ANNUAL REPORT* OF THE KODAIKANAL OBSERVATORY FOR THE YEAR 1950

1. *General.*—A noteworthy feature of the activities of this observatory during 1950 was that a number of constructional works pertaining to development projects were taken up and appreciable progress was made in the execution of these works. The construction of a dome for housing a moderate-sized stellar telescope (20-inch Grubb reflector) and of buildings for an Ionospheric Laboratory were nearly completed; the installation of the telescope was begun and the assembly and testing of a Multi-frequency Automatic Ionosphere Recorder Type C.R.P.L. Model C-3 received from the U.S.A. was taken up. Extensions to the library, the machine shop and the spectroheliograph buildings for providing much needed additional accommodation were also in progress.

2. *International co-operation.*—Exchange of spectroheliograms with foreign observatories was continued as in previous years. 264 calcium flocculus spectroheliograms obtained at Kodaikanal during the period October 1949—September 1950 were sent to the Solar Physics Observatory, Cambridge and 7 photoheliograms for certain specified days in 1947 and 1948 were supplied to the Royal Greenwich Observatory. 36 H-alpha flocculus photographs and 42 K_3 disc spectroheliograms relating to the second half of 1949 were obtained from Meudon Observatory, France; the Mt. Wilson Observatory, U.S.A. also sent 55 H-alpha flocculus and 60 K-prominence plates for the same half-year. Quarterly statements of solar flares observed at Kodaikanal were sent to Dr. L.d'Azambuja of Meudon Observatory and Mr. H. W. Newton of the Royal Greenwich Observatory.

Daily broadcasts of URSIGRAMMES through the All-India Met. Broad casting Centre, New Delhi and the practice of issuing warnings for ionospheric and geomagnetic disturbances, whenever expected, were continued.

In connection with a proposal to introduce a new index of solar activity in the form of length of H-alpha dark markings observed on spectroheliograms, the data for the first 3 months of 1949 were worked out and sent to Dr. L.d'Azambuja, President, Commission 11, International Astronomical Union for comparison with similar data worked out from photographs taken at Meudon. Because of lack of sufficient concordance between the measurements of Meudon and Kodaikanal for the period, the measurements were extended for the remaining months of 1949 for further comparison before the scheme is finalised.

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* 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.

3. *Instruments.*—The present instrumental equipment of this observatory can be broadly classified under the following heads :—

(*a*) *Astronomical and spectroscopic instruments*

1. Six-inch Cooke Equatorial with a grating spectroscope attached for observing prominences.

2. Six-inch Lerebours and Secretan Equatorial, reconstructed by Grubb for direct solar photography. A six-inch astropgraphic camera is also mounted on the same equatorial.

3. Six-inch stellar telescope by T. Cooke and Sons, York.

4. 20-inch Reflecting telescope by Grubb received from the Takhtasinhji Observatory at Poona in 1912.

5. Six-inch transit instrument and barrel chronograph made by the Cambridge Scientific Instrument Co.

6. 8-inch refracting telescope—to be mounted.

7. 4½-inch refractors—2 Nos. (one by Cooke and another by Grubb).

8. Spectroheliograph made by the Cambridge Scientific Instrument Co. with an 18-inch Cooke siderostat and a 12-inch Cooke photovisual lens of 21-ft. focal length, used for photographs in the K line.

9. 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 H-alpha line.

10. Hale Spectrohelioscope together with a six-inch Coelostat kindly loaned by the Mt. Wilson Observatory. A camera is attached to the instrument for photographing the spectra of solar flares, prominences etc. simultaneously with their visual observation.

11. Spectrograph I.—With 3½ prisms in Littrow mount and about 14 ft. focus, designed and built in this observatory. This is fed by a 12-inch Foucault siderostat in conjunction with an eight-inch lens.

12. Spectrograph II.—10 ft. concave grating in Rowland mounting designed and built in this observatory. A 12-inch polar siderostat designed and constructed in this observatory feeds this spectrograph independently. The polar siderostat is working temporarily with a 7-inch mirror until a mirror of appropriate size becomes available.

13. Spectrograph III.—20 ft. plane grating spectrograph in Littrow mount using a 6¼-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 3½ prisms can be brought into use in its place.

The spectrograph is fed by the 18-inch Foucault siderostat in conjunction with the 21-foot Cooke photovisual lens and an auxiliary mirror. Alternatively it can also be fed by a 12-inch coelostat, designed and built at this observatory in conjunction with a 40-ft. lens.

14. Spectrograph IV.—Angular grating spectrograph with collimator lens of about 7 ft. focus and camera lens of about 14 ft. focus using a 3¼-inch Rowland plane grating, designed and built in this observatory.

The spectrograph is fed by the 18-inch Foucault siderostat in conjunction with an 18-inch parabolic mirror of 10 ft. focal length and auxiliary reflecting devices.

15. Spectrograph V.—20 ft. concave grating spectrograph in Eagle mount designed and built at the observatory during the year.

The spectrograph can be fed by the 18-inch Foucault siderostat and 21-foot Cooke photovisual lens and an auxiliary reflecting mirror.

16. Hilger E315 Quartz spectrograph.

17. Standardising spectrograph.

18. Cambridge photoelectric microphotometer.

19. Harvard Visual Sky Photometer.

20. Three Hilger comparators for measuring spectrograms.

21. Large induction coil capable of giving upto 16-inch sparks.

22. Large Dubois Electromagnet.

23. Four mean time clocks—

(*i*) Kulberg M.6326,

(*ii*) Shelton,

(*iii*) Arnold and Dent,

(*iv*) W. Ottway and Co.

24. One sidereal clock by T. Cooke & Sons, York.

25. Two chronometers—

(*i*) Kulberg No. 6244;

(*ii*) Frodsham No. 3476.

26. Two tape chronographs by Fuess.

27. Cooke Theodolite.

28. Meridian Circle (by Throughton & Simms) belonging to the old Madras Observatory. It is at present dismantled.

(b) Magnetic instruments

29. Kew Magnetometer No. 3.

30. Earth Inductor (No. 46, Wild pattern) by Schulze of Potsdam.

31. Horizontal Force Magnetograph (Watson type).

32. Vertical Force Magnetograph (Watson type).

33. Declination Magnetograph (Watson type).

34. Dip circle (Kew pattern).

(c) Electronic instruments

35. Multi-Frequency Automatic Ionosphere Recorder—C.R.P.L. Mode C-3.

36. Dawe Universal Impedance Bridge—Model 314A.

37. Taylor Valve Tester.

38. Avo wide range signal generator

39. Cossor Double-beam Oscilloscope—Model 1035.

40. Marconi Valve Voltmeter.

41. Marconi Video Oscillator.

(d) Other instruments

42. Small dividing engine by the Cambridge Scientific Instrument Co. Ltd.

43. Milne-Shaw Seismograph E-W component only.

44. A complete set of meteorological instruments.

45. Kolhörster's Cosmic Ray Recorder.

46. Microscopes—2 Nos.

47. Aldis Epidioscope.

A number of auxiliary instruments such as galvanometers, photo-cells, thermorelays etc. are also available.

4. *Weather conditions.*—Weather conditions during the year were unfavourable for solar observations as far as the total number of days of observation was considered ; observations were possible on a maximum of 286 days only during the year. But the average definition of the sun's image estimated on a scale in which 1 is the worst and 5 the best was slightly better, being 2·95 as compared with 2·9 of the previous year. There were also 50 days on which the definition was 4 or more and only 54 days on which the definition was 2 or less.

5. *Routine observations.*—The normal observational programmes of work with the photoheliograph, the prominence spectroscope, the spectrohelioscope and the spectroheliographs were carried out uninterrupted. Direct photographs of the sun on a scale of 8 inches to the sun's diameter were obtained on 281 days as against 316 in 1949. Spectroheliograms of the disc in the H-alpha and the K lines were obtained on 286 and 266 days respectively and prominence photographs in the K line on 257 days. The observations of sky and seeing conditions during the day and the night were continued. The results of these observations show that conditions favourable for coronagraph work occur mostly during the winter months and that only the first two or three hours after sunrise are favourable for such observations. They also indicate that there is a good percentage of nights during which conditions are favourable for stellar observations.

6. *Sunspot activity.*—Sunspot activity during the year has shown considerable decrease as compared with the last year. The following table gives the number of new sunspot groups observed during the different months of the year, their distribution in the two hemispheres and the mean daily numbers :—

Month		Jan.	Feb.	Mar.	Aprl.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Number of new groups	N	17	11	19	9	14	16	5	8	7	10	5	4	125
	S	8	8	13	13	10	6	3	9	5	7	3	3	88
Total .		25	19	32	22	24	22	8	17	12	17	8	7	213
Mean daily number .		6·6	5·6	6·7	5·5	5·8	4·4	3·6	4·9	3·6	3·6	3·3	2·8	4·8

The total number of new spotgroups and the mean daily number both show decreases of 41% and 34% respectively as compared with the previous year. There were 3 spot-free days out of the total number of days of observation. The approximate mean latitude of the spotgroups for the whole year shows a very slight decrease—last year's value was 13°—, the decrease being in the southern hemisphere.

7. *Prominences.*—Prominence activity during the year under review shows considerable decrease as compared with the previous year. The mean daily areas and numbers of calcium prominences as derived from photographs taken at Kodaikanal are given below :—

	Areas (in sq. minutes)			Numbers		
	North	South	Total	North	South	Total
January—June	1·71	1·07	2·78	4·96	3·47	8·43
July—December	1·30	1·00	2·30	3·80	3·59	7·39
Whole year (weighted mean) . .	1·54	1·04	2·58	4·48	3·52	8·00

Compared with the previous year's values, the areas and the number show 37% and 26% decreases respectively. The latitudinal distribution of areas indicates maximum activity in the zones 25°–35°N and 20°–25°S, with two secondary maxima at 65°–70°N and 55°–60°S. A comparison with the distribution of areas and numbers in 1949 indicates no marked change.

12 metalic prominences were observed with the prominence spectroscope 11 of these were in the northern hemisphere and 1 in the south. 9 were observed on the east limb and the rest on the west limb.

Doppler displacements of the H-alpha line in prominences were observed on 45 occasions with the prominence spectroscope. In 14 cases the shifts were towards red, in 11 cases towards violet and on the rest of the occasions in both directions. Particulars of a few prominences which showed large Doppler shifts are given below :—

Date	Co-ordinates of prominences	Doppler displacements observed
February 3 . .	W-limb—10°N . .	3°A to viloet } same prominence.
	W-limb—14°N . .	4°A to red }
March 13 . .	E-limb—20°N . . .	4°A to red.
March 15 . . .	W-limb—30°N . .	3°A to violet and 3°A to red.
May 4 . . .	E-limb—10°S . . .	3 to 4°A to red and 1°A to violet.

There were 9 occasions during the year when sudden disappearances of fairly large hydrogen absorption markings on the disc and prominences on the limb were noticed. A large eruptive prominence was observed on February 3rd at mean latitude 2·5°S, extending over 32° on the west limb and covering an area of 8 sq. minutes of arc. Large Doppler displacements indicating great agitation were noticed before the prominence erupted. The maximum height of the prominence as recorded on the calcium spectro-heliogram taken at 05 h. 42 m. G.M.T. was 630 seconds of arc or nearly 2,85,000 miles.

The heights of 98 prominences were measured with the prominence spectroscope in H-alpha, D_3 and Hβ lines. These were compared with the heights of corresponding prominences photographed in the K-line. The mean heights were 58″·8 in K, 56″·1 in H-alpha, 53″·7 in D_3 and 50″·0 in Hβ.

Particulars of Doppler displacements in prominences and H-alpha dark markings observed with the spectrohelioscope are given below :—

	Displacements towards			Total
	Red	Violet	Bothways	
Prominences	9	7	24	40
H-alpha dark markings	6	10	11	27

The mean daily area of H-alpha absorption markings (without applying foreshortening correction) was 3224 millionths of the sun's visible hemisphere representing a decrease of 28% as compared with the previous year. The distribution in latitude shows peaks of activity at 25°–35°N and 25°–30°S, indicating a poleward drift of the zones of maximum activity by 5° compared to the previous year.

8. *Geomagnetic observations.*—Continuous photographic recording of the horizontal and the vertical components of the earth's magnetic force and of declination was made as in the previous years. Absolute observations of dip were made on 5 days in the week and those of declination and horizontal force once a week.

Four severe and five moderate magnetic storms were recorded during the year. The storm commencing at 05 h. 42 m. G.M.T. on March 19, 1950 was the severest recorded at Kodaikanal during the year. The storm was of sudden commencement type with an initial impulse of 75 ν in H and the HF trace extended very much below the base line. The range of HF during the storm was 562ν.

9. *Seismology.*—The Milne-Shaw Seismograph (E-W component) recorded 236 earthquakes during the year—more than double the number recorded during the previous year. The great Assam earthquake of August 15 was the severest recorded during the year. More than 50 aftershocks of this earthquake were recorded.

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

11. *Library.*—127 books and 1101 periodicals were added to the library during the year.

12. *Research work and publications.*—A direct recording photoelectric spectrophotometer for solar line-contour work was constructed and preliminary trials were conducted to test its sensitivity and stability for the purpose in question. A similar photoelectric sky photometer (non-recording) was also constructed for the study of the variations in the intensity and the polarisation of sky light in various spectral regions.

In addition to the research programmes begun in previous years, the following problems were taken up, viz. a determination of absolute solar wavelengths in order to test how far they are consistent with the General Theory of Relativity, a study of the centre-to-limb variation of the intensity of the continuous spectrum of the sun in different wavelength regions with a view to ascertaining how far the observed curve of absorption agrees with that of the negative hydrogen ion and the measurement of temperature in spots and other features of the solar disc using a Moll thermocouple and thermorelay.

The following notes were either published or sent for publication during the year :—

1. Observation of Haze, Clouds and growth of convection over the plains from the Kodaikanal Observatory (Indian Journal of Meteorology and Geophysics),

2. Solar and Geomagnetic phenomena during the first, second and third quarters of 1950 (Indian Journal of Meteorology and Geophysics),

3. Recording photoelectric photometer (Indian Journal of Meteorology and Geophysics).

Kodaikanal Observatory Bulletins for the years 1947-48 and the first half of 1949 were sent to the press for printing.

Printed copies of the Kodaikanal Observatory Bulletin for the year 1946 were received from the press.

During the year the Government of India granted two Research Scholarships in Astronomy tenable for three years at this observatory.

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KODAIKANAL ;
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