DGO. 47-58
405

GOVERNMENT OF INDIA
DIRECTOR-GENERAL OF OBSERVATORIES

ANNUAL REPORT

OF THE

KODAIKANAL OBSERVATORY

FOR THE YEAR

1958

(1879-1880 SAKA)

PRINTED IN INDIA, BY THE MANAGER, GOVT. OF INDIA PRESS, NASIK ROAD, PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
1959

Price: *Rs.* 1·12 *or* 1*sh.* 9*d.*

ANNUAL REPORT* OF THE KODAIKANAL OBSERVATORY FOR THE YEAR 1958

General.—The major optical components for a Lyot Monochromatic Heliograph were received from France ; the construction of the mechanical parts for the heliograph in our own workshop and the assembly of the optical components were completed. The 20cm Lyot Coronagraph ordered from France and the large Solar Telescope ordered from England were received in October. The construction of a 20m spectrograph to work with the Solar Telescope was begun. The dome and the underground tunnel for housing the Solar Telescope and the Spectrograph and the dome for the Coronagraph and the Monochromatic Heliograph were still under construction. The installation of these two instruments will begin as soon as the Central Public Works Department completes the buildings. Plans and estimates for a laboratory specially for radio-astronomical work was approved by Government. The construction of the buildings for the laboratory will begin shortly.

One Danjon earth-light photometer constructed for this observatory by the Pic-du-Midi observatory was received ; regular observations with this instrument will begin shortly.

The I. G. Y. programme of intensive observations (solar, geomagnetic, ionospheric, ozone, auroral and meteorological) was continued during the year. The solar data were sent periodically to the World Data Centres. Ionospheric data including f-plots for RWDs and SWIs and complete magnetic data were prepared for transmission to the concerned World Data Centres.

An Askania Field Balance for Vertical Magnetic Force with normal and quick-run recorders was received and installed. Quick-run records of vertical force were also made in addition to those of Horizontal Force on RWDs and SWIs.

Messages in I. G. Y. code for daily broadcasts of Kodaikanal observations by the All-India Meteorological Broadcasting Centre and plain language messages for inclusion in the special I. G. Y. broadcasts by the All-India Radio were sent daily to New Delhi.

Observations of "Seeing Conditions" made during the last few years at Ujjain in Central India and at Kaliadeh (in the open country outside Ujjain) showed that this area would be suitable for the establishment of a large modern astronomical observatory. The proposal for the establishment of the observatory which had previously been included in the Second Five-Year Plan was however postponed for the time being.

Scientific Cooperation.—Exchange of spectroheliograms with foreign observatories was continued. For the period July 1957—June 1958 52 H-Alpha disc and 59 K-disc spectroheliograms were received from the Meudon Observatory and for the period July 1957—December

*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, the seismological data in the Seismological Bulletin and the administrative details in the Administration Report of the India Meteorological Department.

1—1 D.D.G. Kodai./59.

1957 55 H-alpha disc, 68 K-disc and 68 K-Prominence spectroheliograms from the Mount Wilson Observatory. Copies of daily spectroheliograms (disc in H-alpha and K and limb in K) were supplied in fortnightly batches to the Fraunhofer Institute, Germany for the preparation of daily solar maps.

Three photoheliograms together with the relevant zero plates for certain specified days in 1958 were supplied to the Astronomer Royal, Royal Greenwich Observatory, England.

Quarterly statements relating to solar flares were sent, as in previous years to the Meudon Observatory and to the Royal Greenwich Observatory.

Periodical statements of observational data concerning solar flares, relative sunspot numbers, ionospheric parameters and sudden ionospheric disturbances, information relating to central meridian passage of important sunspots and forecasts of expected magnetic and ionospheric disturbances were supplied to a number of interested institutions in India.

The observatory continued to supply the monthly median values of foF2 and (M3000)F2 to the C. R. P. L., Colorado, U.S.A., quarterly statements of monthly median values of all ionospheric parameters to the above institution and to the Radio Research Station, Slough, England, quarterly magnetic storm data to Prof. John A. Simpson of the University of Chicago and monthly statements of mean hourly values of the horizontal component of the geomagnetic field (between 1500h and 2400h U.T) to Prof. J. Bartels of the University of Göttingen, Germany.

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

(*a*) *Astronomical and Spectroscopic instruments*

(1) 15cm Cooke Equatorial with a grating spectroscope attached for observing prominences.

(2) 15cm Lerebours and Secretan Equatorial reconstructed by Grubb for direct solar photography. A 12·5cm astrographic camera is also mounted on the same equatorial.

(3) 15cm Stellar Telescope by T. Cooke & Sons, York.

(4) 50cm Reflecting Telescope by Grubb.

(5) 20cm Refracting telescope.

(6) 15cm transit instrument and barrel chronograph.

(7) 11cm refractors—2 numbers (one by Cooke and the other by Grubb).

(8) Spectroheliograph made by the Cambridge Scientific Instrument Company with a 45cm Cooke Siderostat and 30cm Cooke photovisual lens of 7m focal length used for photographs in the K line.

(9) An auxiliary spectroheliograph using a 15cm 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 12·5cm coelostat kindly loaned by the Mount 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 3A/mm in the third order.

(11) Spectrograph I: With 3½ prisms in Littrow mount and about 4·6m focus designed and built in this observatory. This is fed by a 30cm coelostat designed and built in this observatory in conjunction with a 20cm lens.

(12) Spectrograph II: 3·3m concave grating in Rowland mounting designed and built in this observatory. A 25cm polar siderostat designed and constructed in this observatory feeds this spectrograph through a parabolic mirror of about 7·5-metre focus.

(13) Spectrograph III: 6·6m plane grating spectrograph in Littrow mount using a 15·5cm 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 45cm Foucault siderostat in conjunction with the 7m Cooke Photovisual lens and an auxiliary plane mirror. Alternatively it can also be fed by a 30cm coelostat designed and built at this observatory in conjunction with a 13·3m lens.

(14) Spectrograph IV: Grating spectrograph in angular mounting with collimator lens of about 2·3m focus and camera lens of about 4·6m focus using a 8cm Rowland plane grating designed and built in this observatory.

The spectrograph is fed by the 45cm Foucault siderostat in conjunction with either a 45cm parabolic mirror of 3·3m focal length or 20cm lens of 3·3m focal length.

(15) Spectrograph V: 6·6m concave grating spectrograph in Eagle mount designed and built in this observatory.

The spectrograph can be fed either by the 45cm Foucault siderostat and 7m Cooke photovisual lens or by the 30cm coelostat and the 13·3m lens.

(16) Spectrograph VI: With 1½ prisms in Littrow mount and 2m 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 by a 30cm Foucault siderostat and a parabolic mirror of 7-metre focus.

(17) Hilger E315 Quartz spectrograph.

(18) Standardising spectrograph.

(19) Cambridge photoelectric microphotometer.

(20) Harvard Visual Sky Photometer.

(21) Dobson Ozone Spectrophotometer.

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

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

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

(25) Fabry-Perot Etalon.

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

(27) Three Hilger comparators for measuring spectrograms.

(28) Large Induction Coil capable of giving up to 40cm sparks.

(29) Large Dubois Electromagnet.

(30) Four mean time clocks—

1. Kullberg M. 6326,
2. Shelton,
3. Arnold and Dent and
4. W. Ottway & Co.

(31) One sidereal clock by T. Cooke & Sons, York.

(32) Three mean time chronometers—

1. Kullberg No. 6299,
2. Frodsham No. 3476,
3. Mercer No. 19443.

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

(34) Cooke Theodolite.

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

(b) *Magnetic Instruments*

(36) Kew Magnetometer No. 3.

(37) Earth Inductor (No. 46 Wild Pattern) by Schulze of Potsdam.

(38) Horizontal Force Magnetograph (Watson type).

(39) Vertical Force Magnetograph (Watson type).

(40) Declination Magnetograph (Watson type).

(41) Dip Circle (Kew Pattern).

(42) La Cour H, D and V magnetographs.

(43) La Cour Quartz Horizontal Magnetometer.

(44) La Cour Magnetometric Zero Balance.

(45) Askania Horizontal Force Magnetic Field Balance with photo-electric recording outfit.

(46) Quick-run recorder for use with Askania Horizontal Force Magnetic Field Balance.

(47) Askania Vertical Force Magnetic Field Balance with photo-electric recording outfit.

(48) Quick-run recorder for use with Askania Vertical Force Magnetic Field Balance.

(c) *Electronic Instruments*

(49) Multi-frequency Automatic Ionosphere Recorder C. R. P. L. Model C-3.

(50) Dawe Universal Impedance Bridge Model 314A.

(51) Taylor Valve Tester.

(52) Avo Wide Range Signal Generator.

(53) Cossor Double-beam Oscilloscope—model 1035.

(54) Marconi Valve Voltmeter.

(55) Marconi Video Oscillator.

(56) Marconi Signal Generator—Type 801 A.

(57) Megacycle Meter.

(58) Dawe Pulse Generator—Type 412 A.

(59) Hallicrafters Receiver—Type SX-62.

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

(61) Dawe Q-Meter—Type 622 C.

(62) Eddystone Receiver—Type 504.

(63) Browning Oscillosynchroscope—Model GL-22A.

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

(65) Squarewave and Pulse Generator—Cintel Type 1873.

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

(67) 100 Mc/s Radio Telescope (designed and built in this observatory).

(68) Three Hammarlund Communication Receivers.

(69) Avo Electronic Testmeter.

(70) Nagard High Gain D. C. Amplifier.

(71) Absorption Wavemeter (E.M.I).

(72) 10cm Solar Radiometer—Model J76.

(73) Marconi Noise Generator—Type T. F. 1106.

(74) Measurement Corporation Model 80 Standard Signal Generator.

(75) Sorensen Voltage Regulator Model 1000 (manufactured by Messrs. Langham Thompson, England).

(76) 200 Mc/s Radio Telescope (designed and built in this Observatory).

(77) Marconi Portable Frequency Meter Type T. F. 1026/4 (2000-4000 Mc/s).

(78) Unit Klystron Oscillator G. R. Type 1220-A2 with power supply unit G. R. Type 1201-A. Q. 18.

(*d*) *Workshop Machinery*

(79) 15cm Cooke Lathe.

(80) 12·5cm Wilfin Lathe.

(81) 12·5cm Jessop Lathe.

(82) Victoria Model U2 Milling Machine.

(83) Cooper 60cm Shaping Machine.

(84) 'Cobra' 22·5cm Hacksaw Machine.

(85) 'Cruickshank' Combined Grinding and Buffing Machine.

(86) 'Adcock & Shipley' Slitting Machine.

(87) Canedy 'Otto' Drilling Machine.

(88) 'Davla' Saw Bench.

(89) Smith's Hearth.

(90) Adcock & Shipley Optical Centring Lathe.

(91) Arc Welding set with Welding Transformer Type TR260.

(92) Westalite Oil Immersed Rectifier Set-Type LOP12/125.

(93) Bendmaster Hydraulic Pipe Bending Machine.

(*e*) *Other Instruments*

(94) Small Dividing Engine by the Cambridge Scientific Instrument Co.

(95) Milne-Shaw Seismograph (E-W component).

(96) A complete set of meteorological instruments.

(97) Kolhörster Cosmic Ray Recorder.

(98) Microscope—2 Nos.

(99) Aldis Epidiascope.

(100) 16mm Cine Projector.

(101) Leica M$_3$ Camera.

(102) Prado 35mm Projector.

Weather Conditions.—Weather conditions were rather less favourable during 1958 for solar observations than in the previous year. Photoheliograms were made on 278 days and visual observations were possible on 275 days as compared to 282 and 278 days respectively in 1957. H-alpha disc, K-disc and K-Prominence spectroheliograms were secured on 273, 264 and 257 days as against 261, 259 and 258 days respectively in the previous year. Observations with the spectrohelioscope were made on 263 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. There were 56 days on which the definition was 4 or better.

Sunspot Activity.—Sunspot activity during the current cycle reached its maximum in 1958. The mean latitude for the year of all the observed spotgroups in the northern and southern hemispheres was 18°·1 and 16°·2 respectively as against 19°·2 and 18°·9 for the previous year. Details of sunspot observations are given in the following table:

Months	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
No. of new spotgroups N	23	14	21	33	29	20	24	24	19	18	32	27	284
No. of new spotgroups S	24	15	16	25	16	18	17	20	23	24	23	15	236
TOTAL	47	29	37	58	45	38	41	44	42	42	55	42	520
Mean daily number of spotgroups	11·90	7·87	8·16	11·36	10·21	5·05	9·93	11·17	10·19	9·94	9 25	10 00	9·59
Kodaikanal daily relative sunspot number	226·9	144·5	200·2	220·7	166·5	189·3	201·6	211·3	207·0	178·5	168·3	198·8	192·8

Solar Flares.—23 Solar flares were observed during the year, 17 of intensity 1 and 6 of intensity 2.

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

1958	Area in Sq minutes					Numbers				
	N	S	E	W	Total	N	S	E	W	Total
January–June	3 94	1·89	2·93	2·90	5·83	5·41	3 62	4·44	4·59	9·03
July–December	3·69	2·28	2·90	3·07	5·97	5·51	4·32	5·02	4·81	9 83
Whole year (weighted mean)	3·85	2·05	2·93	2·97	5·90	5·45	3·91	4·68	4·68	9·36

Compared to 1957 there has been a slight increase in activity judged in terms of both areas and numbers, the increase in areas being 14·5% and that in numbers 6·2%.

The distribution of areas in 5° ranges of latitude shows two peaks of activity in the northern hemisphere in the zones 35°-40° and 70°-75° while in the southern hemisphere the maximum activity is in the zone 30°-35°. Both numbers and areas indicate that the activity in the southern hemisphere has continued to be less than in the northern hemisphere.

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

	North	South	East	West	To Red	To Violet	Both ways	Total
Prominences . .	61	44	56	49	2	..	103	105
Dark Markings . . .	25	18	22	21	1	1	41	43

The heights of 25 fairly tall prominences were measured in H-alpha, D_3 and H-beta lines with the prominence spectroscope. These were compared with the corresponding heights in K-line as obtained from the spectroheliograms. The average heights were:

K	H-alpha	D_3	H-beta
102″·4	90″·0	77″·7	70″ 1

There were six occasions of sudden disappearances of absorption markings on the disc or of prominences on the limb.

The mean daily areas and numbers of hydrogen dark markings on the disc as obtained from Kodaikanal records are as follows:

1958	Area in millionths of the sun's visible hemisphere (uncorrected for foreshortening)					Number				
	North	South	East	West	Total	North	South	East	West	Total
January-June . . .	2927	1939	2345	2521	4866	15·74	11 93	13·60	14 07	27·67
July-December . . .	2584	2259	2066	2777	4843	17·12	14 09	14·50	16·71	31 21
Whole year (weighted mean) .	2796	2084	2238	2642	4880	16·32	12·84	13 98	15·18	29 16

Compared to the previous year, the mean daily area shows a slight decrease of 3·1% while in the case of numbers there is an increase of 3·2%. The distribution of areas in 5° ranges of latitude shows a maximum in the zone 35°-40° in the northern hemisphere and in the zone 25°-30° in the southern hemisphere. The activity in the southern hemisphere is considerably less than in the northern. The western preponderance in areas and numbers observed last year has continued.

Radio Astronomy.—Construction of a receiver for the observation of Solar Noise on 60 Mc and of a new 100 Mc receiver was completed.

Geomagnetic Observations.—Continuous photographic recording of H, Z and D with Watson and La Cour Magnetographs and ink-recording of H with an Askania Field Balance were continued. Ink recording of Z with another Askania Field Balance was started during the year. Values of H, D and Z were determined weekly with a set of Q.H.M. (Nos. 254, 255 and 256) and B.M.Z. instruments. Absolute measurements of H with a kew Magnetometer and those of inclination with a Schulze Earth Inductor were also made once every month. During the year 27 magnetic storms including 25 storms of SC type were recorded with ranges in HF between 163γ and 813γ.

Ionospheric Observations.—Round-the-clock ionospheric vertical incidence soundings and the recording of field-intensity were continued.

Cosmic-ray.—Continuous photographic recording of cosmic-ray intensity was continued using a Kolhörster Cosmic Ray Apparatus.

Ozone.—Regular observations of atmospheric ozone were made with a Dobson Spectrophotometer.

Seismology.—The Milne-Shaw Seismograph (E-W component) recorded 95 earthquakes.

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

Library.—32 books and 2479 periodicals were added to the library.

Research Work.—Under the Research Training Scheme sponsored by the Ministry of Education, Government of India, four Senior Research Scholars were working in this observatory.

The following problems in astrophysics and geophysics were under investigation :

(1) Determination of absolute values of the wavelengths of solar spectrum lines in order to determine how much of their red-shifts can be accounted for by the theory of relativity.

(2) Detection of "Deuterium" on the sun.

(3) Study of the distribution of intensity in the various features of the sun's disc with the help of a Moll Thermo-couple and Thermo-relay.

(4) Simultaneous measurement of temperature and magnetic field of sunspots.

(5) Distribution of calcium flocculi on the sun's disc.

(6) Further study in the scattering of radio waves by ionospheric F-layer and some related geomagnetic phenomena.

(7) The behaviour of night-time sporadic E-layer at Kodaikanal.

(8) Solar cycle variations of F2 layer geomagnetic distortion at Kodaikanal.

(9) The diurnal variation in the sizes of SCs and SIs at Kodaikanal

(10) Solar Flare effects on F2 layer critical frequencies.

Publications.—The following technical reports and research papers were published or communicated for publication :—

(1) Quarterly synopses of results of solar, magnetic, ionospheric and ozone observations—Indian Journal of Meteorology and Geophysics.

(2) Annual Report of the Kodaikanal Observatory for 1957.

(3) Reports to the Royal Astronomical Society on the work of the Kodaikanal Observatory and on Prominence activity during 1957.

(4) Kodaikanal Observatory Bulletin No. 150—Summary of results of solar, magnetic and ionospheric observations for the first half of 1957.

(5) Kodaikanal Observatory Bulletin No. 151—"Variation of F2 layer ionisation with solar activity at Kodaikanal on magnetically disturbed and quiet days".

(6) Kodaikanal Observatory Bulletin No. 152—"The solar cycle and the associated behaviours of sunspots and prominences"

(7) Kodaikanal Observatory Bulletin No. 153—"Magnetic field on the planet Venus".

(8) Kodaikanal Observatory Bulletin No. 154—"Opposition of Mars in 1954 and 1956".

(9) Kodaikanal Observatory Bulletin No. 155—Summary of results of solar, magnetic and ionospheric observations for the second half of 1957 including special observations carried out in connection with the I. G. Y.

(10) "Sudden commencements and impulses in Kodaikanal magnetograms—Their hourly frequency"—Indian Journal of Meteorology and Geophysics.

(11) "Annual wave in the world-wide F-region ionisation"—Indian Journal of Meteorology and Geophysics.

(12) "Ionospheric disturbances associated with magnetic storms at Kodaikanal"—Indian Journal of Meteorology and Geophysics

(13) "Sunrise effect in the F-region of the ionosphere over Kodaikanal"—Indian Journal of Meteorology and Geophysics.

A. K. DAS,

Deputy Director-General of Observatories.

KODAIKANAL OBSERVATORY,
June, 1959.

GIPN—S7—1 D.D.G. Kodi./59—30-12-59—405