

# THE ROYAL OBSERVATORY, GREENWICH

## ANNUAL REPORT OF THE ASTRONOMER ROYAL

THE annual report of the work of the Royal Observatory, Greenwich for the year ending May 1, 1940, was presented by the Astronomer Royal to the Board of Visitors on June 1. The following are among the chief items of the report.

*Reversible Transit Circle.* The observations for providing the foundations of a system of right ascensions have been continued. More than 3,500 transits were observed during the year besides a large number of observations for determining the collimation, level and azimuth of the instrument. The level error has proved to be subject to rapid diurnal variations due to changes of temperature and direction of wind. Experiments are being made to reduce these fluctuations to a minimum. Observations for the errors of the divisions of the fixed circle are progressing; already to date some 180,000 individual microscope readings have been made.

*Small Transit Instrument.* A small reversible transit instrument made by Cooke, Troughton and Simms has been purchased from the Crown Agents for the Colonies. The instrument is of more modern design than the small transit instruments made in 1874 hitherto in use at the Observatory for time determinations. It is hoped that observations made on the same night with (1) the new instrument, (2) the small transit in current use, (3) the large reversible transit circle, will give useful information concerning fluctuating errors of instrumental origin.

*Total Eclipse of the Sun on October 1, 1940.* An expedition from Great Britain had been planned to observe this eclipse in South Africa. On the outbreak of war, the plans for the Royal Observatory expedition were cancelled, but a part of the equipment, together with spectrographic instruments from the Solar Physics Observatory, Cambridge, has been sent to South Africa for use by a combined expedition from the Royal Observatory, Cape of Good Hope, and the Union Observatory, Johannesburg.

*The Greenwich Equatorials.* (a) 28-inch refractor, (b) 26-inch refractor, (c) 36-inch reflector (Yapp). Work on both (a) and (b) ceased on September 1-2, when the object glasses of the instruments were dismounted for safety. Up to that date, however, 402 plates suitable for parallax measurements had been taken with (b). Work with the slit-spectrograph on the Yapp reflector has been continued, and 49 ultra-violet spectra of 35 *F* to *M*-type giant stars have been obtained to test the possibility of the presence of high-temperature companions to those stars that are spectroscopic binaries.

*Observations of Eros.* The discussion of the material obtained at the 1931 opposition already to hand is in progress. It is clear that the final value of the solar parallax will be nearer 8.79" than 8.80", the latter value being that adopted in the *Nautical Almanac* and other natural ephemerides.

*Solar Observations.* The downward trend of the present 11-year cycle after a very high maximum in 1937-38 seems now established, although the sun has shown considerable activity throughout the year. Three of the numerous groups of sunspots recorded

equalled or exceeded 2,000 millionths of the sun's hemisphere at their maximum development. The relationship between bright chromospheric eruptions and magnetic storms has been studied at Greenwich during the past year.

*Time Service.* Astronomical determinations of time were made on 121 nights with the small reversible transit. Star places based on the FK3 Catalogue have been used in the reductions since January 1. The universal adoption for the time determinations of the same fundamental system of star places will make the times determined at different observatories more directly comparable than hitherto. The principle of employing a 'mean clock' has been continued. Six Shortt clocks normally comprise this mean clock.

The quartz crystal controlled oscillator clock is running satisfactorily, but with rather a large rate, and the performance is not as good as it should be. At the completion of the present run, it may be necessary to have a fresh crystal cut; and the opportunity will be taken to use a fundamental frequency of 100 kilocycles per mean solar second instead of per mean sidereal second as at present. The usual service of rhythmic time signals radiated by the Post Office has been maintained. For about two months short-wave transmission was used. The B.B.C. six dots and hourly signals for controlling the 'talking clock' have also been transmitted regularly.

*Nautical Almanac Office.* The work of the Office has been mainly devoted to the routine calculation and proof reading involved in the preparation and publication of (1) the *Nautical Almanac*, (2) the *Abridged Nautical Almanac*, (3) the *Air Almanac*, (4) the *Astronomical Navigation Tables*, and for the first year (5) the *Apparent Places of Fundamental Stars*. Surveying this large output of material, the report adds that the Office is now responsible annually for the calculation and publication of about 5,500 large octavo pages of figures; there is probably no other institution of similar size that approaches this output.

*Magnetic and Meteorological Observations.* The variations of declination, horizontal force and vertical force have been continuously recorded photographically throughout the year at Abinger, absolute observations being made every weekday. The La Cour magnetographs installed during 1937-38 continue to give very satisfactory results. During the year, 30 magnetic storms were recorded of which 7 were 'great' storms. The disturbance on March 24 ranks among the greatest storms of the past ninety years.

Routine meteorology was commenced at Greenwich on November 9, 1840, and the Meteorological Department has thus now entered the hundredth year of its existence. The mean temperature for the past year was 49.1° F. (0.4° lower than the average of seventy-five years, 1841-1915). The highest temperature in the shade was 85.2° on June 7; the lowest, 12.4°, on January 20. Temperatures of freezing point or below were recorded on 66 days, of which 27 were in January. The total rainfall was 30.23 inches, which is 5.99 inches greater than the average.

The Astronomer Royal concluded his report as follows :

"In last year's Report, reference was made to the deterioration of the conditions for astronomical observations at Greenwich and for the urgent need for the Observatory to be removed to a site where the conditions are favourable. At the same time the increasing magnetic disturbance at Abinger caused by the development of electric traction requires the removal of the magnetic observations to a site remote from railways, if high precision in the observations is to be attained and if the Observatory is to be secure for the future against further developments in railway electrification. A number of possible sites, both for the astronomical and for the magnetic observations, were examined during the year. The further consideration of the plans for the removal to new sites of the astronomical and magnetic observations has necessarily had to be deferred until after the conclusion of the War.

"The further improvement in accuracy of the time service provided by the Observatory has been under consideration. For purposes where high precision is needed, corrections to the time signals are published

at approximately monthly intervals, after the errors of the mean clock have been satisfactorily determined from a large number of observations. The great developments in recent years in precision frequency standards and in their use have created a need, which is extending rapidly, for time signals of such precision that an interval of 24 hours can be measured to an accuracy of one thousandth of a second, without the application of corrections published after a considerable interval. This precision is not attainable with pendulum clocks, which are less accurate than the precision frequency standards themselves. The installation of a battery of quartz crystal oscillator clocks of the highest precision is required, in order that the frequency stability of modern frequency standards may be satisfactorily controlled. Conferences on this subject have been held with the Radio Section of the General Post Office and the Research Department of the British Broadcasting Corporation. The help and collaboration of these bodies and also of the National Physical Laboratory are greatly appreciated and should go far towards enabling a satisfactory scheme to be drawn up."

## THE PHYLOGENY OF MAN

PROF. W. E. LE GROS CLARK, discussing recent additions to evidence bearing on the phylogeny of man (*Biol. Reviews*, 15, 2, 1940), begins by passing in review the fossil man-like apes, commencing with the Eocene Tarsioids and the Anthropoidea, of which the earliest representative is Parapithecus from the Oligocene of Egypt. It has now become evident that at the beginning of the Miocene the main groups of the anthropoid apes which exist to-day were already undergoing separately their evolutionary definition. It is probable that the human line of descent became first differentiated at this period and that the initial appearance of the Hominidae is to be sought in the palaeontological records of this period.

The evidence for the fossil man-like apes, the Dryopithecidae, though widespread, consists almost entirely of teeth. Nevertheless, it points to the existence of some twenty to thirty different species, indicating that differentiation from generalized ancestors had already begun. Some of these species already show marked resemblance in dentition to man, while others approximate to the orang. In the Brahmapiithecus and Ramapiithecus discovered in India the resemblance to man is even more emphatically marked—so much so, indeed, that question has been raised as to the propriety of including Ramapiithecus in the Simiidae rather than the Hominidae. A comparison with the Pleistocene apes of South Africa, of which portions of the skull are available, leaves no doubt as to their Simian status.

The evidence relating to the Miocene apes, then, suggests that they may have included among their number the direct ancestry of man. The only evidence apart from teeth, relating to the Dryopithecine groups, consists of a femur and shaft of a humerus of somewhat uncertain identification. If as is

probable they are to be accepted as belonging to Dryopithecus they suggest that Dryopithecus was a 'ground-ape'; and there is every reason to believe that the human line took its origin from a form adapted to a terrestrial life.

Of the extinct man-like fossil apes of South Africa, while there can be no reasonable doubt of the human characters of the milk dentition and palate of Australopithecus, the main difficulty of interpretation lies in the attempt to assess the characters of the adult from an immature individual. Of the recently discovered Paranthropus and Plesianthropus of R. Broom it may be accepted as an established fact that the teeth and palate in several respects are more human than those of any of the living anthropoid apes. The geological and faunal evidence alike debar them as too recent to stand in the direct line of human descent, but on the view that they derive from a dryopithecid ancestry of Miocene date, they support the conclusion that the dryopithecid stock was endowed with a potentiality of evolutionary development in the direction of the Hominidae so far as teeth and palate are concerned.

Turning to the ape-like men, the recently discovered examples of Pithecanthropus, and especially the early infantile skull from Modjokerto, with which are here included the fossils from Choukoutien referred to the genus Sinanthropus, have served to confirm the Hominid status of the Pithecanthropus group. Despite many primitive features of the skull, brain and dentition, the limb bones are closely comparable with those of modern man. If the modern characters of the human limbs had already been acquired so early as the beginning of Pleistocene times, the point of divergence of the Hominidae from the Simiidae must have been correspondingly more remote.