

its variation under natural conditions is determinative for the rate of rotation.

A graphic comparison of the fluctuations in the rate of rotation and degree of humidity showed that there was no connection between them under the (natural) conditions prevailing when the observations were carried out.

From some laboratory experiments with pot-plants it appeared that the rotational movement is not different, or at any rate not essentially different, in the dark and in scattered daylight.

An endeavour was made, with the minimum temperature (which "lies in the neighbourhood of 4°") as starting point, to obtain an expression of the relative quantities of heat, which were of importance for the rate of rotation. The numbers obtained, which are called "active quantities of heat," show that there is a very complete agreement between fluctuations in these and in the rate of rotation, the fluctuations showing a perfect synchronisation under the conditions observed.

Comparative experiments with twining bean-plants, and with *Lonicera periclymenum*, L., showed that a similar daily periodicity in the growth in length and rate of rotation of the stem occurred and that temperature is here also the determining factor. The author concludes by remarking:—"It is probable that the growth movements in many plants living under climatic conditions such as ours, where great temperature fluctuations occur in a diurnal period, have a diurnal periodicity which follows that of the temperature."
E. S. S.

EDUCATION IN INDIA.¹

IN the two substantial volumes before us Mr. Sharp gives an exceedingly able and comprehensive summary of the educational work done in India in the period 1907-12. The value of this record is enhanced by the inclusion of a Resolution of the Government of India dated February 21, 1913, summarising its educational policy, and forming a masterly exposition of its aims. A member of the Council of the Government of India has now been appointed with special charge of education, and the first incumbent of the post is Sir Harcourt Butler, who is to be congratulated on this very able summary.

The impression gained from the volumes is that education in India has now entered on a new and hopeful page of its history, for the progress made in the past five or ten years has been very great. Every effort is being made not only to widen the area of education, but also greatly to improve its methods, while in the forefront the formation of the character of the pupils is rightly insisted on. There are also clear signs that in the future efforts will be made to raise the status of those engaged in education, and to make their position such that the post of a teacher will be much sought after, and not taken as a last resource, as is largely the case at the present time.

India is sometimes pictured as a single country, but it really shows far greater complexities in education than Europe itself. It is computed that there are about thirty-eight million children of school-going age in the area dealt with in this report, while there are only 176,225 educational institutions of all classes, and in these six and three-quarter million pupils are under instruction. Almost all of these are boys, and the most trustworthy figures show that in 1911-12 for every mille of population of school-going age there

were 268 boys and 47 girls under education. Five years previously these figures were 227 and 32 respectively. This really represents rather rapid progress, though compared with civilised Europe, India is still very far behind in the education of its masses.

Until recent years more attention was paid to the development of higher education than to that of the masses, but this has been largely changed during the past ten years, and now primary education is being largely fostered.

The type of higher education at first introduced was unpractical, largely literary, and tended to superficial knowledge, and in a large proportion of the students it did not fit them for their work in after life. Various efforts at reform were made, but the first effective movement came from Lord Curzon when Viceroy of India, who in 1901 summoned a representative conference which dealt with the whole subject of education from the university down to the primary stage. Numerous far-reaching reforms were formulated, and the history of many of the reforms is illustrated in the work under review.

One of the results of the conference was the Universities Act of 1904, under which regulations were framed, which came into force about the beginning of the period which is dealt with in Mr. Sharp's volumes. This Act was most bitterly opposed, but it is now admitted that it has produced a general and most important improvement in both university and secondary education, for some of the universities in India have large powers over the secondary schools which prepare candidates for university education, as they regulate the courses of study and even have powers of inspection, etc. It is probably true to say more progress has been made during these five years in improving and consolidating secondary and university education than in any previous quinquennium, for institutions which were working inefficiently have ceased to be recognised and have disappeared, while others have been helped and made more efficient. Indeed, the report indicates there have been great improvements in the courses of instruction in colleges and schools, also in thoroughness of study, in the more practical requirements in the study of, and examination in, science subjects, and finally in considerable improvements in discipline and in the formation of character, due to the students being compelled to live in recognised hostels (on which much money has been spent) or in messes under proper supervision.

The reforms due to the Educational Congress of 1901 included a large extension and improvement in primary education and its more efficient inspection, and a recommendation that greater attention should be paid to the teaching in and through the vernaculars. Both these reforms have made large progress during the past five years, and are undoubtedly leading to sounder education. Attention is now also being paid to manual training and nature-study. An endeavour to obtain more trained teachers in all stages of education is occupying considerable thought, and efforts are being made to effect this, but when it is stated that there are 215,518 teachers in India, who all ought to be trained, the magnitude of the problem is seen to be almost overwhelming.

Increased attention has also been given to female education, which, owing to the peculiar difficulties arising from the customs of the people themselves, has always been, and still is, in a very backward condition. As the result of this increased attention during the five years, the number of girls at school has increased by 47.7 per cent., but even this large increase only brings up the percentage of girls at school to the population of girls of school-going age to 5.1 per cent. Strenuous efforts are being made to

¹ Progress of Education in India in 1907-12. Sixth Quinquennial Review, by H. Sharp. Vol. I. pp. xvii+284+index; vol. II. pp. 292. (Calcutta: Superintendent Government Printing, India, 1914.) Prices, vol. I., 6s.; vol. II., 3s.

render female education more popular and effective, and on their success the future progress of India in a large measure depends.

It is remarked that during the five years a very great change has taken place in the feeling of the population of India towards education, and it is now much more popular than it was. Indeed there was a proposal to make primary education compulsory in India generally, but this has been negated, though it is being adopted in Baroda.

Much more money is now being spent on education. In 1907 the cost of education was said to be 559 lakhs of rupees, and in 1912 it had risen to 786 lakhs, of which the Government contributed a very large proportion. With this liberal policy there is no doubt very rapid progress will be made, for the cost of educating individual pupils in India is still small. Thus the annual cost of a primary-school pupil is about six shillings, of a secondary-school pupil about 1l. 12s., and of a pupil reading for a university degree about 11l. 5s., and yet with these small individual sums a fair training is being given in the case of university and secondary education, though the primary education is still very defective.

THE MOUNT WILSON SOLAR OBSERVATORY.

IT is always difficult to condense in a few lines the essence of the work accomplished during a year at the Mount Wilson Solar Observatory. The report for the past year, just issued by the director, is a concentrated essence by itself, and as it covers forty-five pages the difficulty of the task will at once be grasped. The director commences the report by summarising the principal results obtained during the year, and the brief paragraphs which compose this summary, each of which is practically restricted to an important piece of research work, number no fewer than *seventy-two*. Space does not permit one to refer even to the more important of these, but many have already received notice from time to time in our astronomical column, and are therefore familiar to our astronomical readers. Perhaps the most important result is that concerning the magnetism of the sun. Observations of the Zeeman effect at various solar latitudes have indicated that the sun is a magnet, and that the magnetic poles are at or near the poles of rotation. Further, the polarity of the sun corresponds with that of the earth, a conclusion, as the director, Prof. Hale, remarks, which may prove to have an important bearing on theories of terrestrial magnetism. The first approximate value for the vertical intensity of the sun's general field at the poles is given as 50 gauss, which is about one-hundredth of the intensity of the most powerful sun-spot fields, and about eighty times that of the earth's field.

One of the most interesting items usually associated with these reports is the work of construction in hand, and this report shows an astonishing amount of work in progress. The fact that the 100-in. disc has been proved to be serviceable for a reflecting telescope has given rise to a great increase of activity. The grinding of the mirror and the 60-in. plane mirror for testing it have been pressed forward, and the requirement for larger shop tools necessitated by the construction of many parts of the 100-in. telescope mounting and the auxiliary instruments to be used with it have even demanded an increase in the already large shop floor-space. The work involved in the preparation of the foundations for this telescope and of the building and the eventual transport of the instrument to the moun-

tain-top has necessitated the adoption of especially powerful motor trucks in place of the mule teams.

Other important work in hand is the construction of a large ruling-machine, embodying the general principles of Rowland's successful ruling-machines. An idea of the accuracy attained after the grinding and polishing of the screw will be gathered from the statement that no periodic errors were found greater than 0.000001 in., and no appreciable error of run could be detected. The maximum error in the teeth of the wormgear did not exceed 0.001 in., a quantity too small to produce appreciable ghosts.

To gain a more complete insight into the contents of the report the reader must be referred to the report itself. The fact that such rapid advances are being made in both solar and stellar physics is due to the happy combination of an energetic and able director, a keen and active staff, a good observing site, and an annual grant (for 1913) of 33,126l. for construction, investigations and maintenance.

MARINE INVESTIGATIONS.

THE report on the Danish Oceanographical Expeditions, 1908-10, to the Mediterranean and Adjacent Seas, under the superintendence of Johs. Schmidt, No. 2, contains two memoirs, one by Dr. Kyle, on flat fishes, and one by Dr. Schmidt, on experiments with drift-bottles. Dr. Kyle's paper is an important contribution, and deals with the following genera in a very comprehensive way:—*Arnoglossus*, *Bothus*, *Solea*, and *Symphurus*. The much disputed question as to the number of species of *Arnoglossus* occurring in European seas is very elaborately discussed, and Dr. Kyle's conclusions differ in several respects from those of previous authors. He recognises five species, the specific names being used, however, in a different sense from that which has been adopted by recent writers on the subject. The species are *Arnoglossus grohmanni*, Bonap., non auctorum, *A. thori*, nov. nom., *A. laterna*, Will., *A. imperialis*, Raf., and *A. rüppelli*, Cocco. Of these *A. thori* is the species which has generally been called in this country *A. grohmanni*. Dr. Kyle discusses not only the adult characters, but also the larval and post-larval stages of this genus and of the other genera of which he treats. The paper is well illustrated with text figures and plates, and will be of the greatest value to future workers. An excellent bibliography of the subject is added. Dr. Schmidt's experiments with drift-bottles show that there is an easterly drift of the surface water from the entrance of the Mediterranean, especially along the north coast of Africa, so that water from the Atlantic is being constantly carried into the Mediterranean. The velocity of this drift may reach eighteen to twenty miles a day.

The Central Bureau of the International Council for the Study of the Sea has issued vol. xvii. A of the "Rapports et Procès-verbaux des Réunions" (English edition), which contains the first part of Prof. Heincke's long-delayed general report upon the investigations on the plaice. This part of the report is confined almost exclusively to a discussion of the statistics obtained from commercial fishing vessels, and is further limited in scope by the fact that the English statistics are alone considered. The report is, in fact, little more than a renewed attempt to discuss the conclusions to be derived from these English statistics, matters which had already been dealt with by the officers of the Board of Agriculture and Fisheries. It is doubtful whether Prof. Heincke's methods of dealing with the statistics are in any way an improvement upon those followed in this country, and, probably from want of adequate trained assistance, it seems clear that the work has not been car-

¹ Annual report of the director of the Mount Wilson Solar Observatory 1913. Carnegie Institution of Washington.