

Ewart Johnstone's way to prepare Nitric Oxide.

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In 1882 D. Ewart Johnstone announced in the *Chemical News*, 45, 159, that cobalt nitrate and potassium thiocyanate heated together readily yield nitric oxide. Except by Schertel, in the *Referate* of the *Berichte* of the *German Chemical Society*, this announcement seems to have been received without criticism, and Michaelis inserted it in his edition of Graham-Otto's *Inorganic Chemistry* among the methods of preparing nitric oxide.

The results of my own testing of the method oblige me to conclude that Johnstone is altogether wrong. We are directed by him to mix four parts of a solution of potassium thiocyanate with one part of a solution of cobalt nitrate, such as are ordinarily in use in the laboratory, and gently heat the mixture, when nitric oxide will be copiously evolved. An equation is given of the action in which four molecules of the potassium salt and one of the cobalt salt appear, and since the quantities to be taken are so indefinitely set down, I started my experiments with these proportions of the salts, both practically in a state of purity. The result proved that, in these proportions, as well as in many others which were tried, whether the solutions are dilute or concentrated, only gently heated or freely boiling, nitric oxide is not formed at all by

them. Beyond the well known fact that the mixed solutions are intensely green, no sign of any action was observed. When the solid salts, a little damp, were heated together, also as recommended by Johnstone, watery fusion occurred and the water boiled off without gas being generated. When, however, the water being gone, the residue got much hotter, there occurred, as might have been anticipated, an explosive reaction in which torrents of gases escaped. These gases, collected over water and gradually mixed with oxygen, proved to consist of nitric oxide to the extent of about two-thirds of their volume, the rest being principally nitrogen. Carbon dioxide and ammonia were also freely given off, and condensed together to form a sublimate, and a cloud, and a solution in the trough-water, of ammonium carbonate or carbamate. The residue smelt strongly of ammonia and was black from the presence of cobalt sulphide, but did not contain the sulphur and the carbon which Johnstone supposed are formed, at least not in quantities which I could detect.

It is a matter of common experience that potassium thiocyanate boiled with dilute nitric acid is decomposed with evolution of nitric oxide and other gases, being partly oxidised and partly converted into the insoluble yellow perthiocyanogen. Now, only a small quantity or, rather, only a weak concentration, of nitric acid is needed for this reaction, and the presence or absence of cobalt nitrate makes, I find, no difference. Probably, therefore, Johnstone's laboratory solution of the latter salt contained nitric acid in some quantity, as Schertel, indeed, has suggested.
