PHILOSOPHICAL TRANSACTIONS.

I. *On a new detonating Compound, in a Letter from Sir* HUMPHRY DAVY, *L.L.D. F.R.S. to the Right Honourable Sir* JOSEPH BANKS, *Bart. K.B. P.R.S.*

Read November 5, 1812.

MY DEAR SIR,

I THINK it right to communicate to you, and through you to the Royal Society, such circumstances as have come to my knowledge respecting a new and a very extraordinary detonating compound. I am anxious that those circumstances should be made public as speedily as possible, because experiments upon the substance may be connected with very dangerous results; and because I have already mentioned the mode of preparing it to many of my chemical friends, to whom my experience may be useful in saving them from danger.

About the end of September, I received a letter from a philosophical gentleman at Paris on some subjects of science, which contained the following paragraph:

" Vous avez sans doute appris, Monsieur, la découverte qu'on a faite à Paris il y a près d'un an, d'une combinaison de gaz azote et de chlorine, qui a l'apparence d'une huile plus

pesante que l'eau, et qui détonne avec toute la violence des métaux fulminans à la simple chaleur de la main, ce qui a privé d'un œil et d'un doigt l'auteur de cette découverte. Cette détonnation a lieu par la simple separation des deux gaz, comme celle de la combinaison d'oxigène et de chlorine ; il y a également beaucoup de lumière et de la chaleur produites dans cette détonnation, où un liquide se decompose en deux gaz."

The letter contained no account of the mode of preparation of this substance, nor any other details respecting it.

So curious and important a result could not fail to interest me, particularly as I have long been engaged in experiments on the action of azote and chlorine, without gaining any decided proofs of their power of combining with each other. I perused with avidity the different French chemical and physical journals, especially *Les Annales de Chimie*, and *Le Journal de Physique*, of which the complete series of last year have arrived in this country, in hopes of discovering some detail respecting the preparation of this substance, but in vain. I was unable to find any thing relative to it in these publications, or in the *Moniteur*.

It was evident from the notice, that it could not be formed in any operations in which heat is concerned; I therefore thought of attempting to combine azote and chlorine under circumstances which I had never tried before, that of presenting them to each other artificially cooled, the azote being in a nascent state. For this purpose I made a solution of ammonia, cooled it by a mixture of ice and muriate of lime, and slowly passed into it chlorine, cooled by the same means. There was immediately a violent action, accompanied by fumes of a pecu-

liarly disagreeable smell; at the same time a yellow substance was seen to form in minute films on the surface of the liquor; but it was evanescent, and immediately resolved itself into gas. I was preparing to repeat the experiment, substituting the prussiate of ammonia and other ammoniacal compounds, in which less heat might be produced by the action of the chlorine, than in the pure solution of the gas, when my friend, Mr. J. G. CHILDREN, put me in mind of a circumstance of which he had written to me an account, in the end of July, which promised to elucidate the enquiry, viz. that Mr. JAMES BURTON, jun. in exposing chlorine to a solution of nitrate of ammonia, had observed the formation of a yellow oil, which he had not been able to collect so as to examine its properties, as it was rapidly dissipated by exposure to the atmosphere. Mr. CHILDREN had tried the same experiment with similar results.

I immediately exposed a phial, containing about six cubical inches of chlorine, to a saturated solution of nitrate of ammonia, at the temperature of about 50° in common day-light. A diminution of the gas speedily took place; in a few minutes a film, which had the appearance of oil, was seen on the surface of the fluid; by shaking the phial it collected in small globules, and fell to the bottom. I took out one of the globules, and exposed it in contact with water to a gentle heat: long before the water began to boil, it exploded with a very brilliant light, but without any violence of sound.

I immediately proposed to Mr. CHILDREN, that we should institute a series of experiments upon its preparation and its properties. We consequently commenced the operations, the results of which I shall describe. We were assisted in our

labours, which were carried on in Mr. CHILDREN's laboratory at Tunbridge, by Mr. WARBURTON.

It was found that the solution of oxalate of ammonia, or a very weak solution of pure ammonia, answered the purpose as well as the solution of nitrate of ammonia. It was formed most rapidly in the solution of ammonia, but it was white and clouded; and though less evanescent than in the strong solution I first used, it was far from being as permanent as in the solutions of nitrate and oxalate. The solution of prussiate of ammonia acted on by chlorine, afforded none of the peculiar oil; but produced white fumes, and became of a bright green colour. An attempt was made to procure the substance in large quantities, by passing chlorine into WOLFE's bottles, containing the different solutions, but a single trial proved the danger of this mode of operating; the compound had scarcely began to form, when, by the action of some ammoniacal vapour on chlorine, heat was produced, which occasioned a violent explosion, and the whole apparatus was destroyed.

I shall now describe the properties of the new substance. Its colour is very nearly that of olive oil, and it is as transparent, and more perfectly liquid. I have not been able to ascertain its specific gravity with accuracy, but it is probably above 1.6. Its smell is very nauseous, strongly resembling that of the combination of carbonic oxide and chlorine, discovered by my brother; and its effect on the eyes is peculiarly pungent and distressing. A little of it was introduced under water into the receiver of an air pump, and the receiver exhausted; it became an elastic fluid, and in its gaseous state was rapidly absorbed or decomposed by the water. When warm water

was poured into a glass containing it, it expanded into a globule of elastic fluid, of an orange colour, which diminished as it passed through the water.

I attempted to collect the products of the explosion of the new substance, by applying the heat of a spirit lamp to a globule of it, confined in a curved glass tube over water: a little gas was at first extricated, but long before the water had attained the temperature of ebullition, a violent flash of light was perceived, with a sharp report; the tube and glass were broken into small fragments, and I received a severe wound in the transparent cornea of the eye, which has produced a considerable inflammation of the eye, and obliges me to make this communication by an amanuensis. This experiment proves what *extreme* caution is necessary in operating on this substance, for the quantity I used was scarcely as large as a grain of mustard seed.

A small globule of it thrown into a glass of olive oil, produced a most violent explosion; and the glass, though strong, was broken into fragments. Similar effects were produced by its action on oil of turpentine and naphtha. When it was thrown into ether there was a very slight action; gas was disengaged in small quantities, and a substance like wax was formed, which had lost the characteristic properties of the new body. On alcohol it acted slowly, lost its colour, and became a white oily substance, without explosive powers. When a particle of it was touched under water by a particle of phosphorus, a brilliant light was perceived under the water, and permanent gas was disengaged, having the characters of azote.

When quantities larger than a grain of mustard seed were used for the contact with phosphorus, the explosion was always

so violent as to break the vessel in which the experiment was made. The new body, when acted upon under water by mercury, afforded a substance having the appearance of corrosive sublimate, and gas was disengaged. On tin foil and zinc it exerted no action; it had no action on sulphur, nor on resin. In their alcoholic solutions it disappeared as in pure alcohol. It detonated most violently when thrown into a solution of phosphorus in ether, or in alcohol. Phosphorus introduced into ether, into which a globule of the substance had been put immediately before, produced no effect. In muriatic acid it gave off gas rapidly, and disappeared without explosion. On dilute sulphuric acid it exerted no violent action. It immediately disappeared without explosion in LIBAVIUS's liquor, to which it imparted a yellow tinge.

It seems probable, from the general tenor of these facts, that the new substance is a compound of azote and chlorine; the same as, or analogous to, that mentioned in the letter from Paris. It is easy to explain its production in our experiments: the hydrogen of the ammonia may be conceived to combine with one portion of the chlorine to form muriatic acid, and the azote to unite with another portion of chlorine to form the new compound. The heat and light produced during its expansion into gaseous matter, supposing it to be composed of azote and chlorine, is without any parallel instance, in our present collection of chemical facts; the decomposition of euchlorine, which has been compared to it, is merely an expansion of matter already gaseous. The heat and light produced by its rarefaction, in consequence of decomposition, depend, probably, on the same cause as that which produces the flash of light in the discharge of the air gun.

The mechanical force of this compound in detonation, seems to be superior to that of any other known, not even excepting the ammoniacal fulminating silver. The velocity of its action appears to be likewise greater.

I am, my dear Sir,

with great respect, very sincerely your's,

H. DAVY.