logy, etc., are all drawn upon in such teaching; and science is taught in a general manner by directing the attention of pupils towards objects rather than by making them learn "subjects." In other schools the study of science is *approached* through its applications in engineering or agriculture.

Now that science is becoming recognised as an essential part of a liberal education, it is probable that the kind of teaching indicated above will be more generally adopted. The inevitable effect of making science compulsory in examinations would be to hinder experimenting in educational methods, at a time when this is most important.

Examination for Entrance to Public Schools.

The work recommended to be done in the preparatory schools is not systematic science, but rather a preparation for this. The kind of nature-study and observational work adopted in the various schools should differ according to their locality and other circumstances. This makes the subject a difficult one for examination purposes, and anything of the nature of a rigid syllabus would have a deadening influence. But so important is this preliminary work that unless preparatory schools will adopt it without compulsion through examinations, the subject should form an essential part of the Common Entrance Examination. The questions set should cover a wide range and offer plenty of choice to the candidate.

It is of the utmost importance that every candidate for scholarships on entering a public school should be examined in such work, and that a high proportion of the total marks should reward him for good work in this subject. The reason for this is obvious. So long as science forms no part of the examination for scholarships, the cleverer boys at the preparatory schools will be tempted to neglect the subject, even when provision is made for teaching it, in order to *specialise* in more paying subjects. Having found these subjects pay, and having attained a certain proficiency in them, they are unlikely to wish to change to science, or to be allowed to do so if they wish. Thus the most clever boys are diverted from science quite early in their lives; it is not putting it too strongly to say that in the large majority of public schools only those boys who show no signs of becoming scholars in other subjects can take up science seriously. We see here the evils of early specialising in their most pronounced form.

Entrance Examinations to Universities and Equivalent School Certificate Examinations.

Compulsory Greek *must* be abolished. Science should take at least as important a place as Latin.

One of the worst things that can be done in these examinations is to group science with mathematics (as is suggested in recent Board of Education circulars and in the reports of the Previous Examination Syndicate). That means filling the upper science divisions of the schools with boys who are weak at mathematics, merely because of that weakness.

Entrance Scholarships offered by the Universities.

The work of schools is affected greatly by these examinations. In their present form these encourage boys to specialise too early. This statement applies to all the subjects of examination. There is little doubt that at present scholarship examinations are exerting a bad influence on general education.

With regard to science in particular, the examinations often have the effect of making boys specialise too strictly within the limits of the subject itself, to the detriment of their general training in science. If a boy knows, for instance, that he may get a scholarship in chemistry alone, he is tempted to neglect the study of kindred subjects. Scholarship papers should test the candidates' general knowledge of science more thoroughly than they do at present.

Fees.

Laboratory work is expensive. It is customary to make special charges for this. In schools where science is compulsory for all boys, the charges do not keep the boys from doing some science; but in some schools where science is not compulsory the charges do have this effect. In certain instances the charges are grossly unfair (in view of the small expenditure on laboratory equipment), and the boys who learn science are robbed in order to provide cheap education for those who do none.

Organisation.

In nearly every school the rate of a boy's progress through the various forms is controlled to an unfair extent by his proficiency in classical subjects. This might be improved by giving a better range of marks for science, but the real remedy is that boys should be grouped for science and mathematics separately from form subjects. Otherwise the logical sequence necessary for science must be broken.

The Teaching of Mechanics.

This is in a most unsatisfactory position. The subject is fundamental for a right study of science. But, as a rule, it is in the hands of mathematicians, who too often do no experimental teaching and treat the subject deductively. Laboratory work in mechanics is essential.

Laboratory Equipment.

During the past twenty years great improvement has been made with regard to equipment for science teaching. Laboratories for the teaching of practical mathematics, including mechanics, are now the most general need.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. D. Keilin, of Magdalene College, has, with the consent of the Vice-Chancellor, been appointed assistant to the Quick professor of biology.

The next combined examination for entrance scholarships and exhibitions at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 4, and following days. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges, from any of whom further information respecting the scholarships and exhibitions and other matters connected with the colleges may be obtained.

LONDON.—The following doctorates were conferred by the Senate at the meeting held on March 21:—*D.Sc. in Chemistry:* Mr. Frank Tinker, an external student, for a thesis entitled "The Colloidal Membrane: its Properties and its Function in the Osmotic System," and other papers. *D.Sc. (Engineering) in Metallurgy:* Mr. Andrew McCance, an internal student of the Imperial College (Royal School of Mines) and the South-Western Polytechnic Institute, for a thesis entitled "A Contribution to the Theory of Hardening." *D.Sc. (Economics):* Mr. J. F. Burke, an internal student of the London School of Economics, for a thesis entitled "The Reform of Irish Land Tenures."

The Carpenter medal for the period 1913–16 has been awarded to Dr. P. B. Ballard for the thesis

entitled "Obliviscence and Reminiscence," for which he obtained the degree of D.Lit. in 1914.

The annual report on the work of University College has just been issued. The total number of students on the college books for the academic year 1915–16 was 1133 (including 51 refugee students), whereas the normal number is about 2200. Of the 1133 there were 535 men (including 36 refugee students); of the 535 men, only 222 were in attendance throughout the session, the remainder taking up military or naval service or some special form of war-work. The normal fee revenue is upwards of 29,000*l.*; the fee revenue for 1915–16 was 14,983*l.* By means of drastic economies and postponement of expenditure, and with the help of generous donations from members and friends of the college, supplemented by the special Treasury grant, expenditure was kept within income. The financial outlook for the current session (1916–17) causes anxiety, the fee revenue having further declined. The chairman and the acting treasurer are asking for help to meet the threatened deficiency, and also to cover the expenditure on the new chemistry buildings that has not yet been provided; this amounts to 15,000*l.* The third issue of the *Pro Patria* list, with the supplement recently prepared, contains 1554 names of members of the college, 1516 of whom are on active service. Of these, 122 have fallen in the war.

OXFORD.—The Departments of Geography and Anthropology have published their arrangements for next term. In geography, lectures will be given on map projections, the historical geography of Europe, the West Indies, and British lands round the Indian Ocean. Practical classes, field work, and informal instruction are also announced. The list of lectures in anthropology includes human anatomy, ethnology, the distribution of man, comparative technology, stages of human culture, the Bronze and early Iron ages, and questions relating to ancient Egypt. Lectures and informal instruction are also announced on various topics of social anthropology and on primitive language in its relation to thought

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THE presidential address delivered by Prof. A. N. Whitehead to the Mathematical Society last January is printed in the current issue of the *Technical Journal*. The subject of the address was the relation of technical education to science and literature, and Prof. Whitehead's ideas deserve wide and careful consideration. The immediate need of the nation, he maintains, is a large supply of skilled workmen, of men with inventive genius, and of employers alert in the development of new ideas; and there is only one way to obtain these, namely, by producing workmen, men of science, and employers who enjoy their work. The basis of the growth of modern invention is science, and science is almost wholly the outgrowth of pleasurable intellectual curiosity. A technical education which is to have any chance of satisfying the practical needs of the nation must be conceived in a liberal spirit as a real intellectual enlightenment as to principles applied and services rendered. There can be no adequate technical education which is not liberal, and no liberal education which is not technical; that is, no education which does not impart both technique and intellectual vision. In any system of technical education, training should be broader than the ultimate specialisation, for the resulting power of adaptation to varying demands is advantageous to the workers, to the employers, and to the nation. Prof. Whitehead applies his generalisations to the specific cases of pupils of thirteen who have completed their elementary education, and those of seventeen whose technical education, so far as it is compressed within a school curriculum, is ended.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 15.—Sir J. J. Thomson, president, in the chair.—Prof T. H. **Havelock**: The initial wave-resistance of a moving surface pressure. Hitherto the wave-resistance associated with the motion of an assigned pressure system over the surface of water has been studied only in the steady state for uniform motion. The present work is an attempt to calculate this quantity at any time for a system which has been suddenly established and set in uniform motion at a certain instant.—Prof. S. W. J. **Smith** and H. **Moss**: Experiments with mercury jets. (i) The relation between the jet-length and the velocity of efflux. (ii) A comparison with jets of other liquids. It has probably been noticed by those who have worked with mercury "dropping electrodes"—in which the mercury issues in a narrow stream from the drawn-out end of a vertical tube—that the length of the jet alters in a peculiar way with the length of the mercury column producing it. The results of a study of this phenomenon are given.—Prof. W. H. **Young**: The mode of approach to zero of the coefficients of a Fourier series.—R. O. **Street**: The dissipation of energy in the tides in connection with the acceleration of the moon's mean motion. On the hypothesis of non-turbulent motion harmonic with espect to the time with a period of twelve hours, an expression is obtained for the mean rate of dissipation of energy by viscosity in a portion of the ocean in the form of a surface integral over that area of a function of the surface current-velocities only. This integral has been evaluated over the greater part of the Irish Sea, the mean rate of dissipation obtained being 5×10^9 foot-poundals per second. In the absence of external forces, this rate of dissipation would cause the energy to be reduced in the ratio e to 1 in about two hours. If the rate of dissipation per unit area for the whole ocean were the same as in the Irish Sea, the total frictional loss of energy by the tides would be at the mean rate 6×10^{13} foot-poundals per second. If the apparent lunar acceleration is attributed to a slowing of the earth's axial rotation, a retardation of the order four minutes of arc per century per century is necessary for its explanation. This retardation implies a decay of the earth's kinetic energy of rotation at the rate of $1{\cdot}6 \times 10^{13}$ foot-poundals per second, which is about a quarter the mean rate of dissipation of tidal energy on the above hypothesis. A maximum surface current velocity of 2 ft. per second over the whole ocean would give rise to sufficient dissipation to account for this retardation of the earth.

Optical Society, March 8.—C. L. **Redding**: A simple method of determining the size of the tool required for a given block of lenses. When a new system of lenses has to be worked, it is desirable to select the best method of blocking, and to make the diameter of the tool equal to the diameter of the complete block. The size of the tool may be determined by calculation or by previous experience, but the author described how this may also be done by making use of any concave tool of known radius.—T. F. **Connolly**: A variable angle collimator. The instrument described differs from an ordinary collimator in having a bi-prism introduced between the diaphragm and the object-glass. The effect of this is to produce two separate images of the central wire, which images are collimated by the object-glass as though they were real wires. The bi-prism is mounted in a short tube sliding within the collimator body, and its position is indicated on the outside of the collimator on a longitudinal scale. A movement of the bi-prism