the weight of the sugar fermented. By using as much as 7 grammes of sugar, an assimilation of 14 milligrammes of nitrogen has been obtained. Washed air, free from ammonia and nitrates, was used in these experiments.

That a vegetable organism should be able to acquire from the air the whole of the nitrogen which it needs is certainly very remarkable, and is an extraordinary fact, both to the physiologist and chemist.

We have no clew as yet to the mode in which the nitrogen enters into combination; but it is evident that in this case, as in the nutrition of the nitrous organism, the difficult piece of chemical work forms but a small part of a much larger reaction that is at the same time in progress, and with which it is essentially connected.

It seems not improbable that these results of Winogradsky will explain some facts which have hitherto presented much difficulty. That a special organism, when in union with the roots of a leguminous plant, is capable of bringing about the assimilation of the free nitrogen of the air is now admitted by all; but it is denied by Schloesing and other accurate observers that the same organism when living in the soil has any such property. May we not suppose that for the assimilation of nitrogen to occur the organism must be supplied with sugar or its equivalent, and that this supply of sugar to the organism only takes place when the organism gains access to the sap of one of the higher plants.

In conclusion, I think we shall all agree that, however imperfect is our knowledge of the chemistry of the three species of bacteria we have considered, the facts which have been established have at least enlarged our conception of the capabilities of a vegetable cell, and I trust that some light has also been thrown on the general method by which some of the extraordinary chemical results are attained.

ON THE DIAMOND IN THE CANON DIABLO METEORIC IRON AND ON THE HARDNESS OF CARBORUNDUM.

By GEORGE FREDERICK KUNZ and OLIVER W. HUNTINGTON, Ph.D.

THE discovery of diamonds in the Canon Diablo meteoric iron was first announced by Dr. A. E. Foote in this journal for July, 1891 (vol. xlii., pp. 413-417). He found in the cutting of this meteorite that it was of extraordinary hardness, a day and a half of time being consumed and chisels destroyed in the process of removing a section. In cutting, the chisels had fortunately gone through a crevice filled with small cavities. The emery wheel used to polish this surface was ruined, and on examination the exposed cavities were found to contain hard particles which cut through polished corundum as easily as a knife cuts gypsum. The grains exposed were small and black, and Professor George A. Koenig pronounced them diamonds because of their hardness and indifference to chemical agents. The extreme hardness was subsequently verified by one of us (G. F. Kunz), who carefully examined the type specimen.

On July 8, 1892 (*Science*, p. 15), Dr. Oliver Whipple Huntington gave the result of his experiments with this remarkably interesting Canon Diablo iron. Taking 100 grammes of the iron he placed it in a perforated platinum cone suspended in a platinum bowl filled with acid, the cone being made the positive pole and the dish the negative pole of a Bunsen cell. The iron was slowly dissolved, leaving on the cone a large amount of black slime. This was carefully collected, digested over a steam bath for many hours, first with aqua regia and afterward strong hydrofluoric acid. A considerable part of the residue disappeared, but there remained a small amount of white grains which resisted the action of the acids. These particles, when carefully separated by hand, had the appearance of fine beach sand. Under the microscope they were found to be transparent and of brilliant luster. One of the grains was then mounted upon a point of metallic lead, which, when drawn across a watch crystal, was found to give the familiar singing noise characteristic of a glass cutter's tool and with the same result, namely, cutting the glass completely through. It deeply cut glass, topaz and a polished sapphire. These facts, first announced in *Science*, April 8, 1892, were presented at the meeting of the American Academy of Arts and Sciences on May 11, 1892, and were published in the Proceedings of this Academy, new series, vol. xxii., pp. 252, 253.

Later M. C. Friedel says in the *Bulletin de la Societe Francaise de Mineralogie*,* that he took a fragment of the Canon Diablo meteorite weighing 34 grammes, which gave the characteristic Widmannstattian figures, and treated it with hydrochloric acid. He digested the residue in aqua regia and obtained a black powder. After various treatments he thus separated about 0·35 gramme of a powder, which he presented to the Academy. The powder sank in a solution of the iodide of methyl, having a density of 3·3. No grains measuring more than 0·5 mm. to 0·8 mm. were found, the powder being fine and impalpable, capable of scratching corundum. He also burned some of the black residue, and as a product obtained CO_2.

At the meeting, above referred to, of the Academy of Arts and Sciences, Dr. Huntington showed to the members, under a microscope, the slightly yellow transparent grains he had obtained, and called attention to their adamantine luster. Not enough of the clear material was obtained at the time for a chemical test, and, on account of the association of the diamond grains with amorphous carbon, such a test would not have been conclusive without a perfect mechanical separation. One of us (G. F. Kunz) suggested that, if enough of the clear grains could be obtained to polish a diamond, it would conclusively prove that the material was diamond. For this purpose about 200 pounds of the meteoric iron was carefully examined, and specimens which appeared to contain diamonds were dissolved. The method used will be published by one of us (O. W. Huntington) later. After enough material had been separated by Dr. Huntington, on Monday, September 11, 1893, through the courtesy of Messrs. Tiffany & Co., we were enabled to try the desired experiment in their diamond cutting pavilion in the Mining building of the World's Columbian Exposition, they having prepared a new skaif or wheel, measuring 10½ inches in diameter, which was placed in position, the wheel having been specially planed down and prepared with the radiating scratches so as to be easily charged with diamond powder. A diamond was then soldered in a metal dopp and placed on the clean wheel, which made 2,500 revolutions to the minute. This diamond was tried for more than five minutes by itself without the slightest polish being produced and no markings other than such as would be produced by the minute shattering of the diamond at extreme edges, due to the friction, as when a diamond is placed on an uncharged wheel. At 9.20 a cleavage, weighing five thirty-seconds of one carat, was set with solder in the metal dopp, which was placed on the wheel. The diameter of the wheel where the diamond was to be placed was four inches. The wheel was then charged with the residue from the meteorite (the powder mixed as usual with oil). The moment that the diamond was placed on the wheel a hissing noise was apparent, showing to an expert that the material was really cutting the diamond. At 9.23 a flat surface. measuring 3 mm. by 1 mm. had been ground down and polished. At 9.30 a small crystal with a natural face up was set in the metal dopp, the crystal being a small natural complex twin weighing four thirty-seconds of one carat. It was first tried on a projecting angle. The cutting was very slow for a time, as the natural face of a diamond is always exceedingly hard. The position of the stone was then slightly changed, and a face measuring 2 mm. by 1 mm. was ground on the stone and cut. Three minutes later the surface had been cut down somewhat and a decided polish was produced on the triangular face, which was 3 mm. by 1·25. The fragment used was one of the octahedral faces of a crystal. The face ground down was at the angle of 45° with the octahedral face. The entire time of this experiment was 15 minutes. The two experiments having been made with great care with both of us present, we cannot hesitate to pronounce the material diamond or a substance with the same hardness, color, luster and brilliancy.

In August last, one of us (G. F. Kunz) while examining the hardness of "carborundum," a carbide of silicon, made by Mr. Acheson, of Pittsburg,* it was found that it readily scratched red, blue, white, pink and yellow corundum in the form of fine gems. It having been suggested that this material would cut and polish a diamond, an experiment was made on a new wheel. After several trials had been made, it was found that carborundum would not scratch or polish the diamond, but on the other hand it was easily scratched by diamond cleavages and crystal faces. This experiment is only mentioned, as it precludes any possibility of the material which has been found in the Canon Diablo meteorite being any such compound of carbon and silicon, such as the new and interesting abrasive material just mentioned. But it establishes the fact that we have an artificial substance that exceeds all natural substances except the diamond in hardness, *i.e.*, being harder than 9, but still far distant from 10.—*Am. Jour. of Science, Dec.*

CAFFEARINE.—A new alkaloid was isolated from coffee by D. P. Palladine by repeatedly boiling the raw coffee (in as fine a condition as possible) with ten times its weight of water, to which a little milk of lime was added; the decoctions are precipitated with solution of lead subacetate in slight excess, filtered, the excess of lead removed by adding sulphuric acid and the solution concentrated; should the solution show considerable color, the precipitation with lead subacetate is to be repeated; the caffeine is removed by extracting with 10-12 portions of chloroform or until nothing more is removable. The solution is acidified with sulphuric acid and evaporated several times to volatilize the acetic acid, after which the aqueous solution is decolorized by animal charcoal; the caffearine is next precipitated by potassio-bismuth iodide, the precipitate carefully washed, suspended in water, and decomposed with hydrogen sulphide, the hydriodic acid neutralized with lead carbonate, filtered, and the precipitation with potassio-bismuth iodine, etc., repeated until the precipitate shows a beautiful crystalline appearance; after decomposing with hydrogen sulphide the solution of the hydroiodate is warmed in a water bath with silver oxide, carefully neutralized with hydrochloric acid and the hydrochlorate allowed to crystallize. The alkaloid itself, $C_{14}H_{16}N_2O_4$, can be obtained from the hydrochlorate by the use of silver oxide, and is obtainable in crystalline needles, which are acted upon by light, and are quite soluble in water and alcohol. The hydrochlorate, $C_{14}H_{16}N_2O_4\,HCl + H_2O$, forms needles extremely soluble in water, also soluble in dilute alcohol, but insoluble in absolute alcohol. Caffearine differs from caffeine by being precipitable by alkaloidal reagents.—*Apotheker Ztg.; Amer. Jour. Pharm.*

STRUCTURE OF YEAST CELLS.

IN connection with the claim of Dangeard (*ante*, p. 83) to have proved the existence of well-characterized nuclei in the *Saccharomyces cerevisiæ*, it may be noted that other recent investigators have not attained similar results. G. Hieronymus (*Ber. deutsch. bot. Gesell.*) finds the contents of yeast cells to present a similar fibrillar structure to that seen in the *Phycochromaceæ*. Angular granules lying in the protoplasm probably consist of nuclein, and are always arranged in rows intertwined into a more or less regular spiral or ball, which is distinguished as the central thread. J. Raum (*Zeit. f. Hygiene*) also failed to find true nuclei present in yeast cells, but found, when the conditions of nutrition were favorable, bodies known as sporogenic granules in the ten species he examined. The granules exhibit great variation, and, as no membrane or any definite structure could be observed in them, are probably of fluid consistence. They are digestible by pepsin, and may, therefore, be of the nature of nuclein. Vacuoles were also frequently present in the cells, of a size in inverse ratio to that of the granules, but in kephir yeast they were absent.—*Jour. R. M. S.*

ELECTROLYTIC INDICATOR.—Moisten paper with a solution of 50 grammes of glycerine, 20 grammes of distilled water, 3 grammes of potassium nitrate, and 0·05 gramme of phenolphthalein. By touching the ends of both wires, the negative pole is indicated by becoming of a reddish violet color.—*Rev. Chem.*

* No. 9, p. 258, December, 1892.

* See *Engineering and Mining Journal.*

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