

The Mathematical Association in Conference.

THE annual meeting of the Mathematical Association was held at the London Day Training College on January 4 and 5, with Prof. G. H. Hardy presiding. The report of the Council records continued growth in membership, and continued activity on the part of committees. The programme of the meeting consisted of three lectures and two discussions, in addition to the president's address.

Prof. E. N. da C. Andrade, whose subject was atomic structure, described the decomposition of a line spectrum into series, and Bohr's theory of the relation of these series to the constitution of the atom.

A lecture on modern theories of integration was in the nature of an experiment, and was brilliantly successful. After recalling the dual rôle of the integral in elementary work, Mr. Carey Francis showed the limitations imposed by any definition of the definite integral in which the only division of the range which is contemplated is a division into sub-intervals. He explained how the measure of a set of points extends the conception of the length of an interval, and introduced the Lebesgue integral and the Stieltjes integral as natural results of subdividing the range of integration into sets of points of any kind instead of into intervals only. Mr. Francis' achievement in making clear the nature and purpose of a mathematical method that was outside the curriculum in the student days of the majority of his audience seems to indicate a new and valuable function of the Association.

A forcible speech by Mr. E. R. Brown opened a discussion on the *Mathematical Gazette*, the organ of the Association; the remarks of different speakers emphasised the variety of tastes for which an editor may be asked to cater, without showing very clearly the sources from which he can draw.

Dealing with the measurement of intelligence, Prof. C. Spearman first illustrated the difficulty of reaching agreement either on a simple definition of intelligence or on the group of elementary qualities to be included in a composite definition. He afterwards explained the discovery that over a very wide range the observations can be systematised by the recognition of two factors, one which can be regarded as a measure

of general intelligence and another which depends on the subject in which the individual is being tested.

The president's address was entitled "The Case against the Mathematical Tripos." Examinations have their place in education up to a certain point as natural and effective tests of industry and of the ability to learn and to reproduce, but the claim made for the Tripos has been that it assesses qualities of a higher order. Because of this claim and of the prestige of the Tripos, training for the examination has been substituted for genuine mathematical education, with the mischievous result to the individual that at any time it has been possible to obtain the highest honours while completely ignorant of all the broad developments of the previous thirty years, and to the nation that in no subject except music has the international position of England been so deplorable throughout two hundred years as in mathematics. Not only is it difficult to present in theory a plausible defence of the claim made for the Tripos, but in practice, position in the Tripos is ignored in all but an insignificant fraction of appointments, and if the Tripos is less harmful to English mathematicians now than fifteen years ago, that is because there is no distinction now which a good student does not obtain as a matter of course. Convinced that the best that can be said for the Tripos is, that so long as no attention whatever is paid to it either inside the University or outside, its ill effects are negligible, Prof. Hardy advised mathematicians at Cambridge deliberately to lower the standard at every opportunity, and so to reduce the examination to an absurdity the abolition of which must be only a matter of time.

Time was allotted for discussion of a "Report on the Teaching of Mathematics to Evening Technical Students," which has just been prepared for the Association; unfortunately, the report was not in the hands of members, and speakers could refer only to a synopsis distributed at the meeting, but interesting views were expressed on such matters as the value of deductive geometry for these students, and appropriate methods of introducing logarithms and the exponential function.

Agricultural Education in the United States.¹

DURING the last half-century the importance of agricultural education has been increasingly recognised in America, until now every State has one or more agricultural colleges, forming a group of institutions occupying a prominent position in the field of education. During the decade 1910-1920 development was extraordinarily rapid, and very large sums of money were appropriated in many States for the provision of new agricultural buildings, the purchase of land, and the endowment of educational programmes. The colleges have had a long struggle for recognition, but have demonstrated their value and are now in such a position, financial and otherwise, that their future usefulness is assured. The immediate need is for trained teachers, investigators, and administrators, and in response to this, graduate work in agriculture has developed with amazing rapidity during recent years, though in certain colleges it is still seriously handicapped by lack of funds and accommodation. At present the full agricultural course extends over four years, but there is a suggestion to

extend this to five in some cases for the purpose of specialised training. In many colleges the curricula have been steadily changed in order to keep abreast of the modern requirements of agricultural education, though there are still some in which the work is too largely restricted to methods of production, resulting in a narrowed outlook.

The field of work covered is very wide, ranging over at least a dozen branches, which, however, are not rigidly separated but dovetail into one another to some extent. All branches have developed from small beginnings, shaping themselves according to the needs of the time, with the result that some subjects which were originally an integral part of one branch are now dealt with more fully and adequately by others. Agronomy was initially defined as covering that part of the general field of agriculture devoted to climate, soils, fertilisers, and farm crops, but it now tends to deal with the more fundamental and far-reaching problems of soil physics and chemistry, plant physiology, and plant genetics. It is claimed that the instruction in agronomy has had much to do with securing the improved crop production of the United States in recent years. Horticulture has almost always

¹ Land Grant College Education, 1910-1920. Part III.: Agriculture. Edited by W. C. John. U.S. Bureau of Education Bulletin, 1925. No. 4. Pp. 105.

had a separate existence in the colleges, but with the growth of various interests, certain branches have developed until now they are treated independently, pomology and vegetable gardening being notable examples. With the better recognition of the importance of the forests to the nation, the instruction of forestry has advanced from exclusive concern with questions of afforestation to consideration of the vital problems of the proper protection, management, and perpetuation of existing stands of timber. The land grant colleges recognise their opportunity and responsibility to train the leaders with the necessary technique and with the broad outlook which will enable them to develop sound public policies of dealing with the forests and to establish right standards of practice. The general scheme of education keeps in view both the scientific and practical aspects of agriculture, and endeavours to emphasise the entire interdependence of the two. In addition to the branches already mentioned, special sections are devoted to soils and fertilisers, plant pathology, entomology, animal, dairy, and poultry husbandry, veterinary education, and agricultural engineering.

It is recognised that the four-year college course is not sufficient to supply the demand for trained workers on the land, partly because so large a percentage of graduates draft off into other occupations, as teachers, county agents, scientific workers, etc., and partly because a large proportion of those intending to farm cannot afford the time or money for a full college training. To meet the needs of the latter class, various types of short courses have been developed covering the various sections of the community concerned. The older boys and girls are catered for by special agricultural schools, farmers are provided

with short courses extending over a few weeks only, at the slackest times of the year, and short schools are held for training specialists in such subjects as dairying, cotton culture, and ice-cream manufacture. In addition, courses in agriculture and horticulture are run for one, two, or three years, primarily for young men and women who intend to make farming their life work. Many problems have arisen in the development of these short courses, and special endeavours are made to solve them in such a way as to render the courses an integral and valuable part of the whole educational scheme.

During recent years a very marked development has taken place with regard to the professional training of teachers in agriculture. Special legislation has provided grants from Federal funds for the purpose, on the condition that equal sums are found by the States participating. The expenditure in this respect increased from 121,244 dollars in 1918 to 651,792 dollars in 1921, the growth of the work being so rapid that it was difficult for the land grant colleges to secure adequately prepared instructors for the purpose. Still more recently a demand has developed for courses in education designed to meet the needs of college instructors, and there seems little doubt that this part of the work will increase in relative importance. The same may be said of the agricultural extension work, which has steadily increased until in 1921 more than 18 million dollars were expended thereon, directly aiding the improvement of the farm and home practice of more than two million workers directly connected with the land, the whole of the extension work in 1920 costing 75 cents for each 1000 dollars of gross returns from agricultural production in the United States.

The Rainfall of Dry Periods in Relation to Water-power Schemes.

IN all questions relating to water-power schemes, some estimate of the water available is of first importance. Most schemes involve the storage of water in reservoirs, the size of which depends on the proposed draw-off compared with the run-off from the gathering ground in a dry period. Undoubtedly measurements of stream flow afford the best hydrological data upon which to base calculations. Such data are, however, often too short to give the average over a long period or the flow in the all-important dry period. Thus to a large extent calculations have to be based upon measurements of rainfall, compared where possible with gaugings of stream flow. It is, therefore, important to consider the relation of the average rainfall (1) to that of the period for which stream gaugings are available, and (2) to falls in dry periods in that area.

An investigation has been carried out on this subject by Capt. W. N. McClean,¹ who has analysed the monthly and annual rainfall figures for the fifty years 1871 to 1920 for thirty-five stations in Scotland. This mass of data is marshalled into a convenient graphical form, the unit of measurement of rainfall being expressed throughout in inches per annum, and the rainfall being plotted as the aggregate excess or deficiency from the average of the whole fifty years. The curves reproduced in the paper make it possible to read off:

- (1) The actual rainfall of each calendar month and year;
- (2) The lowest rainfall of each month and year; and
- (3) The predicted lowest falls of periods of various lengths based on (2) above.

The fifty years, 1871 to 1920, were remarkable for

¹ "An Analysis of Scottish Rainfall Records." By W. N. McClean. Pp. 19 + 16 plates. (The Institution of Water Engineers, December 1925.)

the run of wet years in the 'seventies, the years 1872 and 1877 being the wettest in the series. The rainfall of the years 1886 to 1889, especially that of 1887, provided in many cases the lowest values in the period under discussion and would have severely taxed the storage capacity of the reservoirs. Outside the series, the year 1870 was as dry as 1887 over Scotland as a whole, while 1921 was noteworthy for the lowest annual totals on record in parts of the east of Scotland. Had these years, 1870 and 1921, been included in the analysis, lower values would certainly have been obtained in some instances and the smoothed enveloping curve of predicted values might have been modified.

One of the important facts brought out by the paper is that the rainfall at some stations is more variable year by year than at others, and this characteristic persists throughout the fifty years. The mean deviation of annual rainfall from the average is known to exceed 12 per cent. in central and south-eastern Scotland. This value diminishes towards the coast on all sides, but especially to the north-west, where, in islands to the west of Scotland, the value is only 8 per cent. This small variability factor in the rainfall of parts of Scotland is of considerable importance in connexion with the supply of storage reservoirs. In arriving at the predicted lowest values for each record, a factor is used based on the mean lowest value for the thirty-five gauges. Since there is this marked geographical variation, it would clearly be advantageous to use a factor varying with the geographical position of each individual station.

The curve of lowest predicted values is obtained from the one extreme value of the low rainfall for each of the periods of varying length. It is, however,