

A NEW METHOD OF MANUFACTURING AMMONIA.

We reprint from the *Journal of the Society of Arts*, (London) the following able article, which was written by Mr. Alex. Williams, and discusses a subject of great consequence to our country. If we could obtain cheap ammonia, guano would very soon fall in price, as it is the principal fertilizing ingredient in it:—

The importance of ammonia and its sister compound, nitric acid, in an agricultural point of view, as forming probably the chief sources whence the nitrogen of plants is obtained, and the high commercial price of compounds containing either of these substances, have led practical chemists to look upon any new method of obtaining them as one of the great desiderata of the day.

The atmosphere, with its water, contains the elements necessary for the formation both of ammonia and nitric acid, and during the passage of electricity both are formed; but so far as our present knowledge extends, and from a long series of experiments on the subject, I am led to believe that it will be some time ere the Society's premium will be claimed "for the production of ammonia or nitric acid from their elements, by methods which would admit of practical application."

After having been engaged for many years in experiments on this subject, I have arrived at the conclusion that, except under peculiar circumstances, nitrogen and hydrogen in their gaseous or elementary state will not combine together in sufficient quantities to be commercially available. To make them unite in any quantity it is necessary that the nitrogen should, in its nascent state, be brought in contact with the hydrogen, when union will take place, but this combination is much more readily effected if both be in their nascent state.

To obtain nascent nitrogen it is, of course, necessary to decompose one of its compounds, and thus far I had only arrived at the same conclusion as every one else. The object of this paper is to direct attention to a by-product of one of our most important chemical manufactures, which is exactly adapted to our purpose.

The animal and vegetable kingdoms have been so thoroughly searched by the shoals of manure manufacturers of this and other countries, that the discovery of any new nitrogen compound in these kingdoms seems to be altogether improbable; one is therefore naturally led to the mineral kingdom, and our ideas as naturally become fixed on nitrate of soda as the cheapest source. It has been known for years that nitric acid, or other compounds of nitrogen and oxygen, could be converted into ammonia, and therefore the use of a nitrate would present no novelty; but if we can obtain the nascent nitrogen from nitrate of soda as a by-product, we shall have made a grand step towards facilitating the manufacture of ammonia.

This, I believe, I have accomplished. Of the thousands of tons of nitrate soda annually imported into this country, I have been told, on good authority, that about half is used in the manufacture of sulphuric acid. It is well known that sulphuric acid is usually manufactured in a large leaden chamber having attached to it a burner where sulphur is kept constantly burning, by which it is converted into sulphurous acid. The great difficulty of the manufacture is to give another atom of oxygen to this sulphurous acid ($S O_2$) to convert it into sulphuric acid ($S O_3$), and it is for this purpose that the nitrate of soda (cubic nitre) is used, and usually in the following manner:—One or more movable iron pots are placed in the burner. Into each of these pots is put, as often as required, a few pounds of nitrate of soda, and with a sufficient quantity of sulphuric acid to decompose it. Sulphate of soda (salt cake) remains in the pot, whilst nitric acid and probably other compounds of nitrogen and oxygen pass with the sulphurous acid into the leaden chamber. The sulphurous acid ($S O_2$) gains an additional atom of oxygen from the nitrogen compounds, and becomes converted into sulphuric acid ($S O_3$) which, with water afforded by steam jet or otherwise, condenses as a liquid at the bottom of the chamber, whilst a quantity of gas escapes.

Such is a rough sketch of the first part of the process usually adopted for making sulphuric acid or oil of vitriol, and the gas which escapes from the vitriol chamber must now be the subject of our inquiry,

On referring to Dr. Ure, our great authority on manufacturing chemistry, I found that he asserts that in a properly working chamber nothing but nitrogen gas should

escape; in fact, that the whole of the oxygen should be taken up, and that the nitrogen should be reduced to its elementary condition. This, although the generally received opinion of the manufacturing chemists of the present day, appeared to me fallacious; as, on considering the affinities, I did not think it probable that sulphurous acid, although it is known to form a compound with nitric oxyd ($N O_2$), should, under the circumstances occurring in the vitriol chambers, be able to decompose it. Experiments were immediately instituted to ascertain the truth, and they led to the knowledge of the fact that a chemical compound of nitrogen and oxygen was escaping, and not free nitrogen. What particular compound of nitrogen and oxygen it is has not been ascertained, as the fact of its being a chemical compound was sufficient for the purpose intended, viz., of applying this waste product for the manufacture of ammonia.

At the commencement of the year 1856, I transferred a portion of the gases escaping from a vitriol chamber to my own laboratory, and there and then succeeded in converting them into ammonia.

This was an important step, but I did not feel satisfied until I had tried the process on a large scale; therefore, in November in the same year, an arrangement was entered into, for this purpose, with Messrs. Lewis and Polard, of Pontardawe Vitriol Works, whose kind assistance in the matter I take this opportunity of acknowledging. The apparatus fitted-up was of the following description:—A furnace was built above the exit tube of one of their vitriol chambers, and a brick gas retort, about 14 inches in diameter, 8 feet long, and open at both ends, was passed through its whole length. This retort was filled with charcoal, and kept at a red heat; the exit tube of the chamber, and a steam jet to supply the hydrogen, were attached to one end, whilst to the other end was fixed an upright leaden cylinder filled with coke, and moistened with diluted sulphuric acid. On passing the waste gases and steam through the retort containing red hot charcoal, both were decomposed, the oxygen of each uniting with the charcoal to form carbonic acid ($C O_2$); the nitrogen and hydrogen combining to form ammonia ($N H_3$), or, without water, $N H_2$; then together, probably forming carbonate of ammonia ($N H_4 O_1 C O_3$) which was again decomposed by diluted sulphuric acid, the sulphate of ammonia being found remaining in solution. This solution was then evaporated, and in July, 1857, I first had the pleasure of obtaining any quantity of crystals of sulphate of ammonia, by this process, from a vitriol chamber in actual work.

It was the intention at that time to have secured the invention by patent, and therefore, when the above comparatively rough result had been obtained, the further prosecution of the experiments to ascertain yield, &c., was not proceeded with, lest the process should become public. Several circumstances have since prevented their renewal. I therefore merely wish to offer the process, as it is, to those interested in the matter, hoping some one else may apply it more profitably than I have, and feeling sure that—as there seems no reason why it should not be successfully carried out—it will be the means of advancing the "arts, manufactures, and commerce" of this country, by increasing the supply of one of our most valuable fertilizers.

Perhaps it may be thought that the process is only adapted to such gases as escape directly from the chamber, and that, if any of the late improvements as coke cylinders, &c., be used, it cannot be applied; but provided the assertion be correct that sulphurous acid is incapable of reducing compounds of nitrogen and oxygen to their elementary state, then the process will be available after all of these improvements have been carried out, and not only to the waste gases, but also, by a slight modification, to any nitrogen compounds that may have been absorbed by the dilute sulphuric acid, and be given off in its evaporation, so that really a very minute portion only of the nitrogen contained in the nitrate of soda need be lost.

With regard to the quantity obtainable by these means, I have not as yet been able to ascertain with certainty the amount of nitrate of soda imported, but, as already stated, it appears probable that about half of the whole quantity arriving in this country is used in the manufacture of the oil of vitriol, or sulphuric acid. Now, every thousand tons of this cubic nitre, allowing 10 per cent. for impurities, would, if the whole of its nitrogen were converted into chloride of ammonia ($N H_4 O$), yield

about 565 tons of this substance, which, at £30 per ton, would be worth nearly £17,000, and there are, doubtless, many thousands of tons of nitrate of soda used by the vitriol makers of this country.

Although these figures give, of course, no approximation to the practical yield likely to be afforded by this process, yet they enable us to form a very good idea of the enormous amount of valuable material daily wasted. The process suggested, or some modification of it, may render this waste unnecessary, and thus save the pocket of the manufacturer and at the same time benefit the public.

RECIPES FOR MAKING FANCY INKS.

The following are a few recipes for making uncommon inks, which may be used by fancy writers; and as they are not to be found on sale, they must be very useful to some of our readers:—

Gold Ink.—Mosaic gold, 2 parts; gum arabic, 1 part; are rubbed up with water until reduced to a proper condition.

Silver Ink.—Triturate in a mortar equal parts of silver foil and sulphate of potassa, until reduced to a fine powder; then wash out the salt, and mix the residue with a mucilage of equal parts of gum arabic and water.

Brown Ink.—Digest powdered catechu, 4 parts, with water, 60 parts, for some hours; filter and add sufficient of a solution of bichromate of potassa, 1 part in 16 of water.

Yellow Ink.—Macerate gamboge, 1 part (or $1\frac{1}{2}$); alum, $\frac{1}{2}$ part; gum arabic, 1 part, in acetic acid, 1 part; and water, 24 parts.

Blue Ink.—Triturate best Prussian blue, 6 parts, with a solution of 1 part of oxalic acid in 6 of water, and towards the end of a quarter of an hour or so, add gradually gum arabic, 18 parts, and water, 280. Pour off clear.

Red Inks.—1. Pernambuco wood, 4 parts; alum and cream of tartar, of each, 1 part, with 50 of water; boil down to 16 parts, let stand, pour off, filter and dissolve in the liquid gum arabic, $1\frac{1}{2}$ parts, white sugar, 1 part.

2. Digest powdered cochineal, 8 parts, and sal tartar, 16 parts in 144 of water, for 24 hours. Then boil up with powdered (potash) alum, 4 parts, and add 24 of cream of tartar, with 3 parts of tartaric acid, and when effervescence has ceased, another part of the acid, or enough to produce the color. Let cool, filter, and boil the residue on the filter with 12 parts of water; filter again, mix the liquids and dissolve in them 24 parts of gum arabic, and lastly $\frac{1}{2}$ part of oil of cloves. No iron vessels must be used in this process.

3. Digest powdered cochineal, 16 parts; oxalic acid, 2 parts; dilute acetic acid, 80 parts; distilled water, 40 parts for 36 hours. Then add powdered alum, 1 part; gum arabic, 1 to 10, shake up, let stand for 12 hours and strain.

4. Dissolve 1 part of carmine in 8 to 10 parts of aqua ammonia, and add mucilage of gum arabic sufficient to reduce it properly.

Violet Ink.—8 parts of logwood and 64 parts of water; boil down to one-half, then strain and add 1 part of chloride of tin.

Green Inks.—1. Digest 1 part of gamboge with from 7 to 10 parts of the blue ink.

2. To powdered bichromate of potassa, 8 parts, contained in a porcelain dish, add oil of vitriol, 8 parts, previously diluted with 64 of water; then heat and while evaporating add gradually 24 parts of alcohol, and reduce to 56 parts, which filter, and in the clear liquid dissolve 8 parts of gum arabic.

Crimson Ink.—A beautiful crimson ink is made by mixing red ink, No. 1, with the violet ink; about equal parts will answer.

The parts given are those of weight, not measure. The mucilage of gum arabic prevents the fine particles of color falling to the bottom in the form of a sediment. Sugar gives to inks a glossy appearance, but very little of it should be used, as it is liable to make the ink sticky.

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