

fissures form along the surface, from which pour out the yellow vapours of sodium. Occasionally, the mixture on the top of the furnace is not sufficiently porous to allow the rapid escape of the gases. The result is, that the latter accumulate until the pressure is so great that, at some weak point in the mixture above, a path is forced open and the gases rush out violently. It is mainly for the purpose of avoiding this "blowing" that the sawdust is put in the mixture, since the former, by making the mixture porous, allows the gases to escape freely.

At the end of about twenty-four hours the current is cut off from the furnace, and it is allowed to cool for a few hours. Then the side walls are taken down and the unchanged mixture raked off the top of the furnace, until the outer crust of amorphous carborundum is reached. This crust is cut through with large steel bars, and can then be easily removed from the inner crust of amorphous carborundum. The inner crust is next removed with a spade, and the crystalline carborundum exposed.

A cross-section of a carborundum furnace presents an interesting and beautiful appearance (Fig 2). In the centre is the core, which, on examination, is found to be very different in some of its physical characteristics from the coke of which it was originally composed. It no longer possesses a bright metallic appearance. Many of the kernels are quite soft, and can be squeezed between the fingers, leaving on them a mark like black lead. In fact, the high temperature to which the core has been raised has driven off all impurities from the coke, leaving nothing but pure carbon, either in the amorphous or graphitic form. From the core radiate beautifully-coloured carborundum crystals to a distance of 10 or 12 inches. A single furnace yields over 4000 pounds of crystalline carborundum. Most of these crystals are not remarkable as regards their size, but in places where hollows have formed, large hexagonal crystals are found, sometimes measuring  $\frac{1}{2}$  inch on a side. At the distance of 10 or 12 inches from the core the crystals suddenly cease, and, instead, we find a thin layer of a light-green colour, which is the inner crust of amorphous carborundum. Beyond this is the outer crust of amorphous carborundum, and this also ends abruptly in unchanged mixture. Other curious substances are sometimes produced in the furnaces; for example, silica, which has the appearance of spun glass. On opening a furnace and cutting down to the core, a layer is found that appears at first sight to consist of very dull black carborundum crystals. On closer examination, however, it is found that though this material has the exact form of the carborundum crystals, it is nothing but pure carbon in the graphitic form.

After the carborundum has been removed from the furnace it is taken to a crusher, which consists of a large iron pan, rotated in a horizontal plane by means of a vertical shaft. A horizontal shaft, carrying two heavy rollers, is attached to a collar surrounding the vertical shaft, thus permitting a free vertical motion of the rollers which rest in the pan. The latter, in revolving, causes the carborundum to pass under the rolls, which break the mass of crystals apart. From the crusher the carborundum is taken to large wooden tanks, where it is treated for several days with dilute sulphuric acid to remove impurities. It is then thoroughly washed, dried, and graded.

Carborundum is apparently infusible; for after a certain temperature has been reached, decomposition commences,

without fusion, and the crystals are broken up into carbon and silicon. It is quite insoluble in water or any acid. Its hardness lies somewhere between  $9^{\circ}$  and  $10^{\circ}$ , probably very close to  $10^{\circ}$ , which is the hardness of diamond. An attempt was made to obtain some idea of the relative hardness of diamond, corundum, and carborundum, by the following experiment.

A series of lines was scratched on a small plate of glass with each of the three materials, and the scratches examined with a microscope. The appearance of the lines made by the diamond and the carborundum crystal was indistinguishable; but that made with the piece of corundum was quite different, being rough, and not presenting the clean-cut outlines of the other scratches. This seems to show that carborundum is much nearer diamond than corundum in hardness, although it is not as tough. The specific gravity of carborundum is 3.23, which is less than that of emery,  $1\frac{1}{4}$  pounds of the latter being equal in volume to 1 pound of the former.

Carborundum is chiefly used at present as an abrasive, for which purpose it possesses many advantages over emery and corundum. The Carborundum Company produced during the year 1896, in round numbers, 1,191,000 pounds of crystalline carborundum.

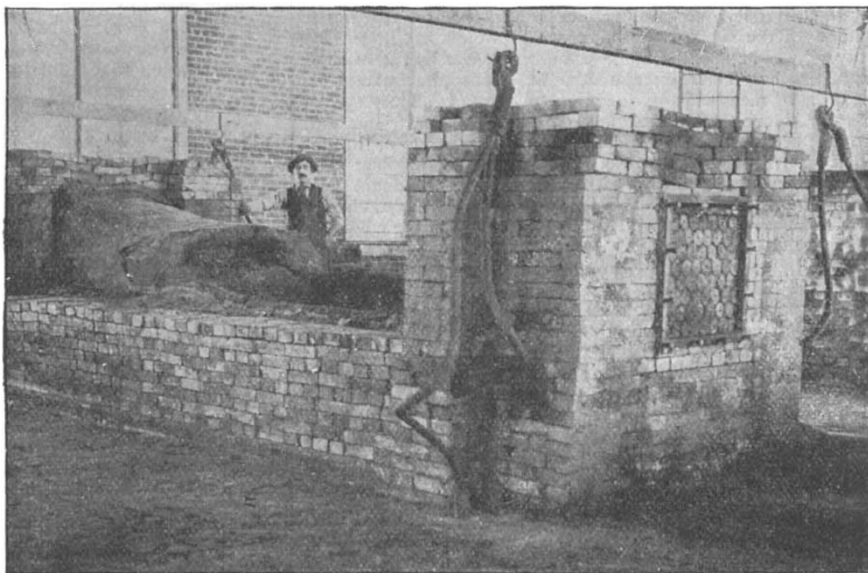


FIG. 2.—Furnace opened to show formation of carborundum around the core.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Prof. E. B. Elliott and Prof. H. H. Turner have been appointed Electors to the Savilian Professorship of Geometry.

The Board of the Faculty of Natural Science have given notice that henceforth in the Final Honour School of Chemistry the use of books in the examination in Quantitative Analysis, and in any part of the examination, shall be at the discretion of the Examiners.

Trinity College has decided to build a laboratory adjoining the existing laboratory of Balliol College, and communicating with it. Such action in favour of Oxford science on the part of a College, far from rich, is especially commendable.

This term Mr. H. H. Champion, of Cambridge, is lecturing, for Prof. Turner, on "Lunar Theory." Prof. Ray Lankester will lecture on Arthropoda, and Mr. G. C. Bourne on Mechanical Theories of Development. Dr. Benham and Mr. Bourne are conducting the annual summer course of Practical Embryology.

Prof. E. B. Tylor's subject for this term is the Anthropology of Political and Social Institutions. Mr. Barclay Thompson

announces courses on Mammalian Morphology and Palæontology. The usual courses are being given in the departments of Physics, Chemistry, Mineralogy and Botany and Physiology.

In the Faculty of Medicine, Dr. Ritchie, Lecturer on Pathology, will give a course of practical instruction on Bacteriology. Lectures will also be given on Medicine, Surgery, and Materia Medica. Prof. Arthur Thomson is lecturing on the Uro-genital system.

April 13 being the twenty-fifth anniversary of the Zoological Station at Naples, Dr. Anton Dohrn sent a telegraphic message to the Chancellor, acknowledging the assistance rendered by the University to the Station.

Prof. Burdon Sanderson has been re-elected Chairman of the Board of Faculty of Medicine.

The large and valuable collection of butterflies offered to the Hope Department of the University by Mr. F. Ducane Godman, F.R.S., and Mr. Osbert Salvin, F.R.S., was accepted by Convocation on Tuesday, and the thanks of the University were voted to the donors. The collection has already been briefly described in NATURE (vol. lv. p. 524, April 1).

CAMBRIDGE.—A memorial, signed by 2100 resident undergraduates and bachelors of arts, has been presented to the Vice-Chancellor, protesting against the proposal to grant titles of degrees to women, on the ground that this would injure the position and efficiency of the University as a University for men. A counter memorial, signed by only 298 of the junior members of the University, has also been received. It states that in the opinion of the signatories the proposal would *not* injure the University. Meanwhile the notice of *non-placet* by the resident graduates has been circulated, and bears the names of about 280 members of the Senate, out of about 450 in actual residence. The list includes eighteen professors and 110 past or present tutors and lecturers. If, therefore, the decision lay with the resident body of teachers and officers, the result would be a decided negative; and there is no doubt that among the students the feeling against the contemplated change is overwhelmingly strong. The latter fact gives some colour to the assertion that the admission of women would probably be followed by a serious falling off in the number of men desirous of entering the University.

The proposal of the Special Board for Physics and Chemistry, that candidates for either part of the Natural Sciences Tripos should be required to submit to the Examiners their laboratory note-books, duly attested by the signatures of their teachers, has been adversely criticised in the Senate. It was feared that it might interfere with the good relations at present existing between teachers and students, and encourage the special preparation of note-books for the Examiners' inspection. The Report was referred back to the Board for reconsideration.

The dates of the next ensuing College Examinations for Scholarships and Exhibitions in Natural Science are announced as follows:—November 2: St. John's and Trinity, Pembroke, Caius, King's, Jesus, Christ's, and Emmanuel. November 30: Peterhouse and Sidney Sussex. December 7: Clare and Trinity Hall. April 1898: Downing. Information as to the value and conditions of tenure of the several emoluments may be obtained from the respective College Tutors.

WE understand that the late Prof. Edward D. Cope left an estate valued at over one hundred thousand dollars. Most of the amount is bequeathed to the University of Pennsylvania, and to establish a chair of Vertebrate Palæontology in the Philadelphia Academy of Natural History.

AMONG the grants just authorised by the legislature of the State of New York are: 2,500,000 dols. for the new public library in New York City; 500,000 dols. for an extension of the Museum of Natural History; 150,000 dols. for the new Zoological Park in New York City; and 10,000 dols. for the proposed public library in Brooklyn.

In a brief note (p. 21) on the application of the Hartley Institution for a share of the increased grant which it is proposed to give to the University Colleges of Great Britain, the term "professorial" staff was misprinted "professional" staff. Dr. R. W. Stewart, the Principal of the Institution, calls our attention to the fact that the Committee appointed to consider the distribution of the Government grant gave, in 1889, what almost amounted to a pledge that if certain defects in the Institution were remedied, a future application for a share of the grant might receive favourable consideration. The work and manage-

ment of the Institution have since then been entirely reorganised, and it is on these grounds that the application has been renewed.

THE following are among recent appointments:—Dr. C. H. Draper to be head-master of the Municipal Technical School at Brighton; Miss M. Maclean to be demonstrator of anatomy, and Miss D. Clark demonstrator in the botanical laboratory, in Queen Margaret College, Glasgow; Mr. W. H. Lang to be lecturer on botany in the same college; Dr. Frech to be professor of geology and palæontology at Breslau; Dr. Walter Kruse to be professor of hygiene at Bonn; Dr. W. Ule to be professor of geography at Halle; Dr. Gustav Jäger, privat-docent in theoretical physics at Vienna, to be a professor; Prof. W. F. Edwards to be president of the Washington University, Seattle; Dr. Andr. Lipp to be professor of analytical chemistry in the Polytechnic Institute at Munich. Prof. Sissingh, of the Polytechnic Institute of Delft, has been called to the chair of Physics in the University of Amsterdam.

THE Technical Education Board of the London County Council will proceed shortly to award not less than five Senior County Scholarships, which are of the value of 60*l.* a year, together with payment of tuition fees up to 30*l.* a year, and are tenable for three years at university colleges and advanced technical institutes. These scholarships are confined to residents within the administrative county of London, and are only open to those whose parents are in receipt of not more than 400*l.* a year. Candidates should, as a rule, be under twenty-two years of age, though the Board reserves the right to give preference to candidates who are under nineteen years of age. The scholarships are intended to encourage more especially the teaching of science, and to enable those students who cannot afford a university training to pursue advanced studies for a period of three years in the highest university institutions in the country. Candidates must apply before Monday, May 17, to the Secretary of the Technical Education Board, St. Martin's Place, W.C.

#### SCIENTIFIC SERIALS.

*American Journal of Mathematics*, vol. xix. No. 2 (April 1897).—On the most perfect forms of magic squares, with methods for their production, is an interesting paper on these squares by Dr. E. McClintock, which treats the subject in a somewhat novel manner. As it was read before the American Mathematical Society so long ago as April 25, 1896, the references to the Rev. A. H. Frost's work on similar lines make no allusion to the recent memoir by this gentleman (the construction of Nasik squares of any order), which was read before the London Mathematical Society, June 11, 1896, and, in its printed form, occupied pp. 487-518 of vol. xxvii. of the Society's *Proceedings*. Dr. McClintock refers to the earlier papers in the *Quarterly Journal of Mathematics* (vol. vii. and xv.).—Dr. Chree contributes a complementary paper to his article in vol. xvi. Its title is "Isotropic elastic solids of nearly spherical form." The method of the two papers is practically the same, but the author states the differences in detail to be considerable. His principal object is to find what may be regarded as the change in pitch due to a small change in the shape of the surface; the result shows what effect an absence of perfect sphericity has on the frequency of vibrations.—Non-uniform convergence and the integration of series, term by term, by W. F. Osgood, is a paper which was read at the August (1896) meeting of the American Mathematical Society. The geometrical method for the study of uniform convergence, set forth in the present article, was treated at some length in a paper by the same writer, which we have noted in our abstract of the Society's *Bulletin* (vol. iii. pp. 59-86) for November 1896.—Two notelets close the number: viz. a note on the factors of composition of a group, by Ellery W. Davis, and simple proof of a fundamental theorem in the theory of functions, by R. D. Bohannon.—A loose sheet gives a very brief outline of Sylvester's career and work. Prof. Sylvester was the principal founder of the *American Journal of Mathematics* (in 1877), and he was the principal editor until his departure from America in December 1883. He contributed to its pages some fifty papers in all.

*Bulletin of the American Mathematical Society*, vol. iii. No. 7 (April 1897).—On Cayley's theory of the absolute, is a paper by Prof. C. A. Scott, which was read at the January (1897)