

obtained from iron pyrites. The pyrites (sulphide of iron), or "gold stones," as it was termed, was stacked in heaps and allowed to weather. The drainings from the heap were boiled, with some iron added, and evaporated, the sulphate of iron crystallising out. There were important and old-established works at Deptford, Rotherhithe, and Whitstable. About 1754, works were established at Wigan.

Sulphuric Acid.

Sulphuric acid, known as "oil" or "spirit" of vitriol, was obtained by two processes, both invented by the alchemist Basil Valentine in the fifteenth century. In one of these crystals of sulphate of iron ("copperas") were distilled in earthen retorts, the resulting oil of vitriol being condensed in glass or earthenware receivers. The process is still employed at Nordhausen, in Saxony, and Nordhausen, or "fuming" acid, is still an article of commerce. It differs slightly in its chemical composition from the ordinary modern acid. The second process is the original form of the modern method. In it sulphur was burned under a bell-jar over water, and the acid liquor evaporated. Valentine also burnt a mixture of sulphur, nitre, and antimony sulphide in the same way, and this was an important improvement. About the middle of the eighteenth century a French chemist found that the antimony was not needed, and considerable amounts of the acid were then made.

Up to the middle of the eighteenth century all, or nearly all, the oil of vitriol made in England was made by the distillation of copperas, but in 1740 Ward introduced its manufacture by the method of burning sulphur and salt-petre. In 1749 he obtained a patent for the process. He set up works for making the acid, first at Twickenham and afterwards at Richmond. Dr. Roebuck improved on the process by substituting lead chambers for the glass receivers, and by this important modification the evolution of the modern method was practically completed. Roebuck and his partner, Garbett, first used their improved system in 1746 at Manchester, and in 1749 they set up work at Preston-Pans, near Edinburgh. This invention revolutionised the industry, greatly lowered the cost of production, and, among other applications, enabled the acid to be used for bleaching instead of the sour milk previously employed.

The method used at the present day for the manufacture of the vast quantities of sulphuric acid now required is really only a development of Roebuck's. The principle is the same, though it has been changed by chemical knowledge from an empirical manufacture to a highly scientific process. Iron pyrites (sulphide of iron) has generally replaced the sulphur first used, details have been improved, and the methods rendered more economical, but it remains in its essential features almost identical with that of a hundred and fifty years ago.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l.* a year, tenable for two years, is offered by the governing body of Emmanuel College to an advanced student commencing residence at Cambridge as a member of Emmanuel College in October. The exhibition will be awarded at the beginning of October. Applications, accompanied by two certificates of good character, should be sent to the Master of Emmanuel not later than October 1.

The chairman of the special board for biology and geology gives notice that applications to occupy the University's table in the Zoological Station at Naples, or that in the laboratory of the Marine Biological Association at Plymouth, should be addressed to him (Prof. Langley) on or before Thursday, May 26.

It is proposed to appoint a syndicate to consider the financial administration of the various scientific departments of the University and the financial relations between these departments and the museums and lecture rooms syndicate; that the syndicate confer with the financial board, the general board of studies, the museums and lecture rooms syndicate, the heads of the various scientific departments, and such other bodies or persons as they may

think fit; and that they report to the Senate before the end of the Lent term, 1911.

At the Congregation to be held at 2 p.m. to-day, April 28, it is proposed to confer the degree of Doctor of Law, *honoris causa*, upon Colonel Theodore Roosevelt.

PROF. SENIER delivered a lecture on March 9 last before the Royal Dublin Society on "The University and Technical Training," which has now been published by Mr. Edward Ponsonby, of 116 Grafton Street, Dublin. The lecture formed the subject of a note in our issue of March 24 last (vol. lxxxiii., p. 118).

MR. MILTON C. WHITAKER, general superintendent of the Welsbach Company's works, has been appointed professor of industrial chemistry at Columbia University, to the vacancy caused by the retirement of Prof. Charles F. Chandler. Dr. Marston Taylor Bogert has been appointed to succeed Dr. Chandler as head of the department of chemistry.

THE annual conference of the Association of Teachers in Technical Institutions will be held this year at Birmingham on May 16-17. Among the subjects for discussion are technical universities, relation of evening continuation schools to technical institutions, registration, superannuation of technical teachers, &c. An address will be given by Mr. Cyril Jackson, chairman of the Education Committee of the London County Council, on the extension of day technical work, and a paper will be read by Dr. T. Slater Price on the relation of technical institutions to universities.

THE second International Conference on Elementary Education is to be held at the Sorbonne, Paris, on August 4-7. It is being organised by an International Bureau, consisting of representatives of the various associations of teachers throughout Europe. Among the subjects to be discussed by the conference may be mentioned the aim and object of elementary science teaching in primary schools; compulsory attendance; the professional training of teachers, inspectors, and educational administrators; and educational continuation work. Further information may be obtained from Mr. Ernest Gray, 67 Russell Square, London, W.C.

IN connection with the appeal for 70,000*l.* for the purchase of a site and the erection of new chemical laboratories thereon at University College, London, to which we directed attention in the issue of NATURE for February 17 (vol. lxxxii., p. 462), the Lord Mayor has arranged a meeting of city men to be held at the Mansion House on May 10, at 4 p.m. The chair will be taken by the Lord Mayor, and the following gentlemen will speak:—the Earl of Rosebery (Chancellor of the University), the Earl of Cromer, Lord Avebury, Sir Felix Schuster (treasurer of University College), Dr. Miers (principal of the University), Sir Henry Roscoe (chairman of the appeal committee), and Sir William Ramsay, K.C.B.

THE attention of the Chancellor of the Exchequer was directed on April 22 in the House of Commons to the grave difficulty experienced by local education authorities in respect of the grant for secondary education based on the reduced amount of the "whisky money" for the present year. The amount received by local education authorities for higher education under the Local Taxation (Customs and Excise) Act has become greatly diminished, and many authorities have had to consider the question of reducing their work for next year, particularly in regard to evening classes. As was pointed out in the House by more than one speaker, it is highly unsatisfactory that the grant for higher education should depend upon the consumption of whisky in the country. The Chancellor admitted that something ought to be done in the course of this year to put the revenue of these local authorities on a more dependable basis. He said the loss owing to the decrease in the whisky revenue was 253,000*l.*, and he suggested, on behalf of the Government, that half the land taxes—which, it is expected, will be, in respect of last year, 490,000*l.*—shall be allocated for the purpose of making good the deficiency; and, secondly, that the

Government shall undertake, when it makes the financial arrangements for the year, to put on a more satisfactory and stable basis the whole question of the existing subvention from Imperial sources.

In the House of Commons on April 20 a satisfactory and altogether sympathetic discussion on the care and education of adolescents indicated that the efforts of educationists during the past few years to instruct public opinion as to the need of a system of compulsory attendance at continuation schools have not been in vain. Mr. Whitehouse moved a resolution, which was subsequently agreed to, "That, in view of the relation of unemployment to adolescent and child labour; this House regards an improved educational system, with more adequate provision for the care and training of adolescents, as a matter of urgent necessity, and considers that the Imperial Exchequer should bear an increased share of the cost of this national service." The chief educational change which he advocated was a system of compulsory education at continuation schools from the time of leaving school until the age of seventeen or eighteen. Mr. S. H. Butcher, in seconding the resolution, pointed out that the great blot of our educational system is that with one hand we spend millions of money on elementary education, and with the other we throw away a large part of the results of that education. There is lavish expense on one side, sheer waste on the other. A system which can lead to such results is economically unsound and educationally ruinous. A change is needed in the curriculum, and that change ought to be in the direction of less insistence upon mere book work, more direct contact with nature, more manual training. The school age must be raised, whether it is to fifteen or to fourteen, and we must abolish, by degrees but ultimately altogether, half-time exemptions below thirteen. Mr. Trevelyan expressed sympathy with the resolution on behalf of the Board of Education. He pointed out that the present is a session in which the Board is not required to produce any legislation, but he said the Board is prepared to move in several directions if time, money, and public opinion are favourable. A drastic method of dealing with street trading, the abolition of the half-time system, the raising of the school leaving age, and the encouragement of attendance at continuation schools, were instanced as subjects on which the Board has been at work and is prepared to act.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 21.—Sir Archibald Geikie, K.C.B., president, in the chair.—Lord **Rayleigh**: The incidence of light upon a transparent sphere of dimensions comparable with a wave-length. The investigation is on the basis of the electromagnetic theory of light, the transparent sphere being supposed to have a dielectric constant different from that of the surrounding medium. The case of a very small sphere, or of an obstacle of any size and shape under the restriction of very small refractivity, was treated in 1881. In the numerical calculations of the present paper the refractive index is supposed to be 1.5, and the ratio of circumference to wave-length has the values 1, 1.5, 1.75, 2, and 2.25. When the ratio in question is small and the incident light is unpolarised, the scattered light is polarised in all directions except, of course, those parallel to the incident ray; and the polarisation is complete at right angles to the primary ray. As the ratio increases, this condition of things is departed from. The maximum polarisation is now to be found in an oblique direction, inclining backwards. A little later the polarisation in certain directions is reversed, such changes occurring very rapidly as the ratio alters. Experiments similar to those made in 1881 upon sulphur particles precipitated from a dilute and acidified solution of "hypo" are described, and it is shown that a passage from red to blue light may reverse the polarisation, although there is no change either in the liquid or in the direction of observation.—Prof. Karl **Pearson**: The improbability of a random distribution of the stars in space.—Dr. R. D. **Kleeman**: The total ionisation produced in different gases by the kathode rays

ejected by X-rays. The results are given in the annexed table, in which are also placed the total ionisations obtained by Prof. Bragg with the α particle. It will be seen that the two sets of values relative to air are very nearly the same. The energy spent in making an ion thus seems not to depend in any marked degree on the nature of the ionising agent.

	Kathode Rays	α particle
Air	1.00 ...	1.00
Carbon dioxide (CO_2)	1.08 ...	1.08
Ethyl oxide ($\text{C}_2\text{H}_5\text{O}$)	1.23 ...	1.32
Pentane (C_5H_{12})	1.31 ...	1.35
Benzene (C_6H_6)	1.20 ...	1.29
Ethyl chloride ($\text{C}_2\text{H}_5\text{Cl}$)	1.33 ...	1.32
Chloroform (CHCl_3)	1.34 ...	1.29

—Prof. F. J. **Cole**: Tone perception in *Gammarus pulex*. The paper has reference to the occurrence of a definite and visible physiological response on the part of the freshwater amphipod *Gammarus pulex* to stimuli of an auditory character. Audition in the lower animals cannot be satisfactorily studied in most cases, since a stimulus produces no response that can be seen or measured. *Gammarus*, however, when confined in a microscope live box, responds in an energetic and striking manner by flexing its first pair of antennæ under its body. A response can be elicited after the second pair of antennæ have been removed, but not after the removal of the first pair. The instrument generally used to produce the stimulus was a tenor trombone, and the experiments were conducted either on the ordinary laboratory table or on a table specially constructed to filter off vibrations from the ground, and thus to ensure that the stimulus reached the animal through the air. It was found that *Gammarus* was most sensitive to the B flat below middle C, and that its range of tonal sense was so limited that it might almost be adduced as an example of absolute or physiological tonality, i.e. of an animal specially sensitive to one note. Only a small percentage of individuals, however, responded at all, and then, probably owing to fatigue, the power of response soon disappeared. One specimen responded to every note of the trombone. The experiments may be interpreted as either tactual or auditory reactions—if it can be held that these two senses have segregated out in such a simple and true aquatic species as *Gammarus pulex*, and do not merely form a part of an indefinite common sensibility.

Geological Society, April 13.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. Tempest **Anderson**: The volcano of Matavanu in Savaii. Savaii is one of the German Samoan Islands. It is volcanic, formed of varieties of basic lavas, and for the most part fringed with coral reefs. The volcano of Matavanu was formed in 1905. The eruption was at first explosive, but since the first few weeks has been mainly effusive and accompanied by the discharge of fluid basic lava, which has run by a devious course of about ten miles to the sea, formed fields of both slaggy and cindery lava, filled up a valley to a depth in some places of probably 400 feet, and devastated the most fertile land in the island. The crater contains a lake, or rather river, of incandescent lava, so fluid that it beats in waves on the walls, rises in fountains of liquid basalt, and flows with the velocity of a cataract into a gulf or tunnel at one end of the crater. It then runs underground until it reaches the sea, into which it flows, and causes explosions attended with the discharge of showers of sand and fragments of hot lava, and the emission of clouds of steam. The resemblances to, and few differences from, the volcano of Kilauea are discussed.—Helen **Drew** and Ida L. **Slater**: Notes on the geology of the district around Llansawel (Carmarthenshire). The stratigraphy and geological structure of a small area some nine miles to the west of Llandoverly, and to the north of Llandello, are dealt with. The rocks consist of a series of sediments, including a coarse conglomerate, grits, shales, and tough blue mudstones. The structure in the eastern part of the district is more complicated than in the west. The repeated outcrops of the conglomerate in the hilly region around Shon Nicholas give the clue to the structure. The paper concludes with a comparison of this district with those of Rhayader and Pont Erwyd.