REPORT* OF THE KODAIKANAL OBSERVATORY FOR THE YEAR 1939

The year 1939 has witnessed a further fall in solar activity, except in regard to the mean daily number of sunspots which remained the same as in the previous year.

The collection of spectroheliograms from other observatories for those days on which complete records could not be obtained at Kodaikanal was continued as part of the programme of the International Astronomical Union. As, however, photographs from other observatories will not be available until a considerable time after the end of the year, the data of solar activity given in this report are based on Kodaikanal photographs only.

During the year under review, 11 original photoheliograms were supplied to the Greenwich Observatory, 314 original calcium disc spectroheliograms to the Cambridge Solar Observatory and positives of 14 photoheliograms, of 47 Hα disc plates and of 9 K flocculus plates to the Meudon Observatory.

Daily character figures of solar activity according to Hα bright flocculi and Hα dark markings for 1939 were communicated to the Observatôire Fédéral, Zürich, for inclusion in the Bulletin of Character Figures. Daily character figures as derived from calcium flocculi from Kodaikanal photographs are communicated for publication by the Solar Physics Observatory, Cambridge, combined with their own.

2. *Observing Conditions.*—Observing conditions were slightly more favourable for solar observations than during the previous year. The mean value of the definition in the north dome before 10 A.M. was only 1·8 on a scale in which 1 is the worst and 5 the best, as against 2·0 during 1938, but there were 17 days on which the definition was estimated to be 4 or above, as against 10 during the previous year.

3. *Photoheliograph.*—Photographs of the sun on a scale of 8 inches to the sun's diameter were taken on 330 days using 6-inch achromatic object glass and a green colour screen.

4. *Spectroheliographs.*—Photographs of the monochromatic image of the sun's disc in K light were obtained on 317 days, prominence plates in K light on 305 days and Hα disc plates on 284 days. A total of 2587 spectroheliograms were taken during the year.

5. *Six-inch Cooke Equatorial and Spectroscope.*—Work with this instrument was continued on the same lines as in previous years for the visual observations of solar phenomena, which cannot be readily photographed.

6. *Spectrohelioscope.*—Observations with the Hale spectrohelioscope were made on all days of favourable weather except Sundays and holidays, special attention being given to bright chromospheric eruptions. A list of these eruptions together with times when the sun was under observation

* This report deals chiefly with the astronomical work of the Kodaikanal Observatory. The Meteorological data will be published in the "India Weather Review" and administrative details will be incorporated in the annual report of the India Meteorological Department.

was sent quarterly to the Meudon Observatory, Paris, for inclusion in the Bulletin of Character Figures. The displacements observed in the prominences and in Hα dark and bright flocculi are summarised in the half-yearly bulletins of this observatory.

7. *Research Work.*—The bright solar eruption of March 3, 1939 was studied by Messrs. M. Salaruddin and C. K. Ananthasubrahmanyam and a paper on it was published in the July number of the Proceedings of the Indian Academy of Sciences, Bangalore.

Messrs. M. Salaruddin and B. G. Narayan made a detailed study of the unusual solar activity during August and September 1939. A preliminary note on it was sent to the " Observatory " for publication and a paper giving full details was published in the December number of the Indian Journal of Physics, Calcutta.

The Director, Mr. M. Salaruddin and Mr. C. K. Ananthasubrahmanyam were engaged in a microphotometric study of the strong Fraunhofer lines in the region of the Magnesium b group and the infra-red triplet of oxygen at λ7774 and preliminary results were obtained for λ5183·62 (1^3P_2—1^3S_1) as given below.

TABLE 1.

Distance from the centre of the sun's disc .	0	·36	·55	·70	·96	·98
Central intensity as percentage of continuous spectrum.	15·5	18·7	19·0	18·9	20·6	26·5
Equivalent width in Å	1·46	1·45	1·40	1·42	1·34	1·17
Total No. of atoms above 1 sq. cm. of photosphere (N.H.f.) × 10^{-16}	4·91	4·85	4·52	4·65	4·14	3·21

TABLE 2.

	Equivalent width.
Centre of the sun's disc	1·43 Å
Equatorial limb	1·17 Å
Polar limb	1·19 Å

Dr. A. K. Das and Mr. B. G. Narayan completed their study of prominence areas to determine the possible influence of the earth on solar prominences. A paper on the results of this work has been prepared for publication.

A theoretical investigation on the mechanism of formation of solar dark markings was undertaken by Dr. A. K. Das and a paper is under preparation.

Mr. P. R. Chidambara Iyer made a re-examination of the relative variations in the extents of bases and in the heights of prominences accompanying variations in their areas, with the additional material available from 1928 to 1938 and he has prepared a paper on " The Evolution of Prominence Phenomena on the Sun ".

Mr. M. Salaruddin has been making a statistical study of the short-lived hydrogen absorption markings.

Mr. B. G. Narayan has made a statistical study of the Doppler displacements on the disc and limb of the sun.

Mr. M. Salaruddin submitted to the Andhra University a thesis on "The First Spark Spectrum of Bromine and the Hyperfine Structure of some Complex lines" and he was awarded the M.Sc. degree for it by the University.

Instruments.—The Director has designed, built and fitted up an amplifier to the photoelectric microphotometer at the observatory. The electrical system is the familiar single tube circuit. The valve used is of type 2 A 6, a Duplex diode High Mu Triode with a high transconductance.

9. *Sunspots.*—In the following table are given the monthly numbers of new groups observed at Kodaikanal and their distribution between the northern and southern hemispheres. The mean daily numbers are also given.

1939.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
New Groups . .	30	27	32	33	35	29	19	26	29	22	25	22	329
North . . .	13	13	15	18	17	14	7	10	16	10	10	12	155
South . . .	17	14	17	14	18	15	12	16	13	12	15	10	173
Equator . . .	..	..	..	1	..	..	..	..	..	..	..	..	1
Mean daily numbers .	5·8	5·7	5·1	6·9	7·5	5·9	4·5	6·5	6·2	6·4	5·4	3·6	5·8

The number of new groups observed was only one more than during the previous year and the mean daily number remained the same. There were no days on which the sun's disc was free from spots. The approximate mean latitude of the spots was 14°·6 in the northern hemisphere and 13°·1 in the southern. Bright reversals of the Hα line over the sun's disc observed with the spectroscope in the neighbourhood of sunspots numbered 963 as against 872 in 1938. The displacements observed in the neighbourhood of sunspots numbered 64 while in the previous year they came to 65. Of these 34 were towards the red, 13 towards the violet and 17 both ways simultaneously. D_3 was observed as a dark line on 720 occasions as compared with 789 during the previous year.

10. *Prominences.*—The mean daily areas and numbers of calcium prominences as derived from Kodaikanal photographs were as follows :—

Areas.

——	North.	South.	Total.
1939 January to June	2·31	2·33	4·64 square minutes.
July to December	2·76	2·66	5·42 ,, ,,

Numbers.

	North.	South.	Total.
1939 January to June	6·35	6·20	12·55
July to December	7·62	7·04	14·66

There have been a decrease of 39 per cent in prominence areas and a decrease of 9 per cent in prominence numbers from the values of the previous year. The activity in the two hemispheres north and south is nearly equal in respect of both areas and numbers. The distribution of areas in latitude

showed the maximum activity confined to near latitude 30° in both the hemispheres. In the first half-year there was a peak of activity in the southern hemisphere near latitude 20°, which was obliterated by a greater increase of activity near 30° during the second half-year. The distribution of numbers is nearly uniform from the equator to latitude 50°.

There were 59 metallic prominences observed during 1939, as against 48 in the previous year. Of these, 22 were in the northern hemisphere and 37 in the southern, and all of them were observed from the equator to latitude 33°. Displacements of the hydrogen line in the chromosphere and prominences observed with the spectroscope numbered 451 as against 323 in 1938. Of these 238 were towards the red, 195 towards the violet and 18 both ways simultaneously. The largest displacement noticed was 9 Å to violet.

The displacements observed in prominences with the spectrohelioscope numbered 282 as against 187 in the previous year. Of these 140 were in the northern hemisphere and 142 in the southern, and 136 were on the east limb and 146 on the west limb. Displacements to the red numbered 154 and those to the violet 127 ; there was also one displacement which was seen both to red and violet simultaneously. The largest displcement in prominences observed in 1939 was 4·8Å to red.

Eruptive prominences on the limb were photographed on February 6, May 2 and 31, September 1 and December 16. The prominences of February 6 on the N. E. limb rose to a height of more than 10′. The prominence of September 1 on the S. E. limb showed the largest displacements of 9 Å to violet at top and 6 Å to red at base. It was connected with an active spot (Kodaikanal No. 7157). A prominence of very large extent was photographed on December 1. Its base extended from 36° N to 38°S on the west limb. Its height was only 80″ but the area it covered was nearly 10 square minutes. Other important phenomena noted during the period are the breaking up of Hα dark markings. Instances of breaking up of markings were observed on August 26 and September 2 and 12. The last of these was remarkable in as much as a big marking which was observed for a number of days completely disappeared with great suddenness leaving a bright marking in its place.

The mean daily areas of prominences projected on the disc as hydrogen absorption markings were 9735 millionths of the sun's visible hemisphere, as against 10161 in 1938. This means a 4 per cent decrease from the previous year. Their distribution in latitude is nearly similar to that of prominences at the limb, with the peaks very much pronounced. But in the second half of the year the peak near 20° has not subsided unlike the prominences but has moved towards the equator by 5°.

11. *Time* *.—The 16-hour signal issued by the Alipore Observatory, Calcutta, was received accurately on most days and all failures were reported to the Postmaster-General, Madras. In addition, wireless time signals were received from Colombo and Rugby during the year.

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* The error of the standard clock of this observatory is usually determined by reference to the 16-hour signal distributed from the Alipore Observatory, Calcutta. The reception of the signal at Kodaikanal is rendered possible by the courtesy of the Telegraph Department which permits the telegraph line to be joined through to this Observatory.

12. *Seismology.*—The Milne-Shaw seismograph recorded 193 earthquakes during the year. For details of records reference may be made to Quarterly Seismological Bulletins published by the India Meteorological Department.

13. *Publications.*—The annual report for the year 1938 and the following bulletins and articles were published during the year:—

1. Bulletin No. 115. Summary of Prominence Observations for the second half of the year 1937.
2. Bulletin No. 116. Summary of Prominence Observations for the first half of the year 1938.
3. The Bright Solar Eruption of March 3, 1939 by M. Salaruddin and C. K. Ananthasubrahmanyam—Proc. of the Indian Aca. of Sciences, July 1939.
4. A paper on " Unusual Solar Activity during August and September 1939 " by M. Salaruddin and B. G. Narayan—Indian Journal of Physics, December 1939.

KODAIKANAL ; A. L. NARAYAN,

The 7th February 1940. *Director, Kodaikanal Observatory.*

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