a form in which it becomes available to the chlorophyllaceous plant; much in the same way as has been observed by Gilbert in the case of fairy-rings, where the fungus, so to speak, prepares the nitrogenous nutriment for the grass. That the tubercules that are nearly always present on the roots of leguminous plants are in some way connected with the assimilation of nitrogen by the plants is an hypothesis that is gaining ground. Much study has of late years been devoted to the morphology and functions of these tubercules by, amongst others, Tschirch, Brunchorst, Frank, Van Tieghem, Lundström, and Marshall Ward; and still more recently by Bréal, Beyerinck, and Prazmowski. It seems almost certain that these tubercules contain micro-organisms, which are the proximate cause of the excrescences, and these may live in symbiosis with the legumes, and prepare their nitrogenous food possibly from free nitrogen. The tubercules are richer in nitrogen than the roots themselves, and some observers look upon them as being merely reservoirs of nitrogenous nutriment, not as manufactories. Beyerinck (*Botan. Zeitung*, 1888) has obtained and cultivated an organism which he calls *Bacillus radicicola*, from these tubercules, and studied some of its reactions. It seems very probable that further study of these tubercules of the Leguminosæ may put us on the right track for solving the mysteries of the nitrogenous nutrition of this order of plants.

In a postscript to the memoir the authors state that they have started some experiments with leguminous plants much on the same lines as those of Hellriegel and Wilfarth. The results of these experiments will be looked forward to with very great interest.

This memoir is a most welcome and solid contribution to a most important problem. It is quite obvious that the last word on the subject has not been said, and probably very much more work must be done before it is. The authors, from their own labours and thought on the subject, continued through so many years, are well able to criticize the work of others, and this they have here done, as far as most of the important papers published up to date are concerned, in an able and frank manner. If leguminous plants are able to avail themselves of the free nitrogen of the air, or if soils are able, through the agency of microbes or in other ways, to fix free nitrogen, the exact conditions necessary for the accomplishment of these ends is not yet known. The conditions of risk and exposure to accidental sources of nitrogen-gain in small experiments in the open air are very great, and experiments made under such conditions require very careful verification. Also the methods of nitrogen determination used should be subjected to rigorous investigation and control, as also the methods of taking the samples used in analysis, which in the case of a complicated body like a soil presents great difficulty in obtaining a perfectly homogeneous mixture. The exact limits of experimental error in the various determinations want investigation. The subject, from its important practical bearings, is worthy the attention of a scientific commission who could give undistracted attention to it.   E. K.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—An examination will be held at Queen's College, in the first week of October, to fill up at least two open Classical Scholarships for candidates proposing to commence residence this October, and one open Scholarship in Natural Science (Chemistry and Physics) for candidates proposing to commence residence in October 1890.

Classical candidates must not have exceeded nineteen years, and Natural Science candidates eighteen years, on October 10, 1889.

A further notice will be issued.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xi. No. 4 (Baltimore, July 1889).—Prof. Cayley opens the number with a resumption of his memoir on the surfaces with plane or spherical curves of curvature (pp. 293–306).—The circular cubic with double focus on itself is treated by Schröter and Durège (*Crelle*, Bd. v.). Mr. F. Morley, writing on the geometry of a nodal circular cubic (pp. 307–16), gives a geometrical account, illustrated by figures, of the case when the curve, in addition, is nodal. Some properties of the special case when the inflexion is at infinity are given by Dr. Booth (*Quarterly Journal*, vol. iii.) in his discussion of the logocyclic curve (cf. vol. i. of his "Collected Papers," cap. xxx.).—The next paper supplies a defect in MM. Briot and

Bouquet's "Propriétés des fonctions définies par des équations différentielles" (*Journ. de l'Ecole Pol.*, cap. xxxvi.): it is entitled, "On the Functions defined by Differential Equations, with an extension of the Puiseux polygon construction (see *Journ. de Math. pures et appliquées*, i. 15) to these equations" (pp. 317–28), and is written by Mr. H. B. Fine.—In the memoir "Sur les solutions singulières des équations différentielles simultanées" (pp. 329–72), M. Goursat extends results obtained by M. Darboux to simultaneous differential equations and to equations of higher order.—The number, and volume, concludes with a note by J. C. Fields, on the expression of any differential coefficient of a function of any number of variables by aid of the corresponding differential coefficients of any n powers of the function, where n is the order of the differential coefficient (pp. 388–96).—All these papers are, of course, purely mathematical: there is a physical paper (pp. 373–87) by Prof. H. A. Rowland, entitled "Electromagnetic Waves and Oscillations at the Surface of Conductors." The calculations are founded on Maxwell's equations. "In these equations occur two quantities, J and ψ. Maxwell has given the reasons for rejecting ψ, and has shown that neither J nor ψ enter into the theory of waves. In order, however, that there shall be no propagation of free electricity in a non-conductor, the components of the electric force must satisfy the equation of continuity, and this leads to components of the vector potential satisfying the same equation, and $J = 0$ therefore. I have satisfied myself that there is absolutely no loss of generality from these changes."

IN the *Nuovo Giornale Botanico Italiano* for July, Sig. A. Bottini has an interesting article on the structure of the olive, especially on that of the several layers of tissue of which the ripe fruit is composed. A disease to which the crop has been recently liable he believes to have been erroneously attributed to a parasitic fungus, *Septoria oleaginea*.—The greater part of this number is occupied by the proceedings of the meeting of the Botanical Society of Italy held in Florence.—Prof. Arcangeli gives an account of a series of experiments on the amount of heat due to the respiration of fungi. The greatest elevation of temperature he finds to amount to $1°\cdot25$ C. in the case of *Lepiota excoriata*. In all cases the elevation of temperature is most conspicuous about midday, or early in the afternoon.—The colouring-matter of the cones of *Abies excelsa* is stated by Sig. L. Macchiati to be due to a mixture of three distinct substances, two of them crystallizable, accompanied by a waxy substance.

Das Wetter for July contains:—(1) The second part of an explanatory discussion, by Dr. Wagner, of the recently published instructions for the observers of the Prussian Meteorological Institute. The points referred to relate especially to rainfall and thunderstorm observations. The author refers to the variability of rainfall values both as regards time and place, and to the necessity of stations near each other, to explain the irregularities of the yearly amounts. It is only since 1887 that such a system has been established in North Germany, where it is proposed to raise the number of stations to 2000, which will then only give one for about 77 square miles. The hours of observation are also discussed, the result being that the usual morning observation cannot be altered; but the instructions direct that the rainfall should be set down to the day upon which it is observed; this has generally been done in Prussia, whereas in other countries it is put down to the previous day. The author refers to the importance of the measurement of rain during the passage of thunderstorms, and also to the advantage to be derived from the more general use, at stations of the second and third order, of simple registering barometers and thermometers, similar to those of Richard Frères.—(2) A criticism of Herr Falb's weather predictions taken from an article in the *Göttingen Zeitung*. M. Falb bases his theory on the influence of the sun and moon upon the interior of the earth, and upon the surrounding media of air and water, and calculates certain "critical days" from the relative positions of these bodies. The author of the article has checked the predictions sent to the German agricultural Press since April 12, and points out that although the weather of May has been unusually warm, no mention of the fact was contained in the predictions, and concludes with the remark that a theory which shows such little success, as in the comparison in question, is useless to the agriculturist.—(3) A description, by Dr. Wagner, of the new popular Observatory, "Urania," opened on July 3, in Berlin, on the site of the Exhibition buildings. It contains a large equatorial, over 16 feet in length, with a lens of about $12\frac{1}{2}$ inches in diameter, a large number of instruments and microscopes, and a spacious lecture theatre.