

Metal.	Ultimate tensile strength.	
	Lbs. per sq. in.	Kg. per sq. cm.
Ag	41,000	2,880
Pt	32,000	2,250
Mg	30,000	2,110
Cu	24,000	1,690
Au	20,000	1,410
Al (cast).....	15,000	1,050
Ca	8,710	612
Zn	7,500	527
Sn	4,600	323
Pb (sheet).....	3,300	232
Bi	3,200	225
Sb	1,000	70.3

Calcium is harder than sodium, lead or tin, almost as hard as aluminum, but softer than zinc, cadmium or magnesium.

The activity with which strontium and barium recombine with their chlorides makes them more difficult to produce. Their production was not tried in the furnace just described. There are many interesting things to be learned about the alkaline earth metals—their isolation, purification and action on gases, solutions, organic compounds, salts, oxides and metals. The question of alloys is a broad one; some might be found of special value because of their electrical conductivity, strength or extreme lightness, calcium being only four-sevenths as heavy as the light metal aluminum. The manufacture of cyanide and peroxide were uses found for metallic sodium, and in like manner uses will be found for calcium. It should be of use in the steel industry and for reduction purposes.

UNIVERSITY OF PENNSYLVANIA.

PREPARATION OF NITROGEN FROM THE ATMOSPHERE.

BY GEO. A. HULETT.

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NITROGEN is well adapted to operations that require an inert gas or atmosphere, and many methods have been proposed for preparing it. Von Knorre¹ gives a resumé of the methods for preparing nitrogen, and studies the conditions for obtaining it, free of oxides, by heating a solution of sodium nitrite, ammonium sulphate and potassium dichromate. Baxter and Hickley² first prepare oxides of nitrogen which are passed through ammonia

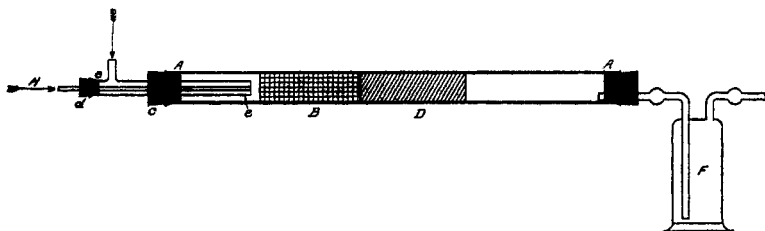
¹ *Chemische Industrie*, 531 and 550 (1902).

² *Am. Chem. J.*, 33, 300 (1905).

water. The gases then contain an excess of ammonia and are caused to interact by passing them over red hot copper, or platinumized asbestos. In these methods care must be exercised to get rid of all the nitric oxide, which is a very stable gas.

Nitrogen prepared from air contains about 1 per cent. of argon and allied gases, but it is seldom that these gases are objectionable and, although nitrogen forms four-fifths of the atmosphere, the methods proposed for removing the oxygen are not very satisfactory. Commonly red-hot copper is employed but the coat of oxide, which soon forms on the copper, renders it ineffective and there is then no assurance that the oxygen is all removed. To obviate this difficulty the author has employed a large carboy in which a jet of hydrogen was allowed to burn until most of the oxygen was used up. The gases remaining in the carboy were then displaced by water and forced over red-hot copper; thus very little copper was oxidized. It seems, however, that the carboy is unnecessary for the air and hydrogen may be led directly into the combustion tube and allowed to mix just before reaching the hot copper. The rate of flow of air and hydrogen is to be regulated and the oxidation of copper, or reduction of copper oxide, indicates which gas is in excess, so that one may admit the gases in exactly the right proportions, and thus prepare nitrogen in unlimited quantities and at any desired rate.

The accompanying figure shows the essential details of the apparatus. *AA* is an ordinary combustion tube 2 cm. or over in diameter, *B* is some 20 cm. of copper, made by rolling gauze on a



core of copper wires so that it completely fills the tube. Beyond this is some 20 cm. of copper oxide or thoroughly oxidized copper gauze, *D*. The tube is placed in a combustion furnace and both the copper and copper oxide are maintained at a good red heat. The double tube for admitting the air and hydrogen is passed through the cork *c*. The hydrogen is introduced through

the small porcelain tube *H* and this hydrogen tube passes through a small combustion tube, *EE*, and is made fast to it by the cork *d*. These two tubes form really an oxyhydrogen blowpipe and are held in position by the cork *c* which closes the combustion tube (metal tubes, on account of their heat conductivity and heating the cork, are to be avoided). The hydrogen must be admitted through the *inner* tube and burns at the end of this tube, *H*, in the air that comes in through the surrounding tube *EE*. The inner tube is to be of porcelain or some such non-fusible material as the end gets very hot, but the surrounding tube *EE* may be of combustion tubing and a little side tube is readily blown on.

These tubes end about 3 cm. from the copper and are adjustable. The flame, which is ignited by the red-hot copper, impinges on the copper, and brings it to a distinctly higher temperature than would otherwise be the case, but the good heat conductivity of copper distributes this heat so that there is no danger of melting or cracking the combustion tube at this point.

After the copper and oxide are at a red heat hydrogen is admitted until the copper *B* is perfectly bright and the oxide *D* shows signs of reducing; then the air is turned on until a slight coat of oxide begins to form on the copper. This delicate coat, a few centimeters long, is a sensitive indicator allowing one to regulate the relative proportions of air and hydrogen to a nicety. With a constant air pressure and a good hydrogen generator the apparatus will need little attention when once adjusted. The resulting gases, nitrogen with 1 per cent. of argon, water vapor and a little carbon dioxide, are passed through the washer *F* which contains a solution of caustic potash. Some water will condense beyond the combustion furnace and the furnace must therefore be tilted so that this water will not run back and crack the hot tube. The water (about $\frac{1}{4}$ cc. per liter of nitrogen) may run into the washer *F* or be removed by a separate little tube and cock.

The following test has been made with this apparatus. A second combustion tube furnace with copper foil was joined to the delivery tube of the washer *F* and 50 liters of nitrogen passed through the second tube without tarnishing the red-hot copper and at the rate of about 3 liters a minute. If oxides of nitrogen are formed in small quantities in this apparatus they

could hardly escape the 20 cm. of copper which is at a higher temperature than ordinary, due to the hydrogen flame impinging on it. The gas is as free of oxygen as copper can make it, but if collected in an ordinary gasometer, oxygen from the air dissolved in the water of the gasometer will get into the nitrogen, so when an exceedingly pure product is required it is best to use the gas direct from the washers, and also rubber connections and stoppers are then to be avoided. With facilities for compressing a gas this nitrogen might be put into cylinders as it can be made in unlimited quantities.

UNIVERSITY OF MICHIGAN,
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ON THE CRYSTALLINE ALKALOID OF CALYCANTHUS GLAUCUS.

BY H. M. GORDIN.

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(SECOND PAPER.)¹

THE subject of this paper is a continuation of the research upon the alkaloid calycanthine, the active principle (according to Cushny)² of *Calycanthus glaucus*.

In the first paper it was shown that the formula of calycanthine is $C_{11}H_{14}N_2 + \frac{1}{2}H_2O$, that the alkaloid is a weak monoacid base forming a chloroplatinate of normal composition and combining with one molecule of the halogen acids, and that it gives some very characteristic color reactions.

In the present paper I wish to report upon the preparation and analysis of the salts of calycanthine with the ordinary acids, with chlorauric acid and mercuric chloride and upon the first attempts to get some idea of the constitution of the alkaloid.

It will be noticed that the analytical figures for the acid part of those salts which could not be washed with the solvent in presence of free acid, as in the case of fixed acids and nitric acid, are generally slightly too low, showing that some acid is lost upon washing away the mother-liquor.

Calycanthine Nitrate, $C_{11}H_{14}N_2.HNO_3$.—As a monoacid base calycanthine combines with one molecule of nitric acid. Like

¹ For first paper see *Proc. Amer. Pharm. Assoc.*, 1904, p. 345, and this Journal, **27**, 144 (1905).

² This Journal, **27**, 155.