

ASTRONOMY IN CANADA

THE April and June issues of the *Journal of the Royal Astronomical Society of Canada* (54, 79, 126; 1960) contain abstracts of reports read to the National Committee for Canada of the International Astronomical Union at a meeting held in Ottawa on November 27, 1959. These reports give a comprehensive view of research programmes at present being undertaken by Canadian institutions, and testify to the virility of Canadian astronomy.

The Dominion Observatory at Ottawa has made important contributions to positional astronomy, and this work is continuing. Two programmes are international in scope, being shared by meridian circle observers at fifteen observatories. These are the observation of 1503 *FK3* supplementary stars, and a programme of 3754 *AGK3* reference stars required for the photographic survey of improved positions and proper motions. Much work is done in connexion with the Time Service, including a co-operative effort to determine the relation between Universal Time and Ephemeris Time by direct lunar photography using a Markowitz Moon camera. Work at Ottawa is by no means confined to positional astronomy, and investigations are in progress on meteor astronomy and meteorites, solar physics and radio astronomy. An intensive search of air photographs of Canada has revealed a number of circular features, some of which may be the remains of meteorite craters. These are being studied by geophysical techniques, and in two cases rock cores have been drilled. It is considered highly probable that the craters at Hollerford, Ontario, and Deep Bay, Saskatchewan, are due to meteoritic impact. An 84-ft. radio telescope has been erected near Penticton, B.C., and installation of equipment is in progress. A programme on 21-cm. hydrogen radiation will soon be undertaken.

At Queen's University a modest programme of astronomical research has been started. Measurements on the scintillation of radio sources have produced results relating to the ionosphere, to rapid variations of the geomagnetic field, and to radio bursts from the Sun. Much radio equipment is in the course of construction, with the view of counting cosmic radio sources.

The David Dunlap Observatory of the University of Toronto is the leading Canadian institution with a large teaching schedule in astronomy. Recently there has been a marked increase in student enrolment in astronomy courses, and there are at present five students taking the full graduating option in astronomy, and six graduate students. Recently accepted theses have included calculations on the interior structure of sub-dwarfs, and photometric and spectrophotometric studies of visual binaries and the determination of their ages. Some work on stellar radial velocities is still in progress, although no new large programmes in this field have been laid out in recent years. The long-established work on globular clusters is continuing; about 4,500 photographs have been accumulated. Many cluster variable stars have been found and periods determined. A supplementary bibliography on individual clusters is being prepared and will shortly be published. Spectroscopic studies of hot carbon stars have been made, and it has been

shown that the photo-ionization of neutral carbon is probably responsible for the opacity in the atmosphere of *R Coronae Borealis*. Investigations of galaxies have led to the identification of a large near-by cluster of galaxies in Canes Venatici, the recalculation of the absolute magnitudes of supernovae and a redetermination of the Hubble constant of expansion of the universe. The radio astronomy programme at Toronto is varied in nature. It includes the measurement of absolute fluxes of the Sun and of selected sky points, and thermal sources are being developed to provide the calibration of the radio-meter.

Several Divisions of the National Research Council are pursuing research on astronomical and related problems. Meteor work has been in progress for many years, and both visual and radio techniques are used. A photographic programme of meteor spectroscopy has been undertaken. Auroral and upper atmosphere research is also in progress. Work in radio astronomy includes regular observations of the total flux of radiation from the solar disk and the measurement of the absolute fluxes from bright radio sources. The existing radio astronomy site near Ottawa is now becoming unsatisfactory because of the large amount of interference arising from the expansion of the city. This has led to the establishment of a new quiet site for radio astronomy in Algonquin Provincial Park at Lake Traverse. Radio astronomical and geophysical investigations are also undertaken at several establishments of the Defence Research Board; most of this work is directed to studies of solar-terrestrial relations, the ionosphere and the aurora.

At the Dominion Astrophysical Observatory at Victoria many astrophysical investigations are in progress. Much time has been given to observations of eclipsing binaries in which one star is a cool super-giant and the companion a smaller hot star. The eclipses last many weeks, and observations at ingress and egress enable the atmospheres of the super-giant components to be studied. Five such binaries have been observed. The outer atmospheres of the super-giants contain local condensations of matter in violent mass motion, with velocities of 20 km./sec., or more, relative to the surface. The super-giants have radii, masses and luminosities of respectively 200, 20 and 3,000 times the corresponding solar quantities. Other cool stars are being observed and their spectra analysed by conventional methods. The hot *O*-type and Wolf-Rayet stars are being analysed. They also show large mass motions in their atmospheres; their atmospheres tend to be unstable, showing shells or halos, and it is likely that matter is ejected from these stars. Variable stars of the β Cephei type are being followed in detail, and cometary spectra are obtained whenever an opportunity offers itself. Much effort at Victoria is devoted to stellar motions. The radial velocities, absolute magnitudes and distances of many early-type stars are being obtained, both for individual stars and for members of clusters and associations. Several long-term programmes of radial velocity observations are also under way. New instruments under construction

include a fast grating spectrograph for the 72-in. telescope and a microphotometer recording directly the intensities of spectrum lines, and a Coudé spectrograph for the new 48-in. reflector is being designed.

An astronomical programme at the University of Western Ontario deals with the photometry and spectrophotometry of peculiar *A* stars. Observations are being made to determine which of these stars are variable and to study the nature of the light vari-

ability. The variations in their spectra are also being studied. A programme of laboratory work on molecular spectra has included the measurement of intensities in many astrophysically important bands, the photography of many bands and the determination of lifetimes of various states. An experimental study of the physical basis of the Hanbury Brown-Twiss intensity interferometer has been undertaken, and further work on this is in progress.

R. H. GARSTANG

THE ROCKEFELLER FOUNDATION

THE President's review from the Rockefeller Foundation annual report for 1959 covers a year of appropriations totalling more than 34 million dollars; 6,769,070 dollars went to programmes in the agricultural sciences, 12,300,071 dollars to those in medical and natural sciences and 4,049,350 dollars to those in the social sciences, while 291 Fellows from 39 countries began advanced study outside their own countries, and 339 other Fellows continued work through earlier awards, besides briefly dealing with the Foundation's operating programmes. Five main topics are discussed. The India International Centre, established at New Delhi in March 1959, with the support of 35 of the 38 universities in India, as well as Government support, is intended to provide a forum for fruitful cultural and intellectual exchange in a congenial setting where foreign and Indian leaders of thought may live together: it should serve as a place where scholars and scientists from Indian universities can meet and live with foreign cultural leaders and provide for more frequent contacts and exchange among the widely scattered Indian universities. A small publishing programme is also planned. Besides a grant of 710,200 dollars for building and selected expenses the Foundation has made allocations of 123,935 dollars for five years towards the operating expenses of the Centre.

To assist the New York University to meet the national needs for research and training defined by the Brooklyn Museum conference as necessary to ensure adequate standards of conservation of the nation's immense art heritage, the Rockefeller Foundation has provided 500,000 dollars towards the initial expenses of establishing a laboratory at the University's Institute of Fine Arts new quarters and, on a declining basis during ten years, towards certain operating expenses. The Foundation has already awarded fellowships to three members of the staff of the All-India Institute of Medical Sciences, in which, it is estimated, the Government of India will have invested the equivalent of more than 9 million dollars by March 1961, as well as six travel grants to members of the faculty and administrators since 1957, and appropriations totalling 300,000 dollars for teaching and research equipment. Still more recently, some 500,000 dollars have been released to meet foreign exchange requirements for the construction of the hospital clinic complex. At September 1, 1959, 50 postgraduate students were enrolled, of whom 40 (selected from 60 applicants) were preparing for teaching and research in the basic medical sciences, but only 13 out of 94 applicants could be accepted for postgraduate studies in the clinical fields. There are now 215 undergraduate students, and the first group

will complete the basic course of study at the end of 1960.

Dean Rusk also directs attention to the unexpected dividends on virtually a world-wide basis which the Foundation's modest agricultural programme, began in Mexico in 1943, is now paying. When the project has been completed, descriptions will have been published of virtually all the races of maize in Latin America and seeds of all races will be in cold storage in three centres in Latin America with duplicate samples in storage in the United States. The seed of these maize races is available to corn breeders in all parts of the world, and the collections, which are serving as models for similar banks involving other crop plants, have been drawn upon extensively and have been widely used by maize geneticists in the United States in connexion with analyses of genetic systems of the maize plant, while classification of the living races of maize has permitted identification of many varieties in the prehistoric collection of maize from archaeological sites. The Foundation has also joined forces with the Ford Foundation in establishing an international research institution to meet the urgent need for rice improvement, and, in co-operation also with the Government of the Philippines, an International Rice Research Institute is being planned on a site adjacent to the College of Agriculture of the University of the Philippines at Los Baños, towards which the Ford Foundation has appropriated 6.9 million dollars for construction and equipment and the Rockefeller 160,000 dollars for operating costs in 1960; the Institute should be in full operation by the end of 1961.

Besides this major advance, the operating programme in agriculture in 1959 saw the inauguration of the Inter-American Food Crop Improvement programme, and as a result in the Central American Corn Improvement Project there are now in the six countries concerned 23 full-time specialists instead of 5 part-time. Development of centres for fundamental research to increase knowledge of varietal improvement, soil fertility, cultural practices and the control of plant diseases is being encouraged. Besides referring to progress in the Mexican, Columbian, Indian and Chilean Agricultural Programmes, Dean Rusk emphasizes the virus research programme of the Foundation for which 1,194,640 dollars was appropriated in 1959, under which 110 agents known or suspected of being arthropod-borne are being investigated, 60 of which fall into four major groups, and very good evidence is available that 84 are transmitted by mosquitoes.

It is becoming increasingly evident that infection of man with an arthropod virus is usually accidental,