ANNUAL REPORT* OF THE KODAIKANAL OBSERVATORY FOR THE YEAR 1946.

1. *General.*—Dr. A. L. Narayan who was the Director of the observatory since 1937 went on leave preparatory to retirement in July 1946 and Dr. A. K. Das assumed charge as Director. Dr. R. Ananthakrishnan joined as Asst. Director in September.

With the resumption of communications after the war exchange of spectroheliograms with observatories in Europe and U.S.A. was recommenced 50 K and Hα flocculus plates for the year 1940 from the Meudon Observatory, France and 747 Hα flocculus and K prominence plates relating to the years 1940-44 from the Solar Physics Observatory, Mount Wilson, were received during the year. 434 K and Hα flocculus plates for the period 1940-42 were supplied to the Meudon Observatory, France, 141 K flocculus plates for the period October 1943 to March 1944 to the Solar Physics Observatory, Cambridge and 39 photoheliograms for the year 1941-42 to the Astronomer Royal, Greenwich Observatory.

2. *Instruments.*—The equipment of this observatory consists at present of the following principal instruments :—

1. Six-inch Cooke Equatoria with a grating spectroscope attached for observing prominences.
2. Six-inch Lerebour and Secretan Equatorial remounted by Grubb for direct solar photography. A six-inch astrographic camera is also mounted on the same equatorial.
3. Six-inch stellar telescope by T. Cooke and Sons, York.
4. Six-inch transit instrument and barrel chronograph made by the Cambridge Scientific Instruments Company.
5. Spectroheliograph made by the Cambridge Scientific Instruments Co., with an 18-inch Cooke siderostat and a 12-inch Cooke photo-visual lens of 20 ft. focal length, used for photographs in the K line.
6. An auxiliary spectroheliograph using a 6-inch Anderson grating designed and built in this observatory is attached to the above for taking spectroheliograms in the Hα line.
7. Hale spectrohelioscope together with a 5-inch coelostat kindly loaned by the Mount Wilson Observatory.
8. *Spectrograph I.*—with $3\frac{1}{2}$ prisms in Littrow mount and about 14 ft. focus, designed and built in this observatory. This is fed by a 12-inch siderostat in conjunction with an 8-inch lens.
9. *Spectrograph II*—10 ft. concave grating in Rowland mounting designed and built in this observatory. Sunlight can be admitted into this spectrograph by the 12-inch siderosta and 8-inch lens using auxiliary reflectors.

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

10. *Spectrograph III*—20-foot plane grating spectrograph in Littrow mount using a $6\frac{1}{4}$-inch Michelson grating, designed and built in this observatory. The spectrograph is so constructed that the grating can be quickly moved aside by turning a handle and a system of $3\frac{1}{2}$ prisms can be brought into use in its place.

11. *Spectrograph IV* :—Angular grating spectrograph with collimator lens of about 7 ft. focus and camera lens of about 14 ft. focus using a $3\frac{1}{4}$-inch Rowland plane grating, designed and built in this observatory.

    Sun light can be admitted into spectrographs III and IV either by the 18-inch siderostat or by a coelostat built for 12-inch mirrors but working temporarily with smaller mirrors until mirrors of appropriate size become available.

12. Hilger E 315 Quartz spectrograph.
13. 20″ Reflecting telescope by Grubb received from the Takhtasinghji Observatory at Poona in 1912. The instrument has not yet been mounted.
14. Cambridge photoelectric microphotometer.
15. Three Hilger comparators for measuring spectrograms.
16. Large Induction Coil capable of giving up to 16-inch sparks.
17. Large Dubois Electromagnet.
18. Small dividing engine by the Cambridge Scientific Instruments Co., Ltd.
19. Four mean time clocks : (*i*) Kulberg M.6326 (*ii*) Shelton (*iii*) Arnold and Dent (*iv*) W. Ottoway and Co.
20. One sidereal clock by T. Cooke & Sons, York.
21. Two chronometers : (*i*) Kulberg No. 6244 (*ii*) Frodsham No. 3476.
22. Two tape chronographs by Fuess.
23. Milne-Shaw seismograph (E-W component only).
24. A complete set of meteorological instruments.

3. *Routine observations.*—Weather conditions were generally less favourable than during the previous year, especially during the last two months of the year on account of the unusual activity of the northeast monsoon. The definition of the solar image before 11 hrs. I.S.T. estimated on a scale in which 1 is the worst and 5 the best, was 2 or less on 94 days and 4 or more on 52 days ; the mean value of the definition was 2·7.

The routine observations with the photoheliograph, the spectroheliograph, the prominence spectroscope and the spectrohelioscope were continued as in the previous year. The Hα spectroheliograph was

completely rebuilt in June—July so as to make it perfectly stable and easy of manipulation. As a result it became possible in spite of unusually bad weather conditions to obtain Hα disc photographs on 126 days during the second hal of the year as against the average figure of 99 for the corresponding period during the previous three years. The total number of Hα disc photographs obtained during the year was 275. Calcium flocculus plates were obtained on 270 days and calcium prominence plates on 258 days. Direct photographs of the sun on a scale of 8 inches to the sun's diameter were obtained on 292 days. Quarterly statements of chromospheric eruptions observed with the spectrohelioscope together with the times of observations were sent to Professor Brünner of Zürich.

4. *Sunspots.*—The marked increase in solar activity referred to in last year's report was maintained, and several big spot groups appeared during the year. The biggest and most active spot group observed during the last 75 years appeared in February. It had an overall area of about 30 times the surface area of the earth. Another big spot group of slightly smaller size appeared in July.

The number of spot groups observed during the different months of the year, their distribution in the two hemispheres, and the mean daily numbers are given in the table below :—

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Numbers of groups	16	24	23	20	26	21	26	16	25	40	38	22	292
North	9	12	7	3	14	9	14	11	14	20	14	9	136
South	7	12	16	17	12	12	12	5	11	20	19	13	156
Mean daily number	3·6	6·1	5·6	5·6	5·7	4·6	5·5	4·4	5·9	7·1	7·5	6·5	5·7

There were no days on which the sun's disc was free from spots as against 35 spot-free days of the previous year. Compared with 1945 there was an increase of 165% in the new spot groups and 185% in the mean daily number of sunspots. The approximate mean latitude of the spots for the whole year was 20°, as against 25° of the previous year. About 20% of the total number of new spots appeared in latitudes higher than 25°. Bright reversals of the Hα line were observed on 92 occasions, Displacements of the Hα line towards the violet were observed on 13 occasions and towards the red on 22 occasions near spot groups.

5. *Prominences.*—The mean daily areas and numbers of calcium prominences as derived from photographs taken at Kodaikanal on 258 days during the year are as follows :—

Areas.

	North.	South.	Total	
January to June	2·64	1·94	4·58	(Sq. minutes.)
July to December	1·61	1·54	3·15	(Do.)
		Numbers.		
January to June	5·17	4·70	9·87	
July to December	4·79	3·89	8·68	

Compared with the figures for the previous year, the areas show an increase in the first half of the year and decrease in the second half ; the numbers show a slight decrease. Both areas and numbers show a general preponderance in the northern hemisphere. The distribution of areas in latitude shows a maximum between 55° and 60° in the northern hemisphere and between 50° and 55° in the southern hemisphere. The numbers are maximum between 45° and 50° of latitude in both the hemispheres.

35 metallic prominences were observed with the prominence spectroscope, 24 in the northern and 11 in the southern hemisphere. Four of these appeared in the latitude zone 50° to 55° and the rest in lower latitudes.

Doppler displacements of the Hα line in prominences were observed on 171 occasions, 56 towards the red, 59 towards the violet and 56 both ways. The largest displacement of 8 A.U. towards the red was shown by a prominence on the southeast limb of the sun at latitude 52° on 1946 September 29.

Observations with the spectroheliosco̊pe showed Doppler displacements in prominences in 80 cases, 26 being towards red, 14 towards violet and 40 both ways. An eruptive arch-type prominence of height 6′ was photographed on the northwest limb of the sun at latitude 42° on 1946 December 20.

The mean daily area of hydrogen absorption markings (without foreshortening correction) was 4907 millionths of the sun's visible hemisphere—*i.e.* more than double the value for the previous year. The latitudinal distribution showed maxima between 35° and 40°N and 20° and 30°S.

6. *Research work*—A programme of experimental study of the motion of matter in sunspots was planned and work was begun with the H & K lines. Spot spectra in the H & K region were secured under good atmospheric conditions on several days with the help of Spectrograph I, the scale of the spectra in this region being 0·45 A°/mm. Some spectrograms were also secured for a study of the structures of the H & K lines over different parts of the sun's disc.

For studying the magnetic field of sunspots simultaneously with the motion of matter in sunspots and for general line-shift work, the construction of a combined plane grating and prism spectrograph (Spectrograph III) of high dispersion and resolving power and a 12-inch coelostat was taken up and practically completed.

A study of the variation of the effective temperature of the solar-disk along a radius with the help of the CH bands was begun. In order to photograph the CH bands on a large scale in the laboratory simultaneously with the solar CH bands a low-pressure arc in a chamber of about 14 litres capacity was constructed and some spectrograms of the CH bands in a carbon arc burning in an atmosphere of hydrogen were secured in the 3rd order of a concave grating (Spectrograph II).

A statistical study of the relation between the lengths and the heights of hydrogen dark markings was begun.

7. *Time.*—The standard clocks of the observatory were rated by comparison with Greenwich time signals.

8. *Seismology.*—The Milne-Shaw seismograph of this observatory recorded 128 earthquakes during the year. The details of the records are given in the Quarterly Seismological Bulletins published by the India Meteorological Department.

9. *Library.*—The library was completely rearranged and the proper indexing of the books and journals was taken on hand. 13 new books were added to the library during the year.

10. *Publications.*—Action was taken to bring up-to-date the routine publications of the observatory (Annual Reports and Bulletins) which had been suspended during the period of the war. The following notes and articles were published during the year :—

(*i*) " Sunspots " by A. L. Narayan. (Current Science).

(*ii*) " The Largest Sunspot Group of Modern Times " by A. L. Narayan. (Journal of Sc. and Ind. Research.)

(*iii*) " The Large Sunspot Group of July 1946 ". (Journal of Sc. and Ind. Research.)

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