the relative degrees of brightness at these times are 1, $\frac{3}{8}$, and $\frac{1}{3}$, and assuming that the eclipses are central, it is easily shown that the observed magnitudes may be explained by supposing that the two components are of equal size, while one is twice as bright as the other. The unequal duration of the minima further indicates that the orbit is an ellipse with an eccentricity of 0·2475, and it is calculated that the semi-axis major of the orbit is six times the diameter of the stars. The plane of the orbit passes through the sun, and the line of apsides is inclined at an angle of 4° to the line of sight. The stars revolve in this orbit in a period of 3 days 23 hours 48 minutes 30 seconds.

It seems probable that this variable may form a connecting link between Algol, which consists of a bright and a dark body, and Y Cygni, consisting of two stars of equal brightness.

THE DIAMETER OF NEPTUNE.—With the Lick telescope and an eyepiece magnifying 1000 diameters, Prof. Barnard finds the mean angular diameter of Neptune, when reduced to the mean distance from sun 30·0551, to be 2''·433. This corresponds to an actual diameter of 32,900 miles, which is from two to four thousand miles less than that stated in most of our text-books.—*Astronomical Journal*, No. 342.

INDUCED MAGNETISM IN VOLCANIC ROCKS.

AN interesting note by G. Folgheraiter, on the magnetism induced in volcanic rocks by the earth's magnetic field, appears in the *Atti della Reale Accademia dei Lincei* (vol. iv. part 5, March 3, 1895). The author has performed a number of experiments on volcanic rocks, in order to determine the amount of induced magnetism left when, after heating to such a temperature that they entirely lose their permanent magnetism, they are either allowed to cool slowly or are suddenly cooled, in each case under the influence of the earth's field. From such observations he hopes to be able to deduce some conclusions as to the conditions under which the rocks experimented on, which were originally permanently magnetised, became magnetised. The rocks are cut into small parallelopepedons weighing about 50 grams, and such that the length is about two or three times the depth or breadth, care being always taken to cut the rock so that the axes of these pieces were vertical when the rock was in its place in the earth. The intensity of magnetisation was in every case measured by the method of deflection; a freely suspended magnetic needle being deflected by the sample, which was placed with its length east and west. After measuring the intensity of magnetisation of the samples, they were heated to redness, and then either allowed to cool slowly, or are rapidly quenched with their axes vertical. Their magnetic moment was determined, first immediately they were cool, and then after they had stood under the influence of the earth's field for three months. The specimens of basalt examined may be divided into two groups: in the first may be placed those specimens which were originally only slightly magnetised, and in this case, after heating to redness, the magnetisation is always increased, but to a very different degree in the different specimens. The second group includes those basalts which were originally strongly magnetised, and in this case after heating the magnetisation was considerably reduced. In both groups the magnetisation underwent no change during three months, and sudden cooling gave the same results as slow cooling. Experiments have also been made on tuff and peperino. The results obtained with the first of these rocks are similar to those obtained with the first group of basalts. Peperino, however, differs in that, before being heated, its coercive force seems almost nil, the bar becoming only temporarily magnetised. After heating, the character of the rock is altered, as it can now become permanently magnetised and behaves just like the tuff. From this the author concludes that peperino has been formed at a low temperature, probably by the action of water on cinders, &c.

THE FREEZING-POINT OF DILUTE SOLUTIONS.

CORRECT determinations of the freezing-point of dilute solutions are of fundamental importance in connection with the general theory of the subject, and it is therefore anything but satisfactory to find that, in spite of the closeness with which the individual results of the same observer agree amongst themselves, the results of different observers are in many cases widely separated. For example, the following values have been given as the molecular depression of the freezing-point in the case of a 1 per cent. aqueous solution of sugar:—2·02, Arrhenius; 2·07, Raoult; 2·01, Pickering; 2·18, H. C. Jones; 1·81, Loomis. The results of Jones and Loomis, both of whom claim increased accuracy for the methods they employ, differ by some 18 per cent. The theoretical value of the molecular depression, calculated from the melting-point and heat of fusion of ice, is 1·86. The cause of these differences has given rise to much discussion. Pickering has attempted to show that Jones's results, wherein the temperature was read to the ten-thousandth of a degree, were affected by thermometer errors. Jones has replied that his thermometer was tested. Kohlrausch has drawn attention to probable sources of error in Jones's method, but is compelled to admit that the differences between the results of Jones and Loomis must, in the main, be due to some unknown source of error.

A definite step in the direction of clearing up this point is made in a recent number of the *Zeitschrift für physikalische Chemie*. Here Nernst and Abegg emphasise the fact that the observed freezing-point must in general be different from the true freezing-point, or the temperature at which solid and liquid are in equilibrium. They point out that a partly-frozen liquid, uninfluenced by the temperature of its surroundings, will strive to reach the true freezing-point at a rate which, at any instant, may be taken as proportional to the difference between its actual temperature and the true freezing-point. Again, in practice, on account of the limited amount of substance employed, and the effect of the temperature of the surroundings, &c., unfrozen liquid strives to reach a definite temperature, which may be termed the "convergence temperature." On these assumptions it is easy to show that the observed freezing-point, or the temperature at which the thermometer becomes steady, will only be the true freezing-point if the "convergence temperature" is equal to the true freezing-point, or if R, the rate at which the temperature of the partly frozen liquid approaches the freezing-point, is infinitely great as compared with r, the rate at which the temperature of the unfrozen liquid approaches the "convergence temperature." If one of these conditions is not fulfilled, corrections determined experimentally have to be applied. For dilute solutions of alcohol and common salt the corrections were found to be inappreciable under the experimental conditions described in the paper. Here the value obtained for R, although, as is always the case, it was largely diminished by the lag of the thermometer, still was sufficiently large as compared with the value of r. In the case of sugar, however, R was so small that by varying the experimental conditions, a 1 per cent. solution gave molecular depressions varying between 1·6 and 2·1—limits which are even further apart than those given by the results of previous observers. On correcting the observed depressions in the manner described, they all gave practically the theoretical value.

Without these corrections, observed freezing-points are thus held to be functions of the size of the apparatus used, the temperature of the cooling-bath, the rate of stirring which largely affects the "temperature of convergence," &c.

Evidence is also given of the futility of expressing freezing-points to the ten-thousandth of a degree. It may readily happen that the above correction is as high as 0°·01, and as the mode of deducing it is but approximate, in such a case 0°·001 or 0°·002 would be a favourable estimate of the error of the end result, even if satisfactory corrections could be applied for the alteration in the concentration of the solution produced by freezing, and the ordinary sources of error incidental to the method of experiment.

J. W. RODGER.

THE EXAMINATION CURVE.

IF the results of the examination of a mixed body of candidates be plotted out on the graphic method, they will be found, in accordance with a well-known law of statistics, to approximate to a curve having a more or less rapid gradient at either end, and a mid-region of gentler ascent. Fig. 1, for example, shows the results of an examination of 27 students in physical geography, the scale of marks running vertically from 10 to 90, the examinees being arranged horizontally at equal distances apart from the lowest to the highest. The larger the number of candidates the more flattened does the mid-region of the curve tend to become. Again, in any series of examinations, the mean results of which are plotted out, the more uniform the standard of difficulty of the papers set, the flatter is the mid region of mediocrity. Fig. 2 shows the mean results of ten separate examinations, of different students conducted by six examiners, in history, English literature, geography, physical geography, physics, botany, arithmetic, and Euclid. They are taken without special selection from the returns of class examinations in University College, Bristol. The standards were somewhat markedly different; in some the head, in others the tail, being excessive; hence the mid-region is not so flattened as it probably would have been had a larger series been taken. The results indicate, however, sufficiently well

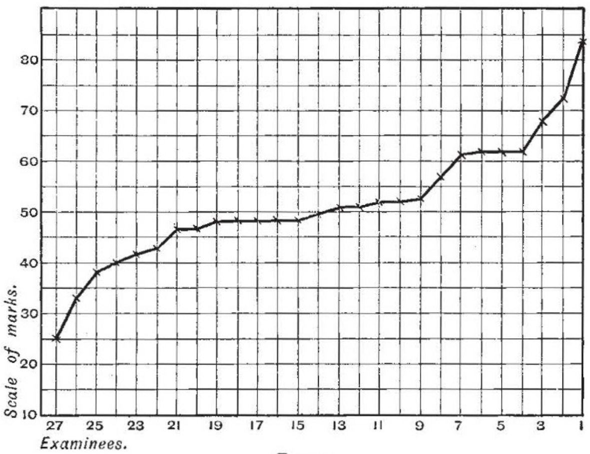

FIG. 1.

the general nature of the examination curve. The total range of marks being from 17·5 per cent. to 84 per cent., 15 out of the 30 students fall within the mid-region of from 40 per cent. to 60 per cent.

It is not my purpose to attempt to determine how far the form of the lower end, or tail, of the curve is due to incapacity on the one hand, or to sheer idleness on the other, and how far that of the upper end, or head, of the curve is due to exceptional ability on the one hand, or to industry and hard work on the other. Whichever cause preponderates, we may say that, at any rate with pupils who have got beyond the school-boy stage,

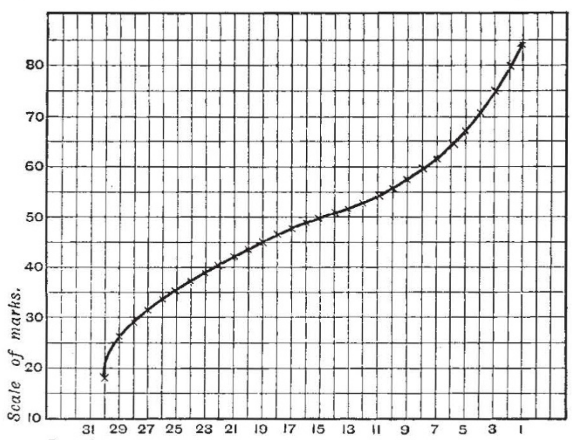

FIG. 2.

and very largely with them too, the teacher's chief field of influence is in the preponderant mid-region of mediocrity. Those in the tail of the curve either cannot or will not profit by his ministrations; those at the head of the curve may be trusted to do well without his aid, or even in spite of his interference. It is on the body of the curve that he can do his best work.

It is, at first sight, somewhat remarkable that the general form of the curve persists as we ascend through a series of graded examinations. It might well be supposed that the tail would be eliminated in the lower examinations; and the results of my own observations show that the tail does tend to flatten out and become raised as we ascend. But it is by no means got rid of. It flattens because we have eliminated the hopelessly idle and those who have altogether mistaken their vocation. It persists because at each stage there are those whose limits of capacity have been reached. A student whose capacity may bring him into upper mediocrity in matriculation, may drop hopelessly into the tail when he proceeds to work for the degree. I was informed, on good authority, at the Cape, that whereas the Kaffir lads were often ahead of white boys in the early stages of education, the limits of their capacity were soon reached, and they were left behind by those whom they had before easily beaten. At each stage there are pupils for whom the work is beyond their powers; and they inevitably fall into the tail.

In the traditional division of candidates into three classes, the most rational method is to place in the first class those at the head of the curve, the mediocrities in the second class, and the tail in the third class. For many years it has been my custom as an examiner to plot out on the graphic method the results of each examination. The advantage of doing so is that one thus sees at a glance the distribution of the examinees. One can also more readily see where the divisions should run between the several classes. It is irrational to fix beforehand some arbitrary number of marks to form the limiting line above which the candidates are to be called first class, those below this and above another arbitrarily chosen number being ranked in the second class. The limit must be determined—and even then it is often only determined with difficulty—by an inspection of the curve. The form of the curve, and the level of mediocrity in the scale of marks, enable one to decide whether the paper has been too hard or too easy. If too hard, the level of mediocrity will be low, and the tail inordinately large; if too easy, the level of mediocrity will be high, and the head not well differentiated from the body.

The examination curve may be commended to the special consideration of those who have to deal with large numbers of candidates in connection with the Education Department and that for Science and Art. And I would recommend to the consideration of those who have the control of Civil Service and Army Examinations the excellent suggestion made by Dr. J. Venn, in a paper on the "Correlation of Mental and Physical Powers," contributed to the *Monist* for October 1893. In these examinations large numbers of candidates compete for a limited number of vacancies. Let the results be expressed in an examination curve. It will have a well-marked head, a longish body of mediocrity, and a decided tail. We may cheerfully eliminate the tail; it consists of duffers intellectually. We may select the head for entrance; it consists of men of marked intellectual superiority, so far as the examinations are an adequate test thereof. If the head exhausts all the vacancies, well and good. But if the number of vacancies involves an extensive incursion into the body of mediocrity, then it will be found that the lower selected candidates will be very little superior intellectually to the higher rejected candidates. The last ten selected, and the ten seniors among the rejected, will probably be separated by a comparatively small number of marks. Moreover, it is a well-known fact, *experto crede*, that, if, after an extensive set of papers has been looked over and carefully marked, an interval of time be allowed to elapse, and then the papers are gone over again, the result of this re-examination is that the head and tail remain practically unchanged, but that there is not a little redistribution among the mediocrities. Furthermore, if a different examiner look over the papers, the head and tail of his curve will not differ markedly in arrangement or form from those of his predecessor; but among the mediocrities there will be not a little shifting of places. While, therefore, such an examination as that for entrance to Woolwich or Sandhurst serves to select the intellectual head, and to reject the intellectual tail, it is by no means so effectual in classifying the candidates who fall within the body of mediocrity.

Now if the same body of candidates be further examined by some physical test (and Dr. Venn regards lung-capacity and breathing power the best single physical test), it will be found that in this respect there will be a curve with well-marked head, a mediocre body, and a rapidly descending tail. But the intellectual head and tail will not include the same candidates as the physical head and tail. Let us therefore select from our intellectual mediocrities those who fall within the head of the physical examination curve. If we must admit intellectual mediocrity, let us, at any rate, secure that we have, in compensation, physical excellence.

In practice this would necessitate the preliminary testing, when they are undergoing their medical inspection, of all candidates by means of the spirometer; neither a difficult nor a lengthy operation. No doubt, as Dr. Venn points out, breathing power may to some extent be improved by practice, and candidates would all flock to a "spirometer-crammer." But probably all of them would be the better for some physical cramming in this way.

C. LLOYD MORGAN.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. W. Watson Cheyne, F.R.S., has been appointed an additional Examiner in Surgery for the present term.

An inter-collegiate Examination in Mechanical Science and Engineering, for candidates for the Mechanical Sciences Tripos, will be held, under the direction of Prof. Ewing, at the end of this term, commencing on June 4.

THE Somerset County Education Committee have adopted a resolution in favour of establishing in the county a fixed Dairy Farm School for adults of both sexes. Instruction in cheese and butter making, and in subjects allied thereto, would be given. Provision is made for granting thirty scholarships, giving free board and tuition at the school for two months, to farmers' sons and daughters engaged in dairy work. The Committee have agreed that it is desirable to set up an agricultural side to one or more of the existing secondary schools in the county. It is hoped that in due course an agricultural college for the West of England will be provided by the combined efforts of the local counties.

WITH the view of acquainting teachers with a course of experiments in accordance with the British Association Committee's programme for the teaching of Chemistry in schools, the Evening Schools Code, and the syllabus for Major Scholarship examinations recently prepared by a committee of the Incorporated Association of Head Masters, Prof. Armstrong, F.R.S., will give a series of demonstrations at the City and Guilds Central Technical College, on Saturday mornings, in May. The special object of the course will be to explain the exact method to be followed in carrying out a carefully arranged series of very simple qualitative and quantitative experiments calculated to impress the chief and most generally useful facts of chemistry on children's minds whilst developing their powers of observing and reasoning.

IT has often been urged against the educated natives of India, that they are admirable at adaptation, but are altogether at a discount where original research is concerned. The Hon. Mr. A. Cadell commented upon this failing in a recent address to Convocation of Allahabad University. His advice was that debating societies, which are so common a feature of student-life, should give place to natural history societies; the object would be to foster the true scientific spirit in the native mind. In this connection, some remarks (which we quote from the Allahabad *Morning Post*), made by Prof. Ingram, of the Madras Educational Service, indicates that the complaint as to the want of scientific research by natives of India is not without foundation. In a recent contribution he says:—"Now, if India is not helping in this work, if she is supplying no additional information, and is offering no aid towards the consummation of this unity, her claim to be regarded as in any sense a scientific country, is null and void. No matter how assiduously her students may devote themselves to studying the science course of their University curriculum; if it all end there, it is nothing. But need it end there? What country could offer greater facilities for scientific research than India? Here is a country teeming with animal and plant life; but the systematic biology of India is still in a nebulous condition. Why are no students devoting themselves to collecting and collating, and studying the plaints of their districts, or the insects that abound within their walls? It would be hard, too, to find a country better suited than India, with her clear atmosphere and cloudless skies, for the study of the stars or of other atmospheric phenomena. In these ways, and in a thousand others, we might be advancing the cause of knowledge. But we can scarcely be said to have begun yet." By way of remedy, Prof. Ingram suggests the formation of an Indian Royal Society, or some such association as would serve the same purposes here as the British Association does at home. It is possible, however, without going to that length, to utilise the resources already at hand. India is not without its scientific societies. There are the Asiatic Society of Bengal, the Indian Science Association, and the Bombay Natural History Society, all of which are amply sufficient for the purposes of scientific research.

SCIENTIFIC SERIALS.

American Journal of Science, April.—Niagara and the Great Lakes, by F. B. Taylor. By a correlation of the abandoned shore lines, moraines, and outlets, and the gorges, recently-submerged shores, and rivers of this region, the author is led to the view that the lakes were at first glacial and ice-dammed, falling by stages as the outlets changed on withdrawal of the glacier-dams. By the withdrawal of the glacier the Niagara river was opened, and the upper lakes became united. The land was gradually depressed at the north, and finally led to the opening of Nipissing outlet, which was then brought down to the sea-level, and marine waters filled the three upper lakes, the Ontario, St. Lawrence, and Winnipeg basins. The subsequent raising of the Nipissing outlet made the upper lakes fresh again. Then followed the stage of the second Lake Algonquin and that of the second (present) Niagara lakes. Lake Superior became independent. The Great Champlain uplift took place at the north-east, and the formation of the St. Clair delta began, and continues to the present day.—Disturbances in the direction of the plumb-line in the Hawaiian Islands, by E. D. Preston. There appears to be a disturbance of more than a minute in the direction of gravity at the south point of Hawaii. At Kohala the plumb-line is deflected half a minute towards the south, and at Kalaieha nearly as much towards the north, the disturbance being in both cases towards the mountain. The deflection at the south point is also northward, and is caused by the great masses of Mauna Loa and Mauna Kea.—Structure and appendages of *Trinucleus*, by Charles F. Beecher. The three posterior thoracic endopodites are very similar, and in a general way closely resemble those of *Triarthrus* from the same region of the thorax. They are, however, comparatively shorter and stouter, and could not be extended beyond the ends of the pleura. The two distal joints are cylindrical, with well-marked articular surfaces and ridges. The joints preceding these proximally become much wider, flattened, and produced into transverse extensions which carry large tufts of setæ at the end. The exopodites seem to be composed of slender joints, the distal exites being long and slightly curved outwards. They carry very long, close-set, overlapping lamellose fringes, which evidently had a branchial function. The characters of the appendages indicate an animal of burrowing habit, which probably lived in the soft mud of the sea-bottom, much after the fashion of the modern *Limulus*. In addition to its limuloid form, the absence of eyes seems to favour this assumption. So does the fact that many specimens have been found preserving the cast of the alimentary canal, showing that the animal gorged itself with mud, like many other sea-bottom animals.

Wiedemann's Annalen der Physik und Chemie, No. 3.—Electric conduction and convection in feebly conducting dilute solutions, by E. Warburg. The alteration of conductivity produced by a current in bodies like aniline, the phenomena of convection exhibited by them, and their apparent deviations from Ohm's law, can all be explained on the supposition that their conductivity depends upon an electrolyte of which the body is a very dilute solution. Bodies were investigated whose conductivities went down to 5×10^{-15}. The similar behaviour of still worse conductors, like xylol, benzol, oil of turpentine, is probably due to the same cause.—Ratio of sectional contraction to longitudinal dilatation of iron rods during magnetisation, by A. Bock. By magnetisation the constants of elasticity of soft iron are altered to an extent not exceeding 0·5 per cent. The observations indicate that flexure diminishes, torsion also decreases, and the ratio of sectional contraction to longitudinal expansion increases. Iron becomes more incompressible in the magnetic field (see p. 614).—Freezing points of some binary mixtures of heteromorphous substances, by Albert Dahms. Eutectic mixtures