tion and depression. From time to time caves have been found in the Carboniferous limestone. Two of these were examined by a local clergyman about the middle of the last century, but the exploration was carried out in an unscientific way, and the remains discovered, without precise identification or record of stratification, are now deposited in the Tenby Museum. A more careful examination of the rock shelter, known as Nanna's Cave, has recently been made by local archæologists, and the results are described in a paper by Mr. A. L. Leach, reprinted from *Archaeologia Cambrensis* for July, 1916. Remains of two skeletons, one female, the other male, were found. The female skull presents no characters which enable us to separate it from modern British skulls, or from remains which have been found in Neolithic or later Palæolithic deposits. It may be as old as the Aurignacean; but it showed no character which would disprove it being of Neolithic or historic age. In association with it was found a skilfully struck flint flake, similar to that obtained from the Hoyle Cave near Tenby, which is probably of the late Palæolithic age. This fact, however, is not conclusive of the age of the human remains. In the Romano-British age the cave was again occupied, and some fragments of pottery of that period formed parts of an olla, or cooking-pot, and a mortarium, probably used for rubbing down fruits and other soft food.

POTASH FERTILISERS FROM FELSPARS.

THE dearth of potassium salts in this country owing to the war has caused renewed attention to be devoted to the possibilities of preparing soluble potassium salts from the large deposits of felspar which are found in certain parts of the country. The problem has occupied the attention of chemists intermittently for many years, but the processes devised in the past have proved commercially unsuccessful, owing largely to the failure to obtain, along with the potash salts, other saleable products which might share the cost of manufacture. This difficulty would appear to have been largely overcome in the process patented by Mr. J. Rhodin, a Swedish inventor, in which, along with the soluble potassium salts, a marketable white cement is obtained. The successful results obtained by this process with Swedish felspars have been brought to the notice of the Board of Agriculture and Fisheries, and under the auspices of a sub-committee of the Fertilisers Committee of the Board further tests with British felspars from Roche, in Cornwall, and Loch Eriboll, in Sutherlandshire, have been carried out, the results of which are summarised in the February issue of the *Journal of the Board of Agriculture*.

The Roche felspar, containing 10·8 per cent. K_2O, yielded 75 per cent. in a soluble form, whilst the Loch Eriboll spar, with 8·6 per cent. K_2O, gave 60 per cent. soluble. A Swedish spar, with 12·9 per cent. K_2O, yielded 54 per cent. in a soluble form. Expert opinion described the cement as a true hydraulic cement, of satisfactory colour, but of much lower tensile strength than Portland cement.

As the result of its examination, the sub-committee expresses the opinion that encouragement should be given to any movement for the manufacture of potash and white cement by the Rhodin process on a commercial scale, and that in the event of a public company applying to the Treasury for permission to raise capital to work this process, the application should receive the strong support of the Fertilisers Committee.

THE NATURAL SCIENCES IN PUBLIC SCHOOLS.[1]

Age Limits for School Science.

THE teaching of natural science in public schools is of recent growth. Until quite recently most of the boys who took up this subject did so with the intention of making use of the training in their future careers. Even now, in some public schools, the number of boys learning science is small. It is, however, becoming recognised that science should form part of every boy's general education. For this reason it is necessary to put some, at least, of a boy's general training in science before the age at which specialising should be allowed. Too early specialising is bad policy: the age at which this may be begun by the average boy is about sixteen and a half years.

Before this age (or its equivalent for forward or backward boys) the pupil should have spent, on an average, four hours a week at science for a period of at least two years, and six hours a week for a further two years. Thus the work should be begun in the preparatory schools. The only work recommended to be done there is in nature-study and practical measurements. See "Nature-Study in Preparatory Schools" and "The Correlation of Mathematical and Science Teaching" (Bell and Sons, each 6*d*.).

After a boy has reached such a standard of general education that he may be allowed to specialise to a certain extent, he should have the opportunity of devoting about eight hours a week to science if he chooses to do so. At a still later stage the specialisation should be more marked in the case of those who choose a scientific career.

Science in Examinations.

If these ideals can be reached by any means other than making science compulsory in examinations, those means should be employed. If they cannot, compulsion by examination regulations must be applied. But this should then be recognised as a necessary evil. It is possible that some system of inspection of schools by examining bodies, combined with the granting of certificates on the recommendation of a properly qualified master, might prove to be the solution of the difficult problem of insisting on science being learnt by every boy, without the restrictions necessarily imposed when there are examination syllabuses. But the details of such a scheme would require careful thinking out.

But there is, at present, a yet stronger argument against the attempt to foster the teaching of science by making the subject compulsory in examinations. So long as instruction in science was given only to those who were destined for a scientific career, it was natural (if, perhaps, unwise) to aim chiefly at inculcating scientific method, with a certain disregard of general knowledge of natural phenomena. This was done, for the most part, by logical courses in hydrostatics, heat, light, electricity, and chemistry. But in some of the schools where science has already become a compulsory subject it has been recognised that such courses may be unsuitable for the non-scientific mind. The attempt is made to arouse a boy's appreciation of the value and scope of science rather than to teach him the elements of a subject which he will drop even before leaving school. In such schools a considerable proportion of his science hours is devoted to studying subjects ranging from the universe to the electron: astronomy, geology, biology, physio-

[1] Abridged from a memorandum drawn up by the committee of the Association of Public School Science Masters to serve as the text of the evidence offered on behalf of the association to the Government Committee on the Teaching of Science.

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