

Report on the Madras Observatory for the year 1898-99.

1. *Staff*.—The only change in the staff during the year was caused by the resignation of Mr. Sambasiva Pathar, 6th assistant. His place was taken by Mr. Nagaraja Aiyar.

2. *Buildings and Instruments*.—The buildings and instruments were maintained in good order during the year. The "Shepherd" mean-time clock and the "Shelton" sidereal-time clock were cleaned, and the latter was fitted with an attachment for making electrical contacts every second.

Milne's Seismograph, for recording photographically distant earthquakes, was brought into regular use in May, and except from June 4 to August 11 (when the Government Astronomer was absent from Madras), has been in constant operation. The following is a list of the shocks recorded. The time given is the Greenwich mean time, reckoned from midnight, of the beginning of each shock :—

	1898	H.	M.	S.		
May	21	17	20	01	Slight.	Recorded also at Shide by Prof. Milne.
"	19	54	00		Do.	Do.
August	31	20	12	25	Well marked.	Do.
September	9	3	43	38	Slight.	
	13	17	34	25	Very slight.	
	22	12	34	43	Do.	
	25	12	24	13	Do.	
October	1	3	27	49	Do.	
	11	17	02	36	Do.	
	15	3	50	19	Moderate	Felt in N. India and recorded at Shide.
November	12	9	47	01	Very slight.	
	30	12	32	30	Do.	
December	1	12	45	14	Moderate.	Recorded at Shide.
	15	12	00	31	Very slight.	
	21	13	51	31	Do.	
	1899					
January	23	2	04	25	Slight.	
"	17	48	19		Moderate.	
February	5	14	08	29	Large.	
	16	41	05		Do.	
	6	18	32	36	Moderate.	
	20	42	15		Do.	
	7	4	53	29	Do.	
	20	28	27		Large.	
	8	0	50	01	Moderate.	
	10	13	36	28	Do.	
March	17	{ 6 to 11	{ 9 to 9		Many small movements.	

The instrument, though on the whole working well, has given a great deal of trouble and it is intended to move it to Kodaikanal as soon as the buildings there are ready for it. It is anticipated that it will be much easier to work it there than in Madras, since a good rock foundation can be obtained at Kodaikanal instead of the clay foundation in Madras, while photographic difficulties will be much decreased. Prof. Milne approves of the proposed removal of the instrument.

3. *Time Service.*—The time service was maintained as in former years. The time-gun at Fort St. George failed on 14 occasions out of 910 giving a percentage of success of 98·5. The semaphore at the Port Office failed at 1 P.M. on five days, but on three of these it was dropped correctly at 2 P.M. The semaphore was temporarily replaced by a time ball on January 24, 1899. The 4 P.M. signal was received at the Central Telegraph office on every day except one. The number of failures is somewhat larger than usual, but on only two occasions, so far as could be ascertained, did the fault lie at the Observatory. The following table shows all the failures and their causes so far as these could be ascertained :—

Month and date	Signal	Fault	Cause
1898 January 11 . .	Semaphore	Failed 1 P.M., dropped 2 P.M. .	Unknown.
" " 12 . .	Do.	Failed both at 1 and 2 P.M. .	Do.
" " 22 . .	8 P.M. gun	Failed	Bad tube.
" February 2 . .	Semaphore	Failed both at 1 and 2 P.M. .	Unknown.
" May 25 . .	Noon gun	Failed	Tube failed.
" June 12 . .	8 P.M. gun	Do.	Do.
" " 24 . .	Noon gun	Do.	Do.
" August 14 . .	Do.	Do.	Tube broke.
" October 6 . .	8 P.M. gun	Fired about 25" late. . .	Gunner at fault.
" " 7 . .	Do.	Do. 4" late. . .	Do.
" " 14 . .	Do.	Do. 2" late. . .	Do.
" " 16 . .	Do.	Do. 2½" late . . .	Do.
" " 23 . .	Noon gun	Failed	Gunner late.
" " 25 . .	Do.	Do.	Bad tube.
" November 5 . .	8 P.M. gun	Do.	Tube failed.
" December 12 . .	Semaphore	Failed at 1 P.M., but dropped at 2 P.M. .	Apparently bad contact.
1899 January 1 . .	Do.	Do. do. . . .	Unknown.
" " 19 . .	8 P.M. gun	Failed	Tube failed.
" February 23 . .	Noon gun	Do.	Bad contact in the clock.
" " " . .	Semaphore	Failed 1 P.M., dropped 2 P.M. .	Do. do.
" March 26 . .	4 P.M. roll	Failed	Unknown. Apparently bad connection at Telegraph office.

4. *Observations and Reductions.*—The observations for the determination of time were carried on as usual. Four hundred and sixty-three observations of time stars, 84 of azimuth stars, and 107 determination of level and collimation were made during the year.

Observations of the November meteors (Leonids) were made by the Government Astronomer, and Mr. K. V. Siva Ramiah on 4 nights in accordance with the plan of international observations issued by the Harvard College observatory. The results of these observations were forwarded to Prof. E. C. Pickering, and will be published along with the observations made elsewhere. Observations were also made of stars occulted by the moon during the total eclipse of

December 27, in compliance with a request made by Dr. O. Backlund of the Pulkowa Sternwarte. The observations were partly interrupted by clouds and by the unfavourable position of the moon which towards the end of totality got behind the anemometer staging. The observations were communicated to Dr. Backlund. The preparation of the *New Madras Star Catalogue* made considerable progress. The press manuscript was completed in August and by the close of the year the first 20 hours were printed off.

5. *Library*.—During the year 240 books and pamphlets were presented to the library.

6. *Kodaikanal Observatory*.—As mentioned in last Report the Government of India requested the Astronomer Royal, and Sir Norman Lockyer to report on the various Indian observatories. The former after visiting Kodaikanal approved generally of the plans for the observatory there and made some suggestions for minor alterations which were at once adopted. Sir Norman Lockyer, on the other hand, without visiting the place objected entirely to the plans, and on his return to England represented to the Secretary of State for India that the buildings were “too costly and too permanent” and generally were badly designed and unsuited for their purpose. He went on to point out that “the South Kensington Solar Physics Observatory thus equipped with temporary structures is the most powerful in the world. It does more and better work than the similar institution at Potsdam where the buildings cost £250,000,” and urged that the new buildings at Kodaikanal should be like those at South Kensington “shanties” built of wood and canvas. As a consequence, the Secretary of State telegraphed out that the work on the observatory was to be stopped till the reports of the Astronomer Royal, and Sir Norman Lockyer had been duly considered.

To any one acquainted with the climatic conditions existing at Kodaikanal the proposal to house valuable instruments in such “shanties,” as Sir Norman Lockyer recommended seems as strange as his estimate of the relative value of the work done at South Kensington and Potsdam, and the Government Astronomer protested strongly against his proposals.* Whether or not this protest was forwarded to the Indian Observatories Committee is not known, but the result of the deliberation of the committee was that no reference whatever was made to the buildings and after a delay extending from the beginning of June to the end of October the buildings were allowed to go on according to the designs which had been so strongly condemned. The stopping of the work for so long naturally led to further delay, for not only was the favourable season for building lost and the staff of workmen dispersed, but the Assistant Engineer in charge of the work was given the superintendence of other works in Madura which necessitate his frequent absence from Kodaikanal and the consequent delay of the work there. Hence the buildings which would have been finished before the end of the year are still far from completion.

As it was necessary that the books and instruments which had to be transferred from Madras should be sent up the ghaut in the dry weather, packing was begun in December, and by the end of March most of the cases—more than 1,000 coolie loads—had reached Kodaikanal. All the cases of books were received before the rain began, and on the whole the removal has been effected with remarkably little damage, considering the difficulties that had to be overcome. The Government Astronomer took up his residence in Kodaikanal towards the end of February as it was necessary for him to be there to advise the Assistant Engineer in charge of the buildings regarding details of the work and to take charge of the instruments on their arrival.

* Since this was written, the roofs of two of the out houses, though well fixed, have been blown off. The corrugated iron being in parts torn off as if it had been little stronger than card board.

7. *Meteorological.*—The meteorological registers were maintained as in former years. A Richard wet and dry bulb thermograph was set up in January, 1898, and was maintained in use throughout the year. Special observations of the motion of the upper clouds were continued three times a day, and daily observations were made with the evaporimeter described in last report. The chief features of the meteorology of the year 1898 are shown in the appended tables and diagram. They may be summarised as follows :—

Pressure—was above average in January and August and below it during the other months. The highest mean daily pressure recorded was 30·143 on January 29, the lowest 29·484 on July 25.

Temperature—was below average in January, March, September, and October, it was normal in November, and above average during the other months. The highest shade temperature recorded was 109°·8 on May 9, the lowest was 59°·8 on February 3.

Humidity—was below average in February and above it in all other months. The driest day of the year was May 12 with a mean humidity of only 27 per cent.

Rainfall—was below average in January and from March to July and above average in the other months. The excess for the whole year was 19·12 inches. The rainfall, during the period, 15th October to 31st December, was 43 inches against an average of 26 inches, and a fall last year of only 9½ inches. The greatest fall on one day was 5·65 inches on December 26.

Wind.—The wind direction was nearly normal from January to October, but in November it was 3 points and in December 2 points more easterly than the normal. The air movement was below normal throughout the year, the defect being large in March, May, July, September, October, and December. This weakness of the wind is probably partly only apparent and is due to the sheltering effect of the trees in the region surrounding the Observatory—an effect which seems to be slowly increasing.

Cloud and Sunshine.—The percentage of cloudy sky was less than normal in January, March, May, October, and December; it was normal in June and above normal in the remaining months. There were 2,464 hours of bright sunshine during the year out of a total possible of 4,380 hours.

Storms.—The centre of a small cyclone passed a little to the south of Madras on November 6, but no damage was done by it in Madras.

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Appendix I.

*Abstract of the Mean Meteorological Condition of Madras in the year 1898,
compared with the average of past years.*

Mean values of	1898	Difference from	Average
Reduced atmospheric pressure . . .	29'849	0'018 below	29'867
Temperature of air	81'4	0'3 above	81'1
Do. of evaporation	75'4	0'9 do.	74'5
Percentage of humidity	75	3 do.	72
Greatest solar heat in <i>vacuo</i>	147'0	7'3 do.	139'7
Maximum in shade	91'0	0'2 do.	90'8
Minimum in shade	74'3	0'4 below	74'7
Do. on grass	72'4	0'5 above	71'9
Rainfall since January 1st on 102 days .	68'14	19'12 do.	49'02
General direction of wind	S.E.	Same as	S.E.
Daily velocity in miles	151	20 below	171
Percentage of clear sky	52	1 above	51
Do. of bright sunshine	56'3	4'8 below	61'1

Duration and Quantity of Wind from different points.

From	Hours	Miles	From	Hours	Miles	From	Hours	Miles	From	Hours	Miles
North.	88	6,13	East.	226	1,199	South.	162	1,133	West.	259	2,121
N. by E.	162	1,102	E. by S.	366	1,896	S. by W.	224	1,379	W. by N.	268	2,453
N.N.E.	370	2,396	E.S.E.	337	1,721	S.S.W.	232	1,419	W.N.W.	144	1,166
N.E. by N.	486	3,361	S.E. by E.	464	2,887	S.W. by S.	253	1,348	N.W. by W.	72	490
N.E.	391	2,311	S.E.	389	2,636	S.W.	140	793	N.W.	37	260
N.E. by E.	449	2,630	S.E. by S.	879	6,924	S. W. by W.	184	1,002	N.W. by N.	46	229
E.N.E.	281	1,762	S.S.E.	374	2,780	W.S.W.	221	1,370	N.N.W.	49	235
E. by N.	281	1,610	S. by E.	261	1,645	W. by S.	302	2,186	N. by W.	66	264

There were two hundred and ninety-seven calm hours during the year. The resultant corresponding to the above numbers is a S.E. by S. wind, blowing with a uniform daily velocity of 39 miles.

Appendix II.

Mean Monthly and Annual Meteorological Results at the Madras Observatory in 1898.

	BAROMETER		DRY BULB THERMOMETER				WET BULB	TENSION RELATIVE OF 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	By Blanford's Tables	Points			Mean Direction	Amount	Days				
															Inches			Cents
January	. . .	30.019	. . .	74.6	84.1	65.5	18.6	. . .	69.4	144.3	62.0	139	4	NE	. . .	. . .	73	262.3
February	. . .	29.909	. . .	76.8	86.6	66.7	19.9	.673	70.6	147.7	64.1	119	8	E	0.49	1	69	239.3
March	. . .	.893	. . .	79.4	89.9	69.1	20.8	.758	73.6	150.0	66.5	127	12	SE	. . .	. . .	90	293.1
April	. . .	.806	. . .	84.5	92.9	77.7	15.2	.921	79.0	157.5	76.1	178	13	SE by S	. . .	. . .	65	254.8
May	. . .	.726	. . .	88.2	100.0	81.4	18.6	.897	79.6	157.7	80.3	194	15	S by E	0.65	1	72	280.4
June	. . .	.689	. . .	87.1	98.9	80.9	18.0	.819	77.6	149.5	79.7	206	19	SW by S	2.09	5	36	149.5
July	. . .	.681	. . .	85.5	97.4	78.9	18.5	.825	77.2	145.6	77.4	170	21	SW by W	3.41	15	22	118.5
August	. . .	.756	. . .	84.1	94.9	77.5	17.4	.829	76.8	147.3	76.1	164	18	SSW	7.14	15	32	177.7
September	. . .	.775	. . .	82.1	91.1	76.0	15.1	.873	77.3	147.0	74.8	118	18	SSW	8.20	20	35	165.8
October	. . .	.838	. . .	80.3	88.0	74.6	13.4	.887	77.1	140.2	73.4	97	8	E	17.91	19	43	168.0
November	. . .	.882	. . .	77.5	83.8	72.9	10.9	.806	74.3	137.5	70.6	146	5	NE by E	20.13	16	38	139.8
December	. . .	.967	. . .	77.0	84.0	70.8	13.2	.745	72.6	139.9	67.7	158	4	NE	8.12	10	53	215.0
Annual	. . .	29.828	. . .	81.4	91.0	74.3	16.6	0.807	75.4	147.0	72.4	151	12	SE	68.14	102	52	2464.2

Appendix III.

Extreme Monthly Meteorological Records at the Madras Observatory in 1898.

	BAROMETER				DRY BULB THERMOMETER				HUMIDITY		SUN TH IN VACUO		GRASS THERM.		WIND				RAIN			
	Highest		Lowest		Range		Highest		Lowest		Lowest		Highest		Lowest		Highest		Lowest		Greatest Fall	
	Inches.	Day.	Inches.	Day.	Inches.	Day.	Inches.	Day.	°	Day.	°	Day.	°	Day.	°	Day.	Miles.	Day.	Miles.	Day.	Inches	Day.
January	30.143	29	29.899	31	0.244	86.3	30	59.9	21	46	20	149.1	22	55.9	18	301	11	48	17	...	...	
February	.094	28	.661	19	.432	96.0	19	59.8	3	30	19	156.3	23	56.2	3	203	10	67	3	0.49	11	
March	.051	7	.736	21	.315	96.5	14	62.9	12	42	15	156.1	30	60.4	12	190	21	75	10	...	...	
April	.013	14	.649	26	.364	97.8	26	72.3	4	50	4	164.5	30	70.1	4	233	11	117	14	...	...	
May	29.866	23	.529	6	.337	109.8	9	72.4	31	27	12	165.1	18	73.2	31	295	30	125	28	0.65	31	
June	.815	1	.528	14	.287	104.2	7	71.3	3	32	16	166.5	5	72.3	3	276	5	138	12	1.13	3	
July	.808	15	.484	25	.324	104.2	2	72.3	20	34	30	159.9	23	70.0	20	235	6	93	18	0.89	18	
August	.901	27	.597	1	.304	100.8	1	72.0	17	41	10	155.6	30	71.2	17	214	6	118	17	1.92	19	
September	.940	28	.625	11 & 12	.315	96.1	15	73.0	21	53	14	160.3	30	72.0	21	202	14	68	22	3.21	21	
October	.977	22	.639	11	.338	95.2	17	70.4	19	47	17	157.0	7	66.4	19	175	11	48	8	5.01	30	
November	30.050	28	.600	6	.450	87.1	12	66.6	18	53	19	153.5	13	62.4	18	301	5	52	8	3.25	5	
December	.068	16	.852	25	.216	85.6	12 & 15	67.1	3	58	6 & 19	147.4	23	63.9	6	264	25	87	31	5.65	26	

Appendix IV.

Abnormals for 1898.

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Barometer	+0'019	-0'059	-0'015	-0'022	-0'012	-0'016	-0'043	+0'005	-0'005	-0'007	-0'045	-0'014	-0'018
Temperature of air	-0'5	+0'1	-0'6	+0'5	+1'5	+0'7	+1'0	+0'8	-0'9	-0'3	Same as	+1'5	+0'3
Do. evaporation	+0'2	-0'2	-0'3	+1'4	+1'3	+1'0	+1'3	+0'8	+1'0	+1'5	+1'4	+2'0	+0'9
Percentage of humidity	+3	-1	+1	+4	+1	+2	+3	+1	+8	+8	+6	+3	+3
Greatest solar heat in vacuo	+5'9	+8'0	+9'5	+15'8	+14'7	+9'0	+6'9	+7'3	+5'7	+1'1	+0'1	+4'1	+7'3
Maximum in shade	-0'5	Same as	+0'7	Same as	+2'2	+0'6	+1'8	+1'2	-2'1	-1'0	-1'2	+0'4	+0'2
Minimum do.	-2'0	-1'3	-3'0	+0'5	+0'6	+0'6	+0'4	+0'2	-1'1	-0'6	+0'6	+1'0	-0'4
Do. on grass	-1'1	+0'3	-2'1	+1'4	+1'4	+1'1	+0'8	+0'7	-0'2	+0'6	+1'1	+1'3	+0'5
Rainfall in inches	-0'89	+0'21	-0'39	-0'62	-1'47	-0'02	-0'46	+2'58	+3'51	+6'91	+6'92	+2'84	...
Do. since January 1st	...	-0'68	-1'07	-1'69	-3'16	-3'18	-3'64	-1'06	+2'45	+9'36	+16'28	+19'12	+19'12
General direction of wind	1 point N	Same as	Same as	Same as	Same as	Same as	1 point W	1 point S	Same as	1 point E	3 points E	2 points E	Same as
Daily velocity in miles	-5	-3	-2'5	-13	-33	-14	-28	-10	-38	-26	-19	-25	-20
Percentage of clear sky	+10	-7	+14	-7	+10	Same as	-7	-1	-3	+2	-3	+5	+1
Do. bright sunshine	-1'5	-11'4	-2'4	-8'2	+2'3	-13'5	-2'8	+4'3	+1'0	-9'5	-14'7	-2'3	-4'8

+ Above normal. -- Below normal.

Madras Observatory Meteorological Observations-Abnormals for Monthly Means.

