ANNUAL REPORT* OF THE KODAIKANAL OBSERVATORY FOR THE YEAR 1954

General.—The Government of India appointed the Director Dr. A. K. Das to the higher post of Dy. Director-General of Observatories in India with effect from 1954 March 1 and also ordered that the post of Director, Kodaikanal Observatory, will remain in abeyance so long as Dr. Das continues to be in charge of the observatory. Dr. R. Ananthakrishnan, Assistant Director, was transferred from this observatory and Dr. T. M. K. Nedungadi joined in his place in June 1954.

Matters relating to the establishment of a Central Stellar Observatory for India were discussed at the 3rd meeting of the Standing Advisory Board for Astronomy and Astrophysics in India which was held at Hyderabad in January, 1954. The Director toured in Udaipur, Ujjain and Aurangabad areas in order to prospect for possible sites for the proposed observatory.

Requirements under the 2nd Five-Year Plan in respect of scientific equipment and machinery for the continuation or expansion of the schemes relating to Astronomy and Geophysics already included in the First Five-Year Plan and in connection with further new schemes were submitted to Government.

Some progress has been made regarding the acquisition of a Lyot Heliograph, an 8″ Lyot Coronagraph and a large Solar Telescope and Spectrograph.

International Co-operation.—This observatory will participate in the intensive programme of observations relating to Solar Physics, Geomagnetism, Atmospheric Ozone, Ionosphere and Cosmic Rays during the International Geophysical Year, 1957-58.

This observatory participated in the photographic programme of the Committee for International Co-operation in the Study of Mars during the 1954 opposition. Details of the photographs of Mars taken here from June to September, 1954, were supplied to the Mars Committee, Lowell Observatory, Arizona, U.S.A.

Exchange of spectroheliograms with foreign observatories was continued. 253 K-disc spectroheliograms for the period 1953 October to 1954 September were sent to the Director, The Observatories, Cambridge University. 6 photoheliograms together with the relevant zero plates for certain specified dates in 1953-54 were sent to the Astronomer Royal, Royal Greenwich Observatory, on request. For the period July-December, 1953, 35 H-alpha and 42 K-disc spectroheliograms were received from Meudon Observatory, France, and 66 H-alpha and 71 K-prominence spectroheliograms from the Mount Wilson Observatory, U.S.A.

Quarterly statements relating to solar flares were sent as in previous years to Dr. L.d' Azambuja of the Meudon Observatory and to Mr. H. W. Newton of the Royal Greenwich Observatory.

---

* This report deals chiefly with the astronomical and allied geophysical 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.

The practice of broadcasting URSIGRAMMES relating to solar and geomagnetic activities and of issuing warnings for expected ionospheric and geomagnetic disturbances was continued.

The practice of supplying to the Chief, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado, U.S.A., the monthly median values of F2 layer critical frequency and the maximum usable frequency for 3,000 km transmission was continued. Monthly median values of all other ionospheric parameters were supplied to him quarterly.

Eclipse Expedition.—An expedition to observe the total solar eclipse of 1954 June 30 was organised and an observing party of three went to Phalodi in Rajasthan. The programme of observations consisted of—

(1) Continuous short-wave signal strength recordings for about 10 days to examine the influence of the eclipse on short wave transmission conditions,

(2) Atmospheric noise measurements from 540 Kc/s. to 29·5 Mc/s.,

(3) Registration of the Horizontal component of the earth's magnetic field using an Askania Field Balance,

(4) Photography of the solar corona with a 6-foot camera and a coelostat.

Due to poor sky conditions, the optical part of the programme was not fully successful. The other observations were, however, successfully carried out.

Instruments.—The present instrumental equipment of the 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 five-inch astrographic 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 Takhtasinghji Observatory at Poona in 1912.

(5) Six-inch transit instrument and barrell chronograph made by the Cambridge Scientific Instrument Company.

(6) The 8-inch refracting telescope which was assembled last year has been installed.

(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 five-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. The camera gives a dispersion of about 3 A/mm. in the 3rd order.

(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 10-inch polar siderostat designed and constructed in this observatory feeds this spectrograph independently. The polar siderostat is working temporarily with a 6-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 : Grating spectrograph in angular mounting 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 either an 18-inch parabolic mirror of 10 ft. focal length or an 8-inch lens of 10 ft. focal length.

(15) Spectrograph V : 20 ft. concave grating spectrograph, in Eagle mount designed and built at the observatory.

The spectrograph can be fed either by the 18-inch Foucault siderostat and 21-foot Cooke photovisual lens or by the 12-inch coelostat and the 40 ft. lens.

(16) Spectrograph VI : With 1½ prisms in Littrow mount and 6 feet focal length, designed and constructed at the observatory specially for eclipse observation. The spectrograph has been constructed so as to be capable of rotation about the optical axis. Sunlight is fed into the spectrograph from a coelostat also constructed at the observatory.

(17) Hilger E315 Quartz spectrograph.

(18) Standardising spectrograph.

(19) Cambridge photoelectric microphotometer.

(20) Harvard Visual Sky Photometer.

(21) Two monochromators to work in conjunction with solar spectrographs (designed and built in this observatory).

(22) Direct Recording Photoelectric Spectrophotometer (designed and built in this observatory) for solar line-contour work.

(23) Large Lummer Interferometer (Quartz) by Hilger.

(24) Photoelectric non-recording Sky photometer (designed and built in this observatory) for visual study of sky radiation.

(25) Three Hilger comparators for measuring spectrograms.

(26) Large Induction Coil capable of giving up to 16-inch sparks.

(27) Large Dubois Electromagnet.

(28) Four mean time clocks—

(i) Kullberg M. 6326,
(ii) Shelton,
(iii) Arnold and Dent,
(iv) W. Ottway and Co.

(29) One sidereal clock by T. Cooke and Sons, York.

(30) Three mean time chronometers—

(i) Kullberg No. 6299,
(ii) Frodsham No. 3476,
(iii) Mercer No. 19443.

(31) Two tape chronographs, one by Fuess and the other by Breguet.

(32) Cooke Theodolite.

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

(b) *Magnetic Instruments.*

(34) Kew Magnetometer No. 3.

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

(36) Horizontal Force Magnetograph (Watson type).

(37) Vertical Force Magnetograph (Watson type).

(38) Declination Magnetograph (Watson type).

(39) Dip Circle (Kew Pattern).

(40) La Cour, H, D and V Magnetographs.

(41) Askania Magnetic Field Balance with photoelectric recording outfit.

(42) La Cour Quartz Horizontal Magnetometer.

(43) La Cour Magnetometric Zero Balance.

(44) Quick-run Recorder for use with Askania Magnetic Field Balance.

(c) *Electronic Instruments.*

(45) Multi-Frequency Automatic Ionosphere Recorder—C.R.P.L. Model C-3.

(46) Dawe Universal Impedance Bridge—Model 314A.

(47) Taylor Valve Tester.

(48) Avo Wide Range Signal Generator.

(49) Cossor Double-beam Oscilloscope—Model 1035.

(50) Marconi Valve Voltmeter.

(51) Marconi Video Oscillator.

(52) Marconi Signal Generator—Type 801A.

(53) Megacycle Meter.

(54) Dawe Pulse Generator—Type 412A.

(55) Hallicrafters Receiver—Type SX-62.

(56) B. P. L. Resistance—Tuned Oscillator—Model L063.

(57) Dawe Q-Meter—Type 622 C.

(58) Eddystone Receiver—Type 504.

(59) Browning Oscillosynchroscope—Model OL-15B.

(60) Browning Sweep Calibrator—Model GL-22A.

(61) Squarewave and Pulse Generator-Cintel—Type 1873.

(62) R. F. Impedance Bridge with Oscillator-detector Unit.

(63) 100 Mc/s. Radio Telescope (designed and built in this observatory).

(64) Three Hammarlund Communication Receivers.

(65) Avo Electronic Testmeter.

(d) *Workshop Machinery.*

(66) 6″ Cooke Lathe.

(67) 5″ Wilfin Lathe.

(68) 5″ Jessop Lathe.

(69) 'Victoria' Model U2 Milling Machine.

(70) 'Cooper' 24-inch Shaping Machine.

(71) 'Cobra' 9-inch Hacksaw Machine.

(72) 'Cruickshank' Combined Grinding & Buffing Machine.

(73) 'Adcock & Shipley' Slitting Machine.

(74) Canedy 'Otto' Drilling Machine.

(75) 'Davla' Saw Bench.

(76) Smith's Hearth.

(77) Adcock & Shipley Optical Centring Lathe.

(e) *Other Instruments.*

(78) Small dividing engine by the Cambridge Scientific Instrument Co., Ltd.

(79) Milne-Shaw Seismograph-E-W component only.

(80) A complete set of meteorological instruments.

(81) Kolhörster Cosmic Ray Recorder.

(82) Microscopes—2 Nos.

(83) Aldis Epidiascope.

Weather conditions.—Weather conditions continued to be rather unfavourable for solar observations as in the previous year. Photoheliograms were taken on 299 days and visual observations of the sun were made on 289 days as against 296 and 295 days respectively in 1953. H-alpha disc, calcium disc and calcium prominence spectroheliograms were taken on 278, 264 and 251 days compared to 285, 273 and 254 respectively in the previous year. Observations with the spectrohelioscope were made on 285 days.

The average definition of the sun's image on a scale in which 1 is the worst and 5 the best was 3·1—same as in last year. There were 17 days on which the definition was 4 or more.

Sunspot Activity.—There was very little sunspot activity during the year. There were 243 spot-free days out of a total of 299 days compared to 142 spot-free days in 1953. The yearly mean latitude of all the observed spotgroups in the northern and southern hemispheres was 24°·8 and 20°·2 respectively as against 9°·0 and 8°·4 for the previous year. Details of sunspot observations are given in the following table :

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
No. of new spot-groups.	N	0	1	1	0	2	0	1	1	0	2	3	2	13
	S	0	0	3	2	0	0	0	2	0	0	2	1	10
Total . .		0	1	4	2	2	0	1	3	0	2	5	3	23
Mean daily No. of spot-groups.		0	0.44	0.46	0.11	0.06	0	0.18	0.48	0	0.22	0.65	0.50	0.22
Kodaikanal Relative Sunspot Number.		0	0.4	7.9	1.2	0.8	0	2.1	6.9	0	2.4	8.0	6.2	3.3

Solar Flares.—Two solar flares were recorded during the year, both of intensity 1.

PROMINENCES

Prominences.—The mean daily areas and numbers of calcium prominences at the limb as derived from photographs taken at Kodaikanal are given below :—

1954	Area in sq. minutes					Numbers				
	North	South	East	West	Total	North	South	East	West	Total
January to June	0.80	0.47	0.55	0.72	1.27	2.67	2.39	2.18	2.88	5.06
July to December	0.93	0.91	0.74	1.10	1.84	2.97	2.87	2.64	3.20	5.84
Whole year (weighted mean)	0.85	0.66	0.63	0.88	1.51	2.79	2.59	2.37	3.01	5.38

Compared with the previous year prominence activity as represented by areas shows a decrease of about 20% while the numbers show a decrease of 23%.

The distribution of areas in 5 deg. ranges of latitude shows maximum activity in the zones 35° to 40° in both the hemispheres with a secondary maximum between 20° and 25° in the northern and between 15° and 20° in the southern hemisphere. There was very little activity beyond latitude 55° in the northern and beyond 50° in the southern hemisphere. The E-W distribution of areas and numbers showed a western excess.

Doppler shifts of the H-alpha line observed in prominences and absorption markings with the prominence spectroscope and spectrohelioscope are given below :—

———	North	South	East	West	To Red	To Violet	Both ways	Total
Prominences	45	25	27	43	1	3	66	70
Dark markings	15	3	10	8	1	..	17	18

The heights of 9 prominences were measured in H-alpha, D3 and H-beta lines with the prominence spectroscope. These were compared with the corresponding heights in the K line as obtained from the spectroheliograms. The average heights were

K	H-alpha	D3	H-beta.
49″·5	47″.1	45″·4	36″·9

Only one instance of sudden disappearance of a hydrogen absorption marking was observed during the year.

The mean daily areas and numbers of hydrogen absorption markings on the disc as obtained from Kodaikanal records were as follows :—

1954	Area (in millionths of the sun's visible hemisphere) uncorrected for foreshortening					Number				
	North	South	East	West	Total	North	South	East	West	Total
January to June	364.1	121.4	274.9	210.6	485.5	4.02	1.51	2.99	2.54	5.53
July to December	500.6	131.7	301.7	330.6	632.3	3.76	1.35	2.34	2.75	5.09
Whole year (weighted mean)	422.6	125.7	286.1	262.2	548.3	3.91	1.43	2.70	2.63	5.34

Compared with the previous year there was considerable decrease in activity in both areas and numbers, the decrease in areas being about 51% and the decrease in numbers 54%.

The distribution of areas in 5 deg. ranges of latitude shows maximum peaks of activity between 40° and 45° in both the hemispheres with very little activity beyond 55° in the northern and 50° in the southern hemisphere. Both areas and numbers show a slight eastern excess.

Radio Astronomy.—Recording of solar noise at 100 Mc/s. was continued. A 200 Mc/s. Radio Telescope was under construction. Steps were taken for the acquisition of a 10 cm. receiver from Australia.

Geomagnetic observations.—Continuous photographic recording of 'H', 'V' and 'D' with Watson and La Cour magnetographs and visible recording of the horizontal force with the Askania Magnetic Field Balance were continued. A quick-run recorder for use with the Askania Magnetic Field Balance was acquired during the year. Absolute measurements of 'H' and 'D' were made once a week with a Kew Magnetometer and observations of inclination on 5 days in the week with an Earth Inductor. A set of QHM and BMZ instruments was received towards the end of the year and put into regular use for absolute measurements.

During the year 7 magnetic storms with ranges in H between 130γ and 170γ were recorded. One of them probably was of the sudden commencement type.

Ionospheric observations.—Regular ionospheric soundings during daylight hours with the Automatic Ionosphere Recorder were continued.

Cosmic Ray Observations.—Systematic observation of cosmic ray intensity could not be continued throughout the year due to the shortage of staff.

Seismology.—The Milne-Shaw Seismograph (E-W component) recorded 96 earthquakes,

Meteorology.—Meteorological observations with all the visual and self-recording instruments were carried out as usual.

Library.—115 books and 1317 periodicals were added to the library.

Research work.—Under the Research Training Scheme sponsored by the Ministry of Education, Government of India, one Senior and two Junior Research Scholars were working in this observatory. The Senior Scholar was released from the scheme in August, 1954.

The following problems in astrophysics and geophysics were investigated or were under investigation during the year :—

(1) Experimental study of solar line contours by means of direct-recording photoelectric photometer and by photographic photometry.

(2) Variation of continuous absorption in the near ultraviolet solar spectrum.

(3) Study of the spectrum of sunspots.

(4) Study of ionospheric and geomagnetic effects during the total eclipse of the sun of June 30, 1954.

(5) Study of solar-weather relationships.

(6) Study of ionospheric changes associated with M-type magnetic storms.

(7) Disturbance daily variation of the magnetic field at Kodaikanal.

Publications.—The following notes and papers were either published or sent for publication :—

(1) Recurrence Tendency of Geomagnetic Activity during the current sunspot Minimum : *Special Geomagnetic Number of the Indian Journal of Meteorology and Geophysics.*

(2) Solar Radiation in the far ultraviolet and some related geophysical phenomena : *Special Geomagnetic Number of the Indian Journal of Meteorology and Geophysics.*

(3) Equivalent widths of lines in sunspot spectra : *Astrophysical Journal.*

(4) Solar Influence on Barometric Pressure : *Indian Journal of Meteorology & Geophysics.*

(5) Reports to the Royal Astronomical Society, London on
   (i) the work of the Kodaikanal Observatory; and
   (ii) the prominence activity for the year 1953 for publication in their monthly notices.

(6) Annual Report of the Kodaikanal Observatory for the year 1953.

(7) Kodaikanal Observatory Bulletin No. 139 for the second half of 1952 giving summary of the results of solar and magnetic observations.

(8) Kodaikanal Observatory Bulletin No. 140 for the first half of 1953 giving summary of the results of solar and magnetic observations.

(9) Kodaikanal Observatory Bulletin No. 141 for the second half of 1953 giving summary of the results of solar and magnetic observations.

(10) Quarterly synopsis of results of solar, magnetic and ionospheric observations : *Indian Journal of Meteorology and Geophysics.*

A. K. DAS,
Deputy Director-General of Observatories,
Astrophysical Observatory, Kodaikanal.

KODAIKANAL ;
April 1955.

GIPN—S II—1 D.D. G. Ob. Kodaikanal—9-9-55—400.