diaphragm may be dispensed with, according to Oettel, if the solution is alkaline, because in that case potassium chlorate is not reduced, to any appreciable extent, by nascent hydrogen. High current density at the kathode, and low current density at the anode, promote the formation of chlorate, the best results being obtained when a quantity of oxygen is evolved, corresponding to some 30 or 40 per cent. of the current passed. The current efficiency is reported to be from 65 to 70 per cent., and there is no doubt that the electrolytic process will eventually displace the older chemical one, about one half of the world's consumption of chlorates being already supplied by it.

Of other electrolytic processes there is not very much to be said.

In Mr. A. B. Brown's process for the manufacture of whitelead a 10 per cent. solution of sodium nitrate is electrolysed in order to obtain caustic soda and nitric acid, which are subsequently used for the preparation of lead nitrate and its precipitation as lead hydroxide, the latter being finally converted into lead carbonate by means of a solution of sodium bicarbonate.

Applications of electrolysis to tanning and to the purification of sugar have been frequently proposed, but nothing very definite is known as to their success.

Among organic compounds iodoform has long been prepared by the electrolysis of an alkaline solution of potassium iodide containing alcohol. According to Elbs and Hertz good results are obtained by electrolysing a solution containing 5 to 6 grams of sodium carbonate, 10 grams of potassium iodide and 20 cc. of alcohol in 100 cc. of water at a temperature of 60° C. with a current density not exceeding 1 ampere per square decimetre. Under these circumstances the current efficiency is over 97 per cent. and the iodoform produced perfectly pure.

It has been proposed to apply ozone to a great variety of purposes, but here again a lack of trustworthy information about the results is found. According to Mr. Swan, however, it is used in making vanilin and heliotropin. When used as a bleaching agent it is necessary to use it in conjunction with other substances, such as hypochlorites or hydrogen peroxide. Mr. Andreoli has devised an ozone producer in which the electrodes are furnished with numerous points and separated by a glass plate. In order to prevent the heating of the gas it is caused to pass rapidly throught the apparatus, and the electrodes are made hollow and cooled by internal circulation of water. The silent discharge is obtained by means of an alternating current dynamo and high tension transformer yielding a rapidly alternating current at a pressure of 10,000 volts or more. By this means 30, or under favourable conditions 40 grams of ozone are obtained for a horse-power hour.

*Electro-thermal Processes.*—The electric current possesses two considerable advantages as a heating agent; in the first place temperatures otherwise unattainable may be reached by its aid, and secondly the heat may be applied directly and economically to the substances which are to be caused to react. The three most important products of the electric furnace are carborundum, phosphorus, and calcium carbide.

Carborundum, a compound of carbon and silicon in equal atomic proportions, was prepared by Acheson in 1891, in the course of experiments on the artificial production of the diamond. It is remarkable for its extreme hardness, which is only inferior to that of the diamond. It is prepared by heating a mixture of powdered coke and sand, to which a little sawdust and salt are added in order to make the mass more porous, in a furnace 16 feet long, 5 feet wide and 5 feet deep, which is built up of loose fire-bricks. Through the end walls of the furnace bundles of 60 carbon rods, each 3 inches in diameter pass, which are connected inside the furnace by a cylindrical core of small pieces of coke. This core is surrounded on all sides by the mixture of sand and coke. The passage of the current through the core gives rise to a cascade of small arcs between the pieces of coke, which soon raises the whole core to a very high temperature which is communicated to the surrounding charge. A current of 6000 amperes at 125 volts pressure is passed for 36 hours, after which the furnace is allowed to cool and the hollow cylinder of crystalline carborundum surrounding the core removed. About 5·3 electrical horse-power hours are expended in producing a pound of the crystalline product, a considerable quantity of valueless, amorphous carbide of silicon being also formed at a greater distance from the core, where the temperature is lower. The carborundum is obtained in the form of steel grey to brownish green crystals, the coloration being due to iron; it is a valuable abrasive, cutting the hardest steel without destroying its temper; and is being largely used in place of emery. The production has increased from 15,000 pounds in 1893, when it was first made on a manufacturing scale, to about one and a half million pounds in 1897.

The manufacture of phosphorus in the electric furnace has been carried on for some years by means of the process of Readmann and Parker and Robinson. Wöhler found, as long ago as 1830, that phosphorus may be obtained from calcium phosphate by heating it to a high temperature with sand and carbon, calcium silicate and carbon monoxide being produced. The employment of the electric furnace has made it possible to use this process for the manufacture of phosphorus. Naturally occurring phosphates are used and siliceous material added, which will furnish a readily fusible slag. The finely-powdered mixture of these substances with carbon is fed in through a hopper at the top of a brick-lined trough, 18 inches square and 36 inches deep, through opposite sides of which the carbon electrodes are introduced. The fused slag collects at the bottom of the furnace, whence it is run off from time to time in the same way as in a blast furnace, whilst the mixture of phosphorus vapour and carbonic oxide pass to the condensing apparatus through an opening placed near the top of the furnace. More than 80 per cent. of the phosphorus contained in the materials used is obtained, the loss being largely due to the presence of iron which combines with phosphorus to form a phosphide which remains in the slag. The heat is concentrated mainly between the electrodes, so that the walls of the furnace do not suffer.

Calcium carbide was prepared by electrically heating together carbon and lime, in 1892 by Moissan in France, and by Willson in America; its manufacture is now carried out on a very considerable scale, both in America and in Europe. The production is said to be about 20,000 tons yearly. The furnaces employed vary considerably in details of construction and in magnitude. Those employed at Niagara consist of a square brickwork shaft in which a bundle of carbon rods, which forms one electrode, is suspended. The bottom of the shaft is closed by an iron rectangular box, running on rails, the bottom of which has a thick lining of carbon, which serves as the other electrode. The finely-powdered mixture of coke and lime is fed into the space round the upper electrode through channels in the brickwork sides of the shaft. The arc having been established between the electrodes, the mixture of coke and lime is shaken down into it, and converted into calcium carbide, which remains in a semi-fluid condition upon the lower carbon plate. The calcium carbide, being a fairly good conductor of electricity, now serves as the lower electrode, fresh material being constantly added to its upper surface until the iron box is full, when it is run out and a fresh one substituted for it. The current employed is 1700 to 2000 amperes, and the electromotive force 100 volts, a pound of the carbide being obtained for an expenditure of 2·25 electrical horse-power hours. When sufficient carbon is employed in the mixture, the electrodes are very little acted upon; the excess of carbon which is required depends very much on the kind of apparatus employed. A pound of well-made carbide yields 5 cubic feet of acetylene gas, the employment of which for lighting appears to be making some progress.

In concluding this brief sketch of the applications of electrochemistry, it is perhaps worth pointing out that, important and interesting as are the applications which have been made, those which yet remain are still more so. For example, it is possible, by compressing sulphur dioxide and air into separate carbon tubes dipping in dilute sulphuric acid, to cause the two gases to combine to form sulphuric acid, and at the same time furnish an electric current. The alluring prospect of obtaining electric energy as a bye-product in a chemical works, should be a sufficient incentive to efforts to overcome the numerous difficulties in the way.

THOS. EWAN.

## *THE STRANGLING OF AN ELEPHANT.*

ONE of the elephants in Barnum and Bailey's Show, which has been visiting Liverpool during the past two weeks, having recently shown signs of insubordination, Mr. Bailey determined, in order to perfectly safeguard his visitors, to sacrifice the animal. He has had during his life occasion to destroy many elephants, which, as a rule, he has handed over to experienced veterinary and other surgeons, who have tried various methods, such as poisoning, shooting and bleeding. All have proved, however, unsatisfactory, because uncertain, tedious, and not seldom dangerous to those engaged in conduct-

ing the operations. On this occasion it was determined, after consultation with several experts and with the Secretary of the Royal Society for the Prevention of Cruelty to Animals, to kill the elephant by strangulation, which had once before been adopted with success by Mr. Bailey. Accordingly it was arranged that on a recent Sunday morning—the day most suitable to the Show people and that freest from intrusion by the public—Don, as the doomed elephant, who was supposed to be about twenty-two years of age and nearly 4½ tons in weight, was named, should be strangled.

At the appointed hour those specially invited—among whom were several veterinary surgeons, Dr. Forbes, Director of the Liverpool Museums (to whom the body was generously to be handed over as a gift from Mr. Bailey to the Museum), Dr. Roberts, and Mr. Burnham, of the Society for Prevention of Cruelty to Animals—found the elephant standing quietly in one of the large tents in line with some twenty to thirty others. A new Manilla rope was loosely wound three times around its neck, and its legs, fully stridden, were securely chained each to a post firmly driven into the ground alongside each limb. The animal was intentionally not isolated from its fellows, as it was feared that if separated by itself it would become restive and ill-tempered. The rope surrounding the beast's neck had one end secured to three strong pillars in the ground, some distance away and slightly in advance of the fore-feet; and the other, which terminated in a loop, was hooked to a double series of pulleys, to the tackle of which ninety men were attached. When all was ready, the slack was gently, quietly, and without any apparent annoyance to the elephant, which kept on eating hay, taken in till the coils round its neck were just taut. The word was then given, "Walk away with the rope." Amid perfect silence the well-disciplined company walked away with it without the least effort. So noiselessly and easily did everything work that, unless with foreknowledge of what was going to take place, one might have been present without realising what the march of these men meant. The elephant gave no sign of discomfort, either by trunk or tail; its fellows standing close by looked on in pachydermatous unconcern, and at the end of exactly thirty seconds it slowly collapsed, and lay down as if of its own accord. There was absolutely no struggle, and no motion, violent or otherwise, in any part of the body, nor the slightest indication of pain. In a few seconds more there was no response to the touch of its eyelashes or other parts of the eye, and this condition remained for a few minutes; but through, perhaps, the leakage into the chest of a small quantity of air, some slight sensitiveness returned to the eye, seen on touching its inner angle, though not the cornea. On slightly tightening up the rope, the chest gave one or two short throbs, and after six and a half minutes all movement ceased, and sensation was entirely lost; while at the end of thirteen minutes from the order "to walk away," the eye had become rigid and dim.

That no more humane, painless and rapid method of taking the life of a large mammal could be devised, was the opinion of all the experts who witnessed the execution of this elephant.

The skin and skeleton have been preserved for exhibition in the Municipal Museums, and all the important viscera have been placed in Formal, for future study by the Director and his staff. Prof. Paterson and Dr. Dunn, of University College, who very kindly aided in the dissection, have made a full study of certain parts of the nervous system, which they had not completed in the dissection made by them (on which they have recently contributed a valuable paper to the *Journal of Anatomy and Physiology*) of the "rogue" elephant poisoned last year in Liverpool. These points, and others which may turn out to be of interest on the fuller dissection of the present specimen, will be published in the *Bulletin* of the Liverpool Museums.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

OXFORD.—On Tuesday evening, May 24, the Oxford University Junior Scientific Club held a very successful conversazione at the University Museum, which was tastefully decorated and lighted for the occasion. Over 1000 persons attended, and were received by the President, Mr. W. E. Moss (Trinity), and the other officers of the club. For the entertainment of the guests numerous exhibits and demonstrations of the most varied description were on view in the central court and the adjacent departments; and in the large lecture theatre two lectures were given: the first, by Prof. H. B. Dixon, F.R.S., of Owens College, Manchester, on "Climbing in the Rocky Mountains"; and the second, by Dr. Gustav Mann (New Coll.), on "Microphotography," both being well illustrated by lantern slides. A short lecture was also given in the geological lecture theatre by Mr. G. J. Burch, on "Artificial Colour-Blindness," in which evidence was brought forward to show that, instead of three, there are really four colour-sensations—red, green, *blue*, and violet. The reason so many experimenters have only detected three, is that a large number of people are colour-blind to either blue or violet. The lecturer's experiments consisted in fatiguing the optic nerve by exposure to special parts of the spectrum, and it was thus shown that the pure blue of the spectrum between violet and green could be eliminated. The Radcliffe Library was open during the evening, by kind permission of the librarian (Sir Henry W. Acland, Bart., K.C.B., F.R.S.), as was also the Pitt-Rivers' Collection, by permission of Mr. H. Balfour, the curator. The band of the Royal Artillery, with Sergt.-Major W. Sugg as conductor, gave an excellent selection of music.

IN view of the importance of ascertaining, with such accuracy as the conditions allow, the number of pupils receiving instruction in public and private secondary schools in England, the Lords of the Committee of Council on Education are repeating the inquiry first made in May 1897. Forms of inquiry have been sent to all those schools which are understood to be giving secondary education, and if one has not been received by the principal teacher an application to the Secretary of the Education Department will ensure the papers being sent.

VOTING by means of ballot papers through the post, Convocation of the University of London have placed Mr. J. Fletcher Moulton, who opposes the scheme for a teaching University, first on the list of those from whom Her Majesty will select a member of the Senate in succession to the late Sir Richard Quain. The two other candidates were Dr. J. B. Benson and Mr. P. Daphne. Mr. Moulton headed the poll by more than two hundred votes. It is not anticipated that the result of this election will influence the Government's intention to introduce the London University Bill at an early date.

THE London County Council has decided to lay out plots of ground in Battersea, Ravenscourt, and Victoria Parks in such manner as will afford assistance to scholars at elementary and secondary schools in the study of practical botany. Hardy typical plants belonging to twenty natural orders will be arranged in beds near the paths, one bed being devoted to each order. Each specimen will be labelled with its common name and its Latin or systematic name. Labels giving the names and natural orders will also be attached to the more important trees, shrubs and plants throughout the parks mentioned. Teachers holding printed orders issued by the Technical Education Board will be able to obtain from the superintendent in each park such specimens as may be required for botanical study. It is hoped that later on the arrangements may be extended to the cultivation of important types of the lower orders of plants, such as fungi, mosses, ferns, liverworts, &c., and facilities afforded for the study of aquatic plants.

A REPORT on the International Congress on Commercial Education, recently held at Antwerp, is given in the *London Technical Education Gazette*. The following items from the report are of interest:—The view of the majority of delegates present at the Congress was that *specialised* commercial education should not be commenced in primary and secondary schools, but that there was ample room for the development of higher commercial teaching. It is a significant fact that the city of Antwerp spends 2½ millions of francs on education out of a total revenue of 4 millions of francs. In connection with the discussion of the question as to what extent special commercial instruction should be given in secondary schools Dr. Stegemann, official German delegate, gave a long account of the German schools, more particularly of the "Realschulen" and of the "Fortbildungsschulen" (continuation schools). He said that the latter were principally supported by leading merchants and members of mercantile corporations, because they fully recognised the importance of giving to their clerks a theoretical education as the complement to their office training. Dr. Stegemann said that commercial instruction could be given