| September ... | 11 | 11 | 12 | 12 | 12 | 12 | 13 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 10 | 10 | 11 | 12 | 12 | 11 | 11 | 12 |
| October ... | 10 | 10 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 9 | 9 | 8 | 9 | 8 | 7 | 7 | 8 | 9 | 8 | 9 | 9 | 9 |
| November ... | 10 | 10 | 9 | 10 | 10 | 9 | 9 | 8 | 9 | 9 | 8 | 9 | 8 | 8 | 7 | 8 | 7 | 8 | 8 | 9 | 9 | 10 | 10 | 10 |
| December ... | 10 | 10 | 10 | 11 | 10 | 11 | 11 | 11 | 12 | 12 | 12 | 12 | 12 | 11 | 12 | 10 | 9 | 9 | 10 | 11 | 10 | 11 | 11 | 10 |
| Annual ... | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 12 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 10 | 10 | 11 | 11 | 11 |

## APPENDIX IV.

KODAIKANAL mean hourly bright sunshine for the year 1915.

| 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 ... ... .. | 0·26 | 0·72 | 0·83 | 0·88 | 0·82 | 0·80 | 0·76 | 0·78 | 0·72 | 0·66 | 0·51 | 0·09 |
| February ... ... ... | ·38 | ·79 | ·83 | ·83 | ·90 | ·86 | ·93 | ·86 | ·74 | ·69 | ·51 | ·21 |
| March ... ... ... ... | ·57 | ·89 | ·92 | ·96 | ·98 | ·94 | ·85 | ·77 | ·71 | ·60 | 39 | ·25 |
| April ... ... ... ... | ·54 | ·91 | ·97 | ·96 | ·98 | ·99 | ·91 | ·82 | ·70 | ·63 | ·55 | ·27 |
| May ... ... ... ... | ·57 | ·92 | ·94 | ·98 | ·93 | ·91 | ·86 | ·77 | ·67 | ·60 | ·52 | ·34 |
| June ... ... ... ... | ·25 | ·53 | ·62 | ·61 | ·66 | 67 | ·52 | ·41 | ·41 | ·33 | ·20 | ·04 |
| July ... ... ... ... | ·17 | ·46 | ·51 | ·51 | ·45 | ·28 | ·31 | ·21 | ·25 | ·19 | ·12 | ·06 |
| August ... ... ... ... | ·17 | ·47 | ·59 | ·67 | ·61 | ·53 | ·30 | ·25 | ·21 | ·27 | ·19 | ·06 |
| September ... ... ... | ·16 | ·38 | ·60 | ·69 | ·69 | ·62 | ·57 | ·48 | ·36 | ·27 | ·23 | ·09 |
| October ... ... ... ... | ·30 | ·76 | ·85 | ·85 | ·73 | ·70 | ·60 | ·54 | ·49 | ·38 | ·24 | ·12 |
| November ... ... ... | ·08 | ·38 | ·48 | ·62 | ·52 | ·49 | ·36 | ·33 | ·33 | ·17 | 09 | ·02 |
| December ... ... ... | ·22 | ·65 | ·65 | ·69 | ·74 | ·76 | ·72 | ·68 | ·66 | ·59 | ·51 | ·08 |
| Mean ... | 0·31 | 0·66 | 0·73 | 0·77 | 0·75 | 0·71 | 0·64 | 0·58 | 0·52 | 0·45 | 0·34 | 0·14 |

## APPENDIX V.

NUMBER of days in each month on which the Nilgiris were visible in 1915.

| Month. | Very clear. | Visible. | Just visible. | Tops only visible. | Total. |
|---|---|---|---|---|---|
| January ... ... | 5 | 10 | 2 | 1 | 18 |
| February ... ... | ... | 4 | 3 | 1 | 8 |
| March ... ... | ... | 2 | 8 | 1 | 11 |
| April ... ... | 1 | 3 | 2 | ... | 6 |
| May ... ... | 1 | 1 | 4 | ... | 6 |
| June ... ... | 3 | 2 | 3 | ... | 8 |
| July ... ... | 6 | 7 | ... | ... | 13 |
| August ... ... | ... | 1 | 6 | ... | 7 |
| September ... | 6 | 4 | 4 | ... | 14 |
| October ... ... | 1 | 15 | 2 | 1 | 19 |
| November ... | 1 | 1 | 2 | ... | 4 |
| December ... ... | ... | 15 | ... | ... | 15 |
| Total ... | 24 | 65 | 36 | 4 | 129 |

# APPENDIX VI.

MADRAS OBSERVATORY—Abnormals from monthly means for the year 1915.

| Abnormals of | January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November | December | Annual. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reduced atmospheric pressure ... ... ... | + 0·024 | − 0·005 | + 0·052 | + 0·032 | − 0·030 | − 0·028 | + 0·001 | − 0·017 | − 0·027 | − 0·051 | − 0·073 | + 0·010 | − 0·009 |
| Temperature of air ... ... ... ... ... | + 1·2 | + 1·8 | + 1·8 | + 0·7 | + 2·9 | + 1·8 | + 0·2 | + 2·1 | + 0·8 | + 2·9 | + 1·6 | + 0·8 | + 1·6 |
| Do. of evaporation ... ... ... | + 2·7 | + 2·4 | + 2·6 | + 1·3 | + 1·9 | + 3·0 | + 2·1 | + 2·3 | + 1·6 | + 2·4 | + 2·6 | − 0·2 | + 2·1 |
| Percentage of humidity ... ... ... ... | + 7 | + 4 | + 3 | + 2 | − 2 | + 5 | + 9 | + 2 | + 4 | Same as | + 6 | − 3 | + 3 |
| Greatest solar heat in *vacuo* ... ... ... | + 8·1 | + 10·0 | + 13·0 | + 13·1 | + 10·2 | + 6·1 | + 5·5 | + 8·5 | + 9·6 | + 13·4 | + 1·2 | + 9·6 | + 9·0 |
| Maximum in shade ... ... ... ... ... | − 0·5 | + 0·1 | + 1·1 | + 0·6 | + 4·0 | Same as | − 1·4 | + 1·8 | − 0·3 | + 2·9 | + 1·0 | + 0·8 | + 0·8 |
| Minimum in shade .. ... ... ... ... | + 2·4 | + 3·1 | + 2·1 | + 0·3 | + 1·8 | + 2·3 | + 0·2 | + 1·8 | + 0·3 | + 1·8 | + 1·8 | + 0·1 | + 1·5 |
| Do. on grass ... ... ... .. ... | + 6·2 | + 4·4 | + 3·2 | + 0·9 | + 2·4 | + 2·8 | + 0·8 | + 2·9 | + 1·1 | + 2·0 | + 2·9 | + 0·6 | + 2·5 |
| Rainfall in inches ... ... ... ... ... | + 8·72 | + 0·02 | − 0·15 | − 0·10 | − 1·76 | − 0·80 | + 4·93 | − 3·36 | + 5·74 | − 8·36 | + 7·58 | − 4·87 | ... |
| Do. since January 1st ... ... ... ... | ... | + 8·74 | + 8·59 | + 8·49 | + 6·73 | + 5·93 | + 10·86 | + 7·50 | + 13·24 | + 4·88 | + 12·46 | + 7·59 | + 7·59 |
| General direction of wind ... ... .. ... | 1 point N. | 1 point N. | 1 point E. | Same as | 1 point S. | 2 points S. | 1 point S. | 1 point S. | 3 points S. | 8 points S. | 2 points E. | Same as | Same as |
| Daily velocity in miles ... ... ... ... | + 1 | − 4 | − 24 | − 32 | − 37 | − 27 | − 27 | − 23 | − 23 | − 16 | − 48 | − 14 | − 23 |
| Percentage of cloudy sky ... ... ... ... | + 15 | + 5 | − 2 | − 12 | − 9 | − 14 | − 9 | − 11 | − 1 | − 12 | Same as | − 16 | − 6 |
| Do. of bright sunshine ... ... ... | − 12·2 | − 6·7 | + 0·3 | + 12·8 | + 3·3 | + 0·3 | + 2·1 | + 4·7 | + 2·9 | + 10·0 | − 6·2 | + 5·7 | − 3·0 |

+ means above normal; — means below normal.

# APPENDIX VII.

ABSTRACT of the Mean Meteorological Condition of Madras in the year 1915 compared with the average of past years.

| Mean values of | 1915. | Difference from | Average. |
|---|---|---|---|
| Reduced atmospheric pressure ... ... ... ... ... | 29·855 | 0·009 below. | 29·864 |
| Temperature of air ... .. ... ... ... ... ... | 82·7 | 1·6 above. | 81·1 |
| Do. of evaporation ... ... ... ... ... | 76 6 | 2·1 ,, | 74·5 |
| Percentage of humidity ... ... .. ... ... ... | 75 | 3 ,, | 72 |
| Greatest solar heat in *vacuo* ... ... ... ... ... | 148·7 | 9·0 ,, | 139·7 |
| Maximum in shade ... ... ... ... ... ... ... | 91·6 | 0·8 ,, | 90·8 |
| Minimum in shade ... ... ... .. ... ... ... | 76·2 | 1·5 ,, | 74·7 |
| Do. on grass ... ... ... ... ... ... ... | 74·4 | 2·5 ,, | 71·9 |
| Rainfall in inches since January 1st on 92 days ... ... | 56·61 | 7·59 ,, | 49·02 |
| General direction of wind .. .. ... ... ... ... | S.E. | Same as | S.E. |
| Daily velocity in miles ... ... ... ... ... ... | 148 | 23 below | 171 |
| Percentage of cloudy sky ... ... ... ... ... ... | 43 | 6 ,, | 49 |
| Do. of bright Sunshine ... ... ... ... ... | 55·4 | 3·0 ,, | 58·4 |

DURATION and Quantity of the Wind from different Points.

| From. | Hours. | Miles. | From | Hours. | Miles. | From | Hours. | Miles. | From | Hours. | Miles. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| North ... | 188 | 1,149 | East ... | 256 | 1,223 | South ... | 206 | 1,336 | West ... | 194 | 1,825 |
| N. by E. ... | 270 | 1,512 | E. by S. | 332 | 1,582 | S. by W. | 230 | 1,513 | W. by N. | 166 | 1,196 |
| N.N.E. ... | 371 | 2,271 | E.S.E. ... | 266 | 1,382 | S.S.W. ... | 272 | 1,723 | W.N.W. | 115 | 798 |
| N.E. by N. .. | 499 | 3,599 | S.E. by E. | 480 | 2,408 | S.W. by S. | 257 | 1,752 | N.W. by W. | 60 | 398 |
| N.E. ... | 258 | 1,869 | S.E. ... | 496 | 2,923 | S.W. ... | 225 | 1,476 | N.W. ... | 50 | 196 |
| N.E. by E.... | 225 | 1,399 | S.E. by S. | 935 | 6,719 | S.W. by W. | 199 | 1,372 | N.W. by N. | 76 | 372 |
| E.N.E. . | 178 | 929 | S.S.E. ... | 574 | 4,298 | W.S.W. ... | 238 | 1,547 | N.N.W. ... | 83 | 441 |
| E. by N. ... | 290 | 1,476 | S. by E. | 254 | 1,742 | W. by S. | 253 | 1,823 | N. by W. | 96 | 528 |

There were 173 calm hours during the year. The resultant corresponding to the above numbers is represented by a S.E. by S.wind, blowing with a uniform daily velocity of 43 miles.

# APPENDIX VIII.

MADRAS OBSERVATORY—Number of hours of wind from each point in the year 1915.

| 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 ... | 32 | 56 | 132 | 161 | 74 | 17 | 40 | 101 | 50 | 25 | 25 | ... | ... | ... | ... | ... | ... | .. | .. | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | .. | 7 | 6 | 18 |
| February ... | 1 | 10 | 24 | 75 | 62 | 80 | 66 | 76 | 62 | 60 | 28 | 101 | 2 | 1 | 3 | 2 | ... | ... | 1 | ... | ... | 2 | ... | ... | ... | ... | ... | ... | ... | ... | .. | ... | 16 |
| March ... | ... | ... | 17 | ... | ... | 13 | 20 | 17 | 59 | 102 | 82 | 50 | 58 | 157 | 76 | 8 | 12 | 12 | 11 | 6 | 5 | 1 | 2 | ... | ... | ... | ... | ... | ... | 1 | ... | ... | 35 |
| April ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | 20 | 25 | 104 | 43 | 294 | 138 | 19 | 15 | 12 | 14 | 8 | 2 | 2 | 1 | ... | ... | ... | ... | ... | ... | ... | .. | ... | 23 |
| May ... ... | ... | 2 | 1 | ... | 2 | 6 | 1 | 4 | 9 | 36 | 12 | 40 | 91 | 162 | 84 | 36 | 27 | 27 | 11 | 17 | 13 | 14 | 4 | 23 | 22 | 33 | 20 | 8 | 9 | 20 | 2 | 1 | 7 |
| June ... ... | ... | ... | 4 | ... | ... | 2 | 4 | 1 | 2 | 6 | 13 | 15 | 52 | 87 | 103 | 49 | 40 | 26 | 40 | 43 | 29 | 31 | 61 | 36 | 29 | 20 | 7 | 10 | 2 | 3 | 3 | ... | 2 |
| July ... ... | ... | 1 | 1 | ... | 1 | 3 | ... | 1 | 2 | 4 | 5 | 11 | 29 | 43 | 38 | 32 | 28 | 47 | 58 | 73 | 89 | 53 | 47 | 62 | 52 | 25 | 10 | 6 | 6 | 13 | 1 | 2 | 6 |
| August ... | 2 | ... | 1 | 1 | ... | 1 | ... | 6 | 11 | 11 | 12 | 50 | 51 | 55 | 37 | 22 | 25 | 30 | 25 | 47 | 24 | 49 | 61 | 75 | 38 | 37 | 37 | 13 | 3 | 13 | 1 | 1 | 5 |
| September ... | 1 | 10 | 2 | 2 | ... | ... | 1 | 6 | 20 | 31 | 23 | 56 | 70 | 59 | 47 | 39 | 42 | 43 | 62 | 32 | 39 | 20 | 24 | 21 | 17 | 18 | 7 | 9 | 1 | 1 | 2 | ... | 15 |
| October ... | 4 | 14 | 32 | 39 | 18 | 6 | 3 | 14 | 16 | 7 | 16 | 20 | 92 | 55 | 44 | 35 | 14 | 28 | 49 | 29 | 22 | 13 | 19 | 32 | 32 | 21 | 32 | 12 | 9 | 4 | 2 | 3 | 8 |
| November ... | 45 | 42 | 33 | 40 | 31 | 45 | 32 | 56 | 25 | 30 | 25 | 33 | 8 | 22 | 4 | 12 | 8 | 5 | 1 | 2 | 2 | 14 | 19 | 4 | 4 | 12 | 2 | 2 | 20 | 9 | 45 | 56 | 32 |
| December ... | 103 | 135 | 124 | 181 | 70 | 52 | 6 | 8 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 12 | 20 | 27 | 6 |
| Annual total. | 188 | 270 | 371 | 499 | 258 | 225 | 178 | 290 | 256 | 332 | 266 | 480 | 496 | 935 | 574 | 254 | 206 | 230 | 272 | 257 | 225 | 199 | 288 | 253 | 194 | 166 | 115 | 60 | 50 | 76 | 83 | 96 | 173 |

# APPENDIX IX.

MADRAS OBSERVATORY—Number of miles of wind from each point in the year 1915.

| 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 ... ... | 231 | 341 | 817 | 1,089 | 530 | 170 | 238 | 530 | 193 | 157 | 86 | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... | .. | . | ... | ... | .. | ... | | ... | 61 | 53 | 4,496 |
| February ... ... | 9 | 88 | 140 | 402 | 313 | 450 | 355 | 421 | 302 | 256 | 150 | 358 | 12 | 8 | 18 | 13 | .. | | 7 | ... | ... | 12 | ... | ... | ... | ... | ... | . | ... | ... | ... | ... | 3,314 |
| March .. .. | ... | ... | 89 | ... | ... | 19 | 84 | 76 | 267 | 468 | 391 | 230 | 299 | 968 | 641 | 68 | 99 | 118 | 110 | 39 | 33 | 12 | 8 | ... | ... | ... | ... | ... | ... | 6 | ... | ... | 3,975 |
| April ... ... ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 87 | 160 | 525 | 339 | 1,923 | 1,061 | 197 | 123 | 112 | 141 | 66 | 18 | 10 | 5 | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4,767 |
| May ... ... | ... | 17 | 7 | ... | 17 | 60 | 12 | 26 | 82 | 223 | 98 | 330 | 651 | 1,469 | 717 | 267 | 191 | 187 | 84 | 143 | 84 | 90 | 33 | 153 | 191 | 333 | 219 | 71 | 51 | 67 | 20 | 9 | 5,902 |
| June ... ... ... | ... | ... | 22 | ... | ... | 10 | 31 | 1 | 10 | 47 | 83 | 120 | 374 | 905 | 816 | 38 | 269 | 216 | 298 | 310 | 248 | 291 | 414 | 303 | 218 | 167 | 70 | 102 | 16 | 23 | 22 | ... | 5,795 |
| July .. ... ... | ... | 3 | 8 | ... | 9 | 25 | ... | 10 | 14 | 27 | 49 | 89 | 248 | 334 | 341 | 243 | 183 | 289 | 344 | 491 | 542 | 408 | 348 | 508 | 364 | 165 | 93 | 36 | 37 | 64 | 3 | 12 | 5,287 |
| August ... ... | 14 | ... | 5 | 3 | .. | 9 | ... | 43 | 81 | 61 | 74 | 359 | 284 | 388 | 237 | 112 | 120 | 138 | 134 | 296 | 149 | 253 | 410 | 549 | 282 | 264 | 261 | 68 | 19 | 58 | 2 | 3 | 4,671 |
| September ... .. | 10 | 42 | 18 | 7 | ... | ... | 8 | 19 | 60 | 132 | 145 | 231 | 388 | 344 | 230 | 247 | 209 | 303 | 431 | 264 | 281 | 162 | 133 | 85 | 75 | 69 | 34 | 43 | 6 | 2 | 20 | ... | 3,998 |
| October ... ... | 29 | 56 | 161 | 207 | 144 | 58 | 26 | 60 | 67 | 17 | 44 | 54 | 288 | 247 | 218 | 133 | 84 | 115 | 170 | 118 | 105 | 75 | 94 | 199 | 172 | 128 | 111 | 70 | 18 | 23 | 7 | 19 | 3,312 |
| November ... ... | 187 | 261 | 203 | 835 | 176 | 236 | 108 | 282 | 147 | 107 | 102 | 112 | 40 | 133 | 19 | 73 | 58 | 85 | 4 | 25 | 16 | 59 | 102 | 26 | 23 | 55 | 10 | 13 | 49 | 58 | 226 | 296 | 3,521 |
| December ... ... | 669 | 704 | 851 | 1,556 | 680 | 362 | 67 | 58 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | . | ... | ... | ... | ... | ... | ... | ... | ... | 76 | 80 | 136 | 5,239 |
| Annual ... | 1,149 | 1,512 | 2,271 | 3,599 | 1,869 | 1,399 | 929 | 1,476 | 1,223 | 1,582 | 1,332 | 2,408 | 2,923 | 6,719 | 4,298 | 1,742 | 1,336 | 1,513 | 1,723 | 1,752 | 1,476 | 1,372 | 1,547 | 1,823 | 1,325 | 1,196 | 798 | 398 | 196 | 372 | 441 | 528 | 54,277 |

# APPENDIX X.

MADRAS OBSERVATORY—Number of inches of rain from each point in the year 1915.

| 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 ... | 0·07 | 2·04 | 3·55 | 0·85 | 2·10 | 0·12 | 0·09 | 0·38 | ... | 0·37 | .. | . | ... | .. | .. | ... | ... | ... | ... | ... | | ... | .. | .. | ... | ... | ... | . | ... | .. | 0·01 | 0·03 | .. |
| February ... | ... | ... | ... | ... | 0·10 | ... | ... | ... | 0·08 | ... | ... | 0·12 | ... | ... | ... | ... | ... | ... | ... | ... | ... | .. | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| March ... | ... | ... | 0·03 | ... | ... | 0·13 | .. | .. | 0·04 | ... | ... | ... | ... | 0·03 | ... | .. | ... | ... | ... | ... | 0·01 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| April ... | ... | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... | 0·44 | 0·04 | ... | ... | ... | ... | 0·04 | ... | .. | ... | ... | ... | | ... | ... | ... | | ... | ... | ... | ... | ... |
| May ... | ... | ... | ... | . | ... | ... | ... | .. | ... | .. | ... | .. | . | 0·32 | ... | . | ... | ... | ... | ... | ... | ... | ... | | ... | 0·02 | ... | ... | ... | 0·02 | ... | | ... |
| June ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 0·02 | ... | 0·05 | | ... | 0·06 | ... | 0·08 | 0·06 | ... | 0·05 | 0·21 | ... | 0·02 | .. | 0·54 | 0·02 | 0·10 | ... | 0·10 | ... | ... |
| July ... | .. | ... | 0·25 | ... | ... | 0·94 | ... | ... | 0·07 | .. | ... | ... | ... | 0·11 | 0·08 | 0·46 | 0·06 | 0·63 | 0·06 | 0·52 | 0·12 | 0·01 | 1·24 | 1·78 | 1·11 | 0·19 | 0·08 | 0·04 | ... | 0·99 | 0·06 | ... | ... |
| August ... | ... | ... | ... | .. | ... | .. | ... | .. | 0·17 | 0·01 | ... | ... | 0·05 | 0·02 | . | ... | ... | 0·13 | ... | .. | ... | ... | ... | 0·03 | 0·09 | 0·15 | 0·04 | 0·06 | 0·08 | 0·36 | ... | 0·01 | ... |
| September.. | 0·01 | ... | 0·03 | .. | ... | ... | ... | ... | 0·06 | 0·02 | 1·05 | 0·05 | 0·16 | 0·02 | .. | 0·20 | 1·54 | 0·33 | 0·81 | 0·73 | 0·99 | 0·01 | 0·46 | 0·01 | ... | 1·20 | 1·71 | ... | ... | ... | ... | .. | 1·04 |
| October ... | ... | ... | ... | .. | 0·08 | .. | ... | 0·05 | ... | ... | ... | ... | .. | 0·23 | 0·12 | 0·03 | ... | 0·04 | 0·12 | 0·09 | ... | 0·06 | ... | ... | 0·13 | 0·02 | 0·18 | 0·07 | 0·59 | 0·83 | ... | ... | ... |
| November ... | 0·66 | 3·33 | 1·48 | 1·16 | 0·10 | 0·15 | ... | 0·51 | 1·87 | 0·54 | 0·19 | 2·94 | 0·17 | 1·68 | 0·35 | ... | .. | .. | ... | 0·30 | .. | 0·38 | 0·38 | 0·09 | 0·06 | 0·43 | ... | 0·19 | ... | 0·26 | 0·70 | 3·36 | 0·01 |
| December ... | 0·12 | ... | ... | 0·08 | 0·17 | 0·04 | ... | ... | ... | ... | . | ... | ... | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... | ... | ... |
| Annual .. | 0·86 | 5·37 | 5·34 | 2·09 | 2·55 | 1·38 | 0·09 | 0·94 | 1·79 | 0·94 | 1·24 | 3·57 | 0·42 | 2·46 | 0·55 | 0·69 | 1·66 | 1·17 | 1·07 | 1·70 | 1·12 | 0·51 | 2·29 | 1·91 | 1·41 | 2·01 | 2·55 | 0·38 | 0·77 | 2·46 | 0·87 | 3·40 | 1·05 |

# APPENDIX XI.

MADRAS OBSERVATORY—Wind, cloud and bright sunshine, 1915.

| Month. | Wind resultant. | | Clouds (0—10). | | | | | Bright sunshine. | |
|---|---|---|---|---|---|---|---|---|---|
| | Velocity. | Direction. | 8 H. | 10 H. | 16 H. | 20 H. | Mean. | Average per day. | Greatest number of hours in a day. |
| | MILES. | POINTS. | | | | | | HOURS. | HOURS. |
| January ... ... | 128 | N.E. | 5·5 | 5·5 | 4·9 | 4·6 | 5·2 | 6·4 | 9·0 |
| February ... ... | 99 | E.N.E. | 2·4 | 3·7 | 3·3 | 2·3 | 2·9 | 8·2 | 10·4 |
| March ... ... | 104 | E.S.E. | 2·6 | 3·0 | 1·4 | 1·6 | 2·2 | 8·9 | 10·7 |
| April ... ... | 148 | S.E. by S. | 2·3 | 2·6 | 0·8 | 0·7 | 1·6 | 10·2 | 11·3 |
| May ... ... | 103 | S.S.E. | 3·1 | 2·6 | 3·1 | 2·6 | 2·9 | 8·1 | 10·2 |
| June ... ... | 122 | S. by W. | 5·0 | 4·6 | 4·7 | 5·6 | 5·0 | 5·1 | 8·3 |
| July .. ... | 103 | S.W. by W. | 6·2 | 5·7 | 6·0 | 6·7 | 6·2 | 4·3 | 9·4 |
| August ... ... | 71 | S.W. by W. | 5·4 | 4·9 | 6·6 | 5·4 | 5·6 | 5·5 | 9·8 |
| September ... ... | 93 | South. | 6·3 | 6·2 | 6·0 | 5·7 | 6·1 | 5·4 | 10·3 |
| October ... ... | 23 | South. | 4·3 | 5·2 | 5·1 | 4·1 | 4·7 | 7·1 | 10·6 |
| November ... ... | 56 | N.E. by N. | 5·7 | 6·6 | 6·0 | 5·4 | 5·9 | 4·8 | 9·8 |
| December ... ... | 158 | N.N.E. | 3·8 | 3·9 | 3·7 | 3·1 | 3·6 | 6·6 | 8·9 |
| Annual ... | 43 | S.E. by S. | 4·4 | 4·5 | 4·3 | 4·0 | 4·3 | 6·7 | ... |

# APPENDIX XII.

## MEAN Monthly and Annual Meteorological Results at the Madras Observatory in 1915.

| Month. | Barometer. | | Dry Bulb Thermometer. | | | | Wet Bulb. | | Tension of Vapour. | Relative Humidity. | Sun Max in *Vac.* | Min. on Grass. | Wind. | | | Rain. | | Clear Sky. | Bright Sun-shine. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reduced to 32°. | Daily Range. | Mean. | Max. | Min. | Range. | Mean. | Min. | By Blanford's Tables. | | | | Daily Velocity. | Mean Direction. | | Amount. | Days. | | |
| | INCHES. | INCHES. | ° | ° | ° | ° | ° | ° | INCHES. | CENTS. | ° | ° | Miles. | Points. | | INCHES | No. | CENTS. | HOURS. |
| January ... .. | 30 021 | 0·102 | 76·3 | 84·1 | 69·9 | 14 2 | 71·9 | 68·8 | 0·722 | 80 | 146·5 | 69 3 | 145 | 4 | N.E | 9·61 | 8 | 48 | 197·7 |
| February ... ... | 29·959 | ·116 | 78·5 | 86·7 | 71·1 | 15·6 | 73 2 | 69·7 | ·744 | 77 | 149·7 | 68·2 | 118 | 7 | E. by N. | 0·30 | 1 | 71 | 230·3 |
| March ... ... | ·956 | ·127 | 81·8 | 90·3 | 74·2 | 16·1 | 76 5 | 73·4 | ·840 | 77 | 153·5 | 71·8 | 128 | 11 | S.E. by E | 0·24 | 2 | 78 | 276 3 |
| April ... ... | ·857 | ·125 | 84·7 | 93·5 | 77·5 | 16·0 | 78·9 | 76·3 | ·907 | 76 | 154·8 | 75 6 | 159 | 13 | S.E. by S. | 0 52 | 3 | 84 | 306·2 |
| May ... ... | ·705 | ·124 | 89 6 | 101·8 | 82 6 | 19·2 | 80 2 | 77·0 | ·902 | 65 | 153 2 | 81·3 | 190 | 16 | South. | 0·36 | 2 | 71 | 250·7 |
| June ... ... | ·680 | ·115 | 88·2 | 98·3 | 82·6 | 15·7 | 80 6 | 76·6 | ·893 | 67 | 146·6 | 81·4 | 193 | 17 | S. by W. | 1·31 | 8 | 50 | 153·9 |
| July ... ... | ·722 | ·111 | 84·7 | 94·2 | 78·7 | 15·5 | 78·0 | 74·8 | ·869 | 74 | 144·2 | 77 4 | 171 | 19 | S.W. by S. | 8·80 | 11 | 38 | 131·9 |
| August ... ... | ·733 | ·117 | 85·4 | 95·5 | 79·1 | 16·4 | 78·3 | 75·3 | ·870 | 72 | 148·5 | 77·7 | 151 | 18 | S S.W. | 1·20 | 11 | 44 | 169·2 |
| September ... ... | ·750 | ·137 | 83·8 | 92 9 | 77·4 | 15·5 | 77·8 | 74·6 | ·868 | 76 | 150·9 | 76·1 | 133 | 15 | S. by E. | 10·43 | 14 | 39 | 161·1 |
| October ... ... | ·741 | ·128 | 83·5 | 91·9 | 77·0 | 14·9 | 78 0 | 75·4 | ·885 | 78 | 152·5 | 74·8 | 107 | 15 | S. by E. | 2·64 | 10 | 53 | 219·5 |
| November ... ... | ·851 | ·115 | 79·1 | 86·0 | 74·0 | 12·0 | 75·5 | 72·8 | ·834 | 85 | 138 6 | 72·4 | 117 | 4 | N.E | 20·79 | 18 | 41 | 142 8 |
| December ... ... | 988 | ·108 | 76·3 | 84·4 | 69·9 | 14·5 | 70·4 | 67·4 | ·663 | 74 | 145·4 | 67 0 | 169 | 2 | N.N E. | 0·41 | 4 | 64 | 205·3 |
| Annual ... | 29·834 | 0·119 | 82·7 | 91·6 | 76·2 | 15·4 | 76·6 | 73·5 | 0 833 | 75 | 148·7 | 74·4 | 148 | 12 | S.E. | 56·61 | 92 | 57 | 2,444 9 |

## EXTREME Monthly Meteorological Records at the Madras Observatory in 1915.

| 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 ... | **30·140** | **18** | 29·891 | 29 | 0·249 | 86·7 | 11 | 65 9 | 9, 18 | 65·1 | 8 | 54 | 8 | 153·2 | 14 | 62 5 | 8, 19 | 215 | 14, 15 | 59 | 28 | **6 69** | **15** |
| February ... | ·073 | 16 | ·843 | 5 | 230 | 90·5 | 5 | 66·3 | 10 | 65·5 | 10 | 52 | 6, 25 | 156 8 | 15 | 63 3 | 10 | 185 | 23 | 75 | 20 | 0·30 | 27 |
| March ... | ·127 | 8 | ·766 | 27 | 361 | 97·4 | 26 | 68·8 | 11 | 68·2 | 11, 12 | 51 | 15 | 160·5 | 21 | 65·4 | 11 | 207 | 27 | 68 | 3 | 0·23 | 3 |
| April ... | 29·993 | 8 | ·710 | 18 | ·283 | 99·8 | 2 | 73·2 | 8 | 72·5 | 8 | 47 | 2 | 163·7 | 16 | 70·4 | 8 | 210 | 3 | 107 | 27 | 0·43 | 29 |
| May ... | ·871 | 26 | **·498** | **9** | ·373 | **107·3** | **12, 20, 21, 23** | 77·4 | 5 | 72·9 | 11 | **23** | **21** | 158·4 | 21 | 76·1 | 5 | 257 | 25 | 93 | 4 | 0·34 | 13 |
| June ... | ·805 | 29 | ·525 | 20 | ·280 | 106·3 | 1 | 76 8 | 24 | 73·2 | 28 | 32 | 20 | 159·6 | 29 | 74·6 | 24 | 263 | 4 | 88 | 22 | 0·58 | 21 |
| July ... | ·863 | 11 | ·540 | 21 | ·323 | 105·8 | 3 | 70·6 | 15 | 70 6 | 15 | 33 | 3 | 155·2 | 3 | 70·8 | 15 | 264 | 3 | 71 | 19 | 3·26 | 15 |
| August ... | ·862 | 12 | ·598 | 1 | ·264 | 100 0 | 22 | 73·7 | 31 | 72 7 | 31 | 43 | 18 | **165·7** | **23** | 72 5 | 31 | 201 | 3 | 80 | 31 | 0·37 | 28 |
| September ... | ·904 | 2 | ·521 | 9 | ·383 | 101·3 | 10 | 74·8 | 17 | 71·4 | 9 | 39 | 10 | 163·5 | 13 | 71 6 | 17 | 224 | 10 | 67 | 23 | 4 15 | 17 |
| October ... | ·912 | 30 | ·638 | 10 | ·274 | 97·7 | 17 | 71·4 | 11 | 71·4 | 11 | 49 | 31 | 161·1 | 18 | 71·4 | 11 | 174 | 28 | 61 | 10 | 1·42 | 11 |
| November ... | 30·024 | 30 | ·554 | 5 | **·470** | 92·7 | 1 | 71·4 | 5, 14 | 69 7 | 5 | 54 | 1 | 156·4 | 18 | 68·1 | 20 | **314** | **21** | **51** | **24** | 3·18 | 21 |
| December ... | ·108 | 11 | ·862 | 6 | ·246 | 86·5 | 16 | **63·8** | **5** | **62·0** | **5** | 46 | 12 | 153·3 | 13 | **60·5** | **5** | 301 | 20 | 80 | 31 | 0·15 | 25 |