

UTTAR PRADESH STATE OBSERVATORY

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GENERAL :

In April 1954 the Government of Uttar Pradesh established an astronomical observatory at the Government Sanskrit College, Varanasi (now the Varanaseya Sanskrit Vishwavidyalaya) with Dr. A. N. Singh as its first Director (Honorary). Dr. Singh died in July 1954 and was succeeded in November 1954 by Dr. M. K. Vainu Bappu who remained in charge of this observatory upto March 1960.

The observatory was moved over to Nainital in November 1955 and to its present location at Manora Peak (longitude $79^{\circ}27'$ E, latitude $29^{\circ}22'$ N, altitude 1951 m), just south of Nainital town, in November 1961. The campus extends over some 48 hectares of forestland, the principal buildings being the main block, eight telescope houses, a workshop and an optics shop. Besides, residential and other facilities for some staff have been provided.

The observatory is a full department under the Ministry of Cultural Affairs and Scientific Research, Uttar Pradesh, the director being the head of the Department. An Advisory Committee comprising of 13 scientists and 5 officials advises the Government on all important matters.

The sanctioned strength of the observatory staff on 31 March 1973 stood at 100 comprising 25 scientists (including 2 Fellows), 27 technicians, 9 ministerials and 39 assistants. A few ex-cadre staff work under PL-480 schemes.

The annual recurring expenditure of the Observatory now is Rs. 0.65 million (salaries Rs. 0.4 million, contingencies Rs. 0.25 million). In addition, non-recurring grants averaging Rs. 0.4 million per year were granted to the Observatory during the Fourth Plan Period, which figure is likely to be increased substantially during the Fifth Plan. The total up-to-date expenditure on the observatory is about Rs. 10 million.

EQUIPMENT :

The principal stellar equipment in use at the Observatory until early 1972 consisted of three reflectors of apertures 56 cm, 52 cm and 38 cm used for stellar photoelectric photometry (both broad-band and spectro-photometric). In 1972, an 104-cm Cassegrain coude reflector (made by Carl Zeiss, Jena) has been commissioned (Sinvhal, Kandpal, Mahra, Joshi and Srivastava 1969) for photographic and photoelectric studies. Spectroscopic studies with this telescope will follow after completion of the Cassegrain spectrograph, in another year's time. The Observatory also has a few other smaller telescopes.

For solar work, an H-alpha patrol unit working on a 16-mm image of the sun is available. Recently, a

horizontal solar spectrograph working on a 16-cm solar image has become operational.

In addition, the observatory has a 79/51 cm Baker-Nunn Camera (loaned by the Smithsonian Astrophysical Observatory, U.S.A.) for optical tracking of artificial earth satellites.

The above equipments are supported by ancillary equipments like astrophotometer, comparators, spectrum projector, microphotometer, quartz clocks, etc. The quartz clocks at the Observatory are among the best anywhere in India and can monitor time to a millionth part of a second. The Observatory has a good library and four well equipped workshops, including an electronics shop, a machine shop, an optics shop and an aluminizing unit at which quite many of the instruments required at the Observatory are designed and completed.

ACTIVITIES :

(A) **Developmental:** A good amount of activity goes on at the Observatory by way of designing and fabrication of instruments required by the Observatory staff for their own researches and for development purposes ancillary thereto. Quite many efforts including the designing and fabrication of mounting for the 56-cm reflector, of the horizontal solar spectrograph, of an optical grinding and polishing machine and of an aluminizing unit have been successfully undertaken. The mounting for the 56-cm reflector required the construction of a 76-cm diameter high precision worm wheel which was successfully accomplished. The optical grinding and polishing machine has the capability to take upto 76-cm diameter jobs while the aluminizing unit can take upto 60-cm diameter jobs. At the optics workshop, optical mirrors upto 45-cm diameter have been figured to an accuracy of a tenth wave. In the near future, it is proposed to expand this facility to take up the production of high precision optics for general research purposes. A number of electronic instruments have also been fabricated.

(B) Research :

a) *Stellar research:* In stellar physics our interests lie, broadly speaking, in the evolution of stars, studied from different aspects.

One group at the observatory has been studying Algol type eclipsing binaries, for determinations of their orbital and systemic elements and thence the evolution of the individual components of the systems. In the near future, it is proposed to take up studies of period changes and mass transfer in close binary systems with particular reference to ultra-short period binaries. Observations of very long period variables.

employing the techniques of photographic photometry, through the use of the Baker-Nunn Camera are also planned.

Another group is interested in the study of short period cepheids, viz. the RR Lyr, δ Sct and β CMa stars. In the RR Lyr stars their interests lie in a study of the evolutionary significance of the Blazhko effect and of the humps in the light curves, with special reference to Christy's models for such stars. In the δ Sct and β CMa stars, the group is interested in studies of the beat phenomenon in such stars, and of their energy distribution, leading to determinations of their effective temperatures and gravities.

A third small group is studying late type stars. Their efforts are confined to studies of energy distribution in K and M stars and to devising of photometric indices for two dimensional spectral classification of such stars. The frequency of flares and their energy output in Mira type variables are also being studied.

Energy distribution studies of A stars including Ap, Am and magnetic stars are also being carried out.

In the near future, it is proposed to undertake studies of stellar evolution in clusters through studies of their H-R diagrams and of individual variables in these clusters. Spectral classification studies with objective prism spectroscopy and surveys for faint H-II regions and other spiral tracers in the galaxy are also proposed.

- b) *Solar research*: The solar group at the Observatory is primarily interested in studies relating to molecules on the Sun. So far they have undertaken dissociation equilibrium and profile calculations for lines belonging to quite a few diatomic molecules and some triatomic molecules based on various sunspot, photospheric and facula models, the aim being to pick up some new molecular species for spectroscopic identification in spot and facular spectra. In turn this should lead to a refinement of the existing models for these features. In the near future, it is proposed to study the centre-to-limb variation of the facula/photosphere and spot/photosphere contrasts in these lines. Corresponding observations will soon be started.

Similar calculations for other G-type stars, particularly the classical cepheids are also being carried out.

The spatial and temporal variations of features over the solar K-line profiles have also been studied, employing power-spectrum analysis techniques with a view to understanding the energy transport mechanisms in these features. In future, it is proposed to initiate studies of chromospheric solar features by obtaining simultaneous filtergrams in H-alpha and calcium-K lines.

- c) *Planetary research*: Occasionally, studies of changes in the composition and structure of comets during their perihelion passage and of planetary atmospheric scale heights by observing stellar occultations by planets have also been made.

In the past, studies in the local behaviour of the night airglow emissions at wavelengths 5577 Å, 5890-96 Å and 6300-6364 Å as also of some possible mechanisms for the origin of these emissions were carried out.

- d) *Miscellaneous*: In addition to the above astrophysical programmes, the optical tracking of artificial earth satellites has been carried out at the Observatory since 1958. In fact, the Uttar Pradesh Observatory, is the only centre in India for this kind of work.

Studies of VLF propagation and estimation of accuracy of ATA time signals have also been made.

Upto 31 March 1973, a total of 85 research papers and 3 Ph.D. thesis have been contributed by the staff of the Observatory.

PROSPECT :

If and when a stellar telescope of apertures-2m or larger becomes available to our astronomers, hopefully at our own Observatory within the next ten years, studies of galactic structure and of extragalactic sources will be taken up.

In the realm of solar physics, we propose undertaking studies of the general magnetic field of the sun and of short period magnetic field variations in features like spots etc. with suitable equipment, proposed to be built at the Observatory within the next ten years.

Reference

Sinvhal, S. D., Kandpal, C. D., Mahra, H. S., Joshi, S. C., and Srivastava, J. B. 1969, Proceedings of the Symposium on "Optical Astronomy with Moderate Size Telescopes (Hyderabad : Osmanla University), p. 20.

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