X. *On a new Fulminating Platinum.* *By* Edmund Davy, *Esq. Professor of Chemistry, and Secretary to the Cork Institution. Communicated by Sir H.* Davy, *LL. D. F. R. S. V. P. R. I.*

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I. *Introduction.*

The metals, as is well known, closely resemble each other in their physical and chemical characters. A chain of analogies connects them together into one class, and serves to distinguish them from all other bodies with which we are acquainted. Hence, the observation of a new property, or the discovery of a new relation in any one of the metals, is a sufficient ground for extending similar enquiries to all the others. And though the same methods may not furnish equally successful results in the case of different metals, yet by varying the processes, some new truths are usually brought to light.

The analogies that exist between the different metals, are in some cases nearer, and in others more remote; but in all instances they are sufficiently numerous and striking to serve the ends of classification, and facilitate the progress of scientific discovery. Gold, silver, and platinum, were formerly distinguished by the epithet *noble* or *perfect* metals; this distinction, though it no longer exists, was founded on a similarity in their physical properties. Gold and silver furnish with the volatile alkali, well known fulminating compounds. Gold and platinum appear to be more closely related to each other than they are to silver, or to any of the other metals; though separated by a number of marked distinctions, they yet possess in common, many points of resemblance. They are both soluble in the same menstrua, and can only with difficulty be made to unite with oxygene, chlorine or sulphur; and their oxides form peculiar triple compounds with acid and alkaline or earthy substances. From these analogies, and especially the last, it might be presumed that platinum, like gold, by particular treatment, was capable of furnishing a fulminating compound. Since platinum has been known to chemists, different attempts have been made to produce such a compound, but without effect. On the discovery of fulminating mercury by Mr. Howard, he endeavoured to communicate fulminating properties to compounds of platinum, by means of alcohol, but his trials were unsuccessful. I have to a certain extent succeeded in this way, and my attempts have led to the observation of some new facts. I have also obtained a new compound of platinum, analogous in its properties and composition to *aurum fulminans*, and which, in consequence, I shall venture to designate by the term *fulminating platinum.* I have, indeed, already noticed a peculiar compound of platinum under this name,* but the term should be restricted to the new compound, on account of its superior fulminating properties. This fulminating platinum serves to extend the existing analogies between the noble metals, and fills up a vacant space in their chemical history. In the present communication, I shall endeavour to describe this substance; but before I enter

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on the detail of its physical and chemical properties, it may be proper to notice the methods by which it may be procured.

II. *Modes of obtaining Fulminating Platinum.*

In the year 1812, whilst I was engaged in experiments on some compounds of platinum, I obtained an ammonia sulphate of this metal, by treating sulphate of platinum with pure ammonia. On boiling a little of the ammonia sulphate with pure potash, it became of a darker colour. I supposed it might have been converted into an oxide, but I did not examine it. On recently renewing this enquiry, I was led to the discovery of fulminating platinum.

The platinum I employed, in preparing the fulminating compound, it may be proper to remark, was in the form of thin sheets, but previous to its being used it was dissolved in nitro-muriatic acid, then precipitated by muriate of ammonia, and again reduced to the metallic state.

The platinum so prepared was dissolved in nitro-muriatic acid, the solution evaporated to dryness, and the dry mass dissolved in water. A current of sulphuretted hydrogene gas was then passed through the aqueous solution, till the supernatant fluid remained colourless. The hydro-sulphuret of platinum, after being well washed and partially dried, was converted into sulphate by the agency of nitrous acid. The fulminating platinum was prepared, by treating the aqueous solution of sulphate of platinum with a slight excess of pure ammonia; the precipitate thus obtained was placed on a filter, and partially dried, so as to be easily separated from the paper. It was then put into a Florence flask, with a strong solution of pure potash, and the fluid boiled nearly to dryness. A quantity of water was then added, the whole thrown on a filter, and the solid matter, after being well washed* and dried for several days at the temperature of about 212° Fahrenheit, exhibited properties, which will presently be described.

In preparing fulminating platinum, it may be here remarked, other alkaline substances as soda, common kali, &c. may be substituted for pure potash. And farther, it may be added, nearly similar results are obtained, whether the ammonia sulphate of platinum be put into the fixed alkali in fine powder, or in a moist or wet state; whether the fixed alkali be immediately added, after the precipitation from the sulphate of platinum by ammonia, or the precipitate be first separated and partially dried, previous to such treatment. In making fulminating platinum, (as is the case with aurum fulminans,) circumstances may be varied to a considerable extent, without materially impairing its properties.

III. *Properties of Fulminating Platinum.*

Fulminating platinum, when prepared in the manner I have described, appears in the form of a loosely coherent brown powder. I have obtained it of different shades of colour, from a light brown to a dark chocolate, and even almost black. These varieties of colour seem to be connected with the agencies of the fixed alkalies, and the peculiar circumstances which accompany its formation. The fulminating powder seems to be of a lighter or darker colour, as the

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* The washings contain a little fulminating platinum in solution, for when neutralized by nitrous or oxalic acid, a precipitate is obtained, which when washed and dried, exhibits fulminating properties.

quantity of fixed alkali employed is smaller or greater, and the process of boiling continued for a shorter or longer time. If, after the addition of the fixed alkali the fluid be boiled down to dryness, the fulminating powder will be of a dark colour, and if the heat be still continued, it will be partially decomposed, and this effect will be accompanied with slight explosions. The differences of colour observed in the fulminating powder are not perhaps connected with any difference in its constitution; at least this variety of circumstance does not appear to deteriorate its fulminating properties in any sensible degree, except in cases where the process has been carried too far in the use of the fixed alkali, aided by long continued heat.

When the fulminating powder in small quantity is placed on bibulous or filtering paper, and gradually heated over a clear fire, or an Argand lamp, it explodes with a loud report, the paper is lacerated, and its parts violently rent asunder. A bit of the powder no bigger than the head of a pin, or about $\frac{1}{20}$ of a grain, produces a sharp crack, and makes a hole in the paper.

One grain of the powder was placed on a slip of thin sheet copper, and exploded by the heat of a taper: it produced a report louder than the discharge of a pistol, and the copper was deeply indented, as if it had received the impression of a large punch.

A $\frac{1}{4}$ of a grain of the powder was exploded on a slip of tinned iron: the lustre of its surface was tarnished, and it had the appearance of an alloy of platinum and tin. The same quantity of the powder was placed between two slips of filtering paper and exploded; both slips were perforated and lacerated, but the greatest effect was produced on the lowest slip. The results were analogous when the powder was placed between two slips of thin sheet copper, or platinum, and exploded.

In one experiment, 1 ½ grain of the powder (containing particles of paper from the filter,) was put between two flat slips of sheet copper, they were bound together by strong copper wire, and to render them more secure, the ends of the upper slip were made to lap closely over those of the under slip. They were then put on the ring of a brass stand, on the floor, and a lighted taper was placed so as to communicate in a gradual manner a sufficient degree of heat to explode the powder. In about four minutes this effect took place. The report was very loud; the slips were thrown on a high table at a distance of several feet; the wire still held them loosely together, but both were considerably depressed, and especially the lower slip, which in two places, to the extent of half an inch, had its parts folded, the one over the other. These experiments, though on a very limited scale, are sufficient to prove that the powder is capable of exerting a very considerable power, when fired by heat. Its explosive force appears to be exerted in all directions, but principally downwards. By thoroughly drying the powder, and gradually raising it to the temperature at which it explodes, its fulminating property is very much increased. Before it explodes, its colour varies, and from being brown, it becomes almost black. At the instant of the explosion a flash of light is perceived, and the powder is totally dispersed. In all these circumstances, there is a very near coincidence between fulminating platinum and fulminating gold, and I shall again have occasion to notice other points of resemblance in their properties.

The temperature at which fulminating platinum explodes, appears to be about 400° Fahrenheit. When it was placed on a surface of mercury heated to 420°, it instantly exploded. When the thermometer stood at 410°, a short interval elapsed before this effect took place. In two instances I succeeded in exploding it at 400°. From some comparative trials, I found fulminating gold exploded in similar circumstances, but I could not succeed with it at a temperature below 406°. I am inclined to think, both fulminating powders, if dried at the same temperature, will be found to explode nearly at the same degree of heat. Under certain circumstances, both of the fulminating compounds appear to lose their explosive property, and to be quietly decomposed. This was observed, in some instances, when they were placed on mercury at a temperature varying from 300° to 380°, and a very short interval suffered to elapse before the heat was raised. It was not possible, then, to explode them at any temperature. In other cases, however, in which there was a similarity of circumstances, both powders exploded. These results, though apparently capricious, or even opposite, may perhaps admit of some explanation. The mercury on which the experiments were tried was impure, and exhibited by heat a tarnished surface, from partial oxidation. Hence, in the foregoing experiments, the fulminating powders exploded in some cases, as when placed on an oxidated surface, because the heat did not call into play any other affinities than those existing between the elements of the compounds. But the powder did not explode in other instances; as when in contact with a surface of mercury, the affinity of this metal interfered, and it slowly formed amalgams with the metallic part of the powders. This view of the facts seems to derive additional evidence from the circumstance, that in cases when no explosions occurred, the powders remained stationary, and gradually acquired a whitish colour from amalgamation.

I tried to explode the powder by friction, and did not at first succeed, but on well drying it, and warming the vessels in which the experiment was to be made, I was able to explode it, both in a Wedgwood and steel mortar. The effect was feeble, and consisted merely of a few slight cracks. Fulminating gold is much more readily exploded in this way. I was unsuccessful in my attempts to explode fulminating platinum by percussion.* The powder did not appear to conduct electricity, when tried with a power of forty plates of four inches square, charged so as to burn thin iron wire; but when the spark was taken from two metallic surfaces in the vicinity of the powder, a few particles of it exploded and produced a red light. I afterwards well dried some fulminating platinum and gold, and when a battery of two hundred plates of four inches square was in good action, so as readily to burn the different metals, I could not succeed in exploding either of the powders. Fulminating mercury was instantly fired under the same circumstances. When the charge of a Leyden battery of fifteen large jars was passed through a quarter of a grain of fulminating platinum, most

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* I was unable also to explode fulminating gold by percussion. I made the attempt with both powders, in a steel mortar warmed before the fire. The steel pestle was also warm, and the powders previously well dried.

of it was dispersed, but there was a slight effect with the appearance of red light.

Fulminating platinum is tasteless, and insoluble in water. It is not affected by this fluid at any temperature. When exposed to air in a dry state it acquires a little moisture, but this effect is very limited. Twenty-two grains when well dried at a temperature of about 212°, and made to expose a large surface to the atmosphere for two days, gained half a grain, but there was no farther increase on exposing the powder for two days longer, and when gradually heated to the temperature at which it had been dried, it weighed twenty-two grains, as at first.

I have not ascertained the specific gravity of the powder, but from the greater apparent bulk of an equal weight of it, as compared with that of fulminating gold, I conceive its specific gravity is less than this last substance.

Fulminating platinum is soluble in cold sulphuric acid, but much more readily so by the assistance of heat. The solution is of a dark red brown colour. It is less soluble in muriatic and nitrous than in sulphuric acid. There seemed to be a slight spontaneous action, and a disengagement of gas, when each of the above acids was brought in contact with the fulminating powder. At first, I thought carbonic acid might exist in the powder, and the manner in which it was prepared, did not necessarily preclude the presence of that substance. To ascertain if this were the case, or whether any gas were disengaged by the agency of an acid, I put two grains of the powder in a cubic inch, filled it with mercury, and inverted it over a mercurial trough; half a cubic inch of sulphuric acid diluted with $\frac{1}{10}$ its volume of water was let up into the tube, but there was no disengagement of gas, the acid slowly dissolved the powder, and the solution was of a very dark colour.

Chlorine has no spontaneous action on the fulminating powder, but on the application of heat it is decomposed, white fumes are disengaged, a whitish brown sublimate of muriate of ammonia and a dark coloured muriate of platinum are produced. The powder is not affected by pure liquid ammonia. This alkali may be boiled off from it without impairing its fulminating properties.

The powder was not apparently affected when suffered to remain for twelve hours in a retort filled with ammoniacal gas, nor did any change take place by the application of a gentle heat; but when the temperature was increased, there was a succession of slight explosions, the powder was decomposed, and the metal reduced.

When the powder was put into a retort filled with muriatic acid gas, there was a slight spontaneous action; on the application of heat, there was a feeble crack, the powder was decomposed, white vapours of muriate of ammonia were disengaged, and muriate of platinum was formed, which deliquesced by exposure to the air. The effects were similar when fulminating gold was treated in the same way.

Alcohol has no action on the powder. When mixed with flowers of sulphur and heated in a small retort, the powder is quietly decomposed, and sulphuret of platinum is obtained.

When the powder is brought in contact with phosphorane, a hissing noise is produced, the powder appears to be partially decomposed, and muriatic and phosphoric acids are probably formed. Fulminating gold is affected in a similar way by phosphorane.

IV. *Composition of Fulminating Platinum.*

From the manner in which fulminating platinum was obtained, it was not difficult to form conjectures concerning its constitution. As it was furnished by the agency of potash or soda on the ammonia sulphate of platinum, it was easy to conceive it might be composed of oxide of platinum and ammonia. The composition of aurum fulminans, and the analogies existing between this substance and fulminating platinum, were favourable to this idea; but the experiments I made afforded me more direct and satisfactory evidences on the subject, and confirmed the opinion I had previously formed of its nature. Thus, when the powder (previously well dried,) was put into small green glass tubes filled with dry mercury and exploded by heat, a quantity of gas was obtained, which had the properties of nitrogene; moisture lined the sides of the tubes, and the mercury formed an amalgam with the platinum.

When the powder was mixed with quicklime, and the mixture heated in a small retort, it was decomposed with a few slight cracks; a little fluid condensed in the neck of the retort; it had the smell of ammonia, and instantly rendered turmeric paper brown; a little gas also came over, having the properties of nitrogene. The presence of moisture appeared to be necessary in the foregoing experiment to develope the ammonia; for when the powder was mixed with quicklime, previously heated to redness, the slight explosions arising from its decomposition were more numerous, and the odour of ammonia could not be perceived. When, however, a few drops of water were added to the mixture of dried quicklime and fulminating powder, ammonia was produced by the application of heat. When the powder was put into a small retort with pure muriatic acid, the fluid boiled to dryness, and the dry mass heated to redness, the platinum remained in the metallic state, and a whitish sublimate was deposited in the neck of the retort, which, when collected and mixed with quicklime, spontaneously evolved ammonia.

When nitrous acid was boiled to dryness on the powder, and the heat continued, a quantity of gas was obtained, which appeared to be nitrous oxide, as it enlarged the flame of a taper and was absorbed by water, and oxide of platinum alone remained in the retort.

The foregoing results appear to furnish satisfactory evidences as to the nature of fulminating platinum, that it is a compound of oxide of platinum and ammonia. From the following experiments, I shall venture to deduce the proportions of its constituent parts. In the analysis, I employed muriatic acid and sulphur to ascertain the quantity of platinum, and nitrous acid to determine the proportion of oxide in the fulminating compound; and the coincidence between results obtained by such different methods, affords strong presumptions as to the accuracy of the experiments.

Exp. 1. Ten grains of the fulminating powder were put into a small retort with pure muriatic acid, the retort was heated over water so as to boil the fluid to dryness and decompose the dry mass; no permanently elastic fluid came over, except the common air in the retort; a grey substance sublimed, that had the taste of sal ammoniac, and readily afforded ammonia when mixed with quicklime. The presence of ammonia was not only indicated by the odour, but by the instant production of white fumes when muriatic acid was brought near the mixture; and turmeric paper was immediately changed to brown by the ammonia disengaged. The bulb of the retort contained the platinum; it was of a white colour, and appeared to be quite reduced. But to secure this effect, the bulb containing the platinum was put into a small Hessian crucible, and exposed to a dull red heat. The metal was then carefully separated from the bulb, and exposed to a full red heat in a platinum crucible, when it weighed $7\frac{3}{8}$ grains = 7.375 grains.

Exp. 2. Ten grains of the powder treated precisely as in the preceding experiment afforded 7.3 grains of platinum.

Exp. 3. Five grains of the powder were well mixed with rather more than an equal bulk of flowers of sulphur. The mixture was exposed to a dull red heat in a small retort, and furnished a black sulphuret of platinum, which when decomposed at a red heat in contact with the atmosphere afforded $3.\frac{11}{16}$ grains =3 .6875 grains of platinum.

Now, according to these experiments, the first and third of which exactly agree, 100 grains of the fulminating powder contain 73.75 grains of platinum; for 10:7.375::100:73.75.

Exp. 4. Ten grains of the powder were put into a small retort with pure nitrous acid. The acid was boiled to dryness, nitrate of ammonia was formed and yielded nitrous oxide gas by its decomposition. The retort after being exposed to a dull red heat contained 8.25 grains of a shining dark grey substance, which I have found is a pure oxide of platinum. It is decomposed at a full red heat, and yields only oxygene and platinum. I presume this compound has not yet been described; an account of it I hope to have the honour of shortly laying before the Society.

Exp. 5. Ten grains of the powder, after being decomposed by the agency of nitrous acid, as in the preceding experiment, afforded 8.5 grains of dark grey oxide of platinum. But a little of it appeared to be damp; it was put into a small dry retort and exposed to a dull red heat; nitrous acid vapour appeared in the neck of the retort, but no gas was expelled. Whilst the retort was yet warm the bulb was taken off, and the oxide when carefully collected weighed 8.25 grains. From the two last experiments it appears that 100 grains of the fulminating powder contain 82.5 grains of oxide of platinum, for 10 : 8.25 : : 100 : 82.5.

In one experiment in which I decomposed the dark grey oxide of platinum at a full red heat, 10 grains afforded me 8.82 grains of platinum. In another instance, 7 grains of the oxide yielded 6.187 grains of platinum. If the mean of these experiments be taken, 100 grains of the oxide will contain

88.3 platinum
11.7 oxygene
———
100.0
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If the results obtained in the five preceding experiments be compared with the subsequent ones on the composition of the grey oxide of platinum, they lead to the conclusion, that the platinum in the fulminating powder is in the same state of oxidation as the oxide directly procured from the powder by the agency of the nitrous acid. There is indeed a slight difference in the composition of the oxide, as deduced from the experiments with the nitrous and muriatic acids, compared with those on the immediate decomposition of the oxide by heat. But as this difference is only about 1 per cent. of oxygene greater by the latter than the former methods, there can be no ground to suppose the state of oxidation different in either case.

The quantity of platinum and of oxygene, or of oxide of platinum, in the fulminating compound, having been determined, it remained to ascertain the proportion of ammonia in the powder. With this object in view, I made a number of experiments on the decomposition of the powder by the agency of heat in close vessels. I first used small green glass retorts containing the powder and filled with recently boiled mercury; but I found in two trials the retorts would not stand the shock from a single grain, but snapped off at the neck at the instant of the explosion, owing perhaps to the principal explosive force being directed downwards. I then had recourse to straight tubes, varying in length from nine to eighteen inches, and in diameter of bore from one-third to half an inch. The quantity of the powder I used in these tubes was from half a grain to two grains. The experiments were made in this way: the powder being placed in the tube, it was held in an oblique direction, and filled with dry mercury, so that when inverted in a vessel of mercury, all the powder remained nearly at the top of the tube. The tube was then fastened to a brass stand, in an inclined position, and heat sufficient to explode the powder was communicated by means of red hot balls, or by a spirit lamp. In a number of trials made in this way there was no instance in which the whole of the powder exploded at once; it went off at intervals, as its particles reached the proper temperature, without producing much noise, though the gas generated was driven down the tubes with sufficient violence to force, in most cases, some of the powder out of the tubes. This mode of operating seemed to promise more accurate results than any other that occurred to me. The products, in cases when the tubes did not break, were the same, viz. a quantity of gas, aqueous moisture, and platinum in alloy with mercury. But the quantity of gas varied in most instances, owing to the difficulty of exploding the whole of the powder. In two cases, however, I obtained corresponding results. In one of these experiments a grain of the powder, after being dried at about 212°, and decomposed in contact with dry mercury, afforded 0.18 of a cubic inch of gas; in the other, half a grain of the powder furnished, under similar circumstances, 0.09 of a cubic inch of gas. But in both of these experiments, it is proper to remark, a minute portion of the powder had been thrown out of the tubes by the explosions. This was evident on inspecting the surface of the mercury, and from the slight explosions which took place when a heated iron was brought near.

Though the preceding experiments could furnish no data for determining the exact proportion, they might at least afford approximations to the true quantity of ammonia in the fulminating powder; and this consideration induced me to examine the gas I procured with some attention. I shall briefly state the particulars of one examination of this kind, the barometer being at 30°, and the thermometer at 60°. The permanent gas obtained from one grain of the fulminating powder, when standing over mercury, occupied 0.18 of a cubic inch. When it was transferred to pure water and agitated, it diminished to 0.15 of a cubic inch. An equal volume of pure nitrous gas being added to the 0.15, there was no sensible diminution. After the nitrous gas had been absorbed by a fresh solution of green sulphate of iron, the residual gas immediately extinguished a lighted taper. These experiments corresponded with others I had previously made, and they all seemed to prove that the gas produced during the decomposition of the fulminating powder is for the most part nitrogene. The appearance of gas absorbable by water, was at first rather unexpected. I supposed this gas might be ammonia, and this opinion acquired additional probability from calculations derived from the results of my experiments; but I soon convinced myself from actual trials, that ammoniacal gas is disengaged during the decomposition of fulminating platinum by heat.

I attempted to explode five grains of the powder in a strong green glass tube, two feet in length, and two-thirds of an inch in diameter of bore. I succeeded in exploding a sufficient quantity of the powder to furnish a half cubic inch of gas; but in cooling, the tube cracked and the mercury fell. I immediately examined the tube. The space occupied by the gas was lined with a thin coat of moisture. The odour of ammonia was very perceptible in the tube, and turmeric paper was changed to brown by the moisture in it.

The fact of the disengagement of ammoniacal gas on exploding the powder, seems also to be proved by a very simple experiment I made. I put a little of the powder in the centre of a tube about eighteen inches in length. I opened a bottle of strong muriatic acid, and placed it at the open end of the tube. I then exploded the powder by the heat of the spirit lamp; at the instant of the explosion, a quantity of dense white vapour, like muriate of ammonia, made its appearance.

The effects are similar, when aurum fulminans is treated in the same way. I have mentioned the appearance of moisture in cases when fulminating platinum was exploded in close vessels, after being well dried; and it is proper to state, that the uniform exhibition of water in such circumstances, in much greater quantity than could be formed in the experiments, leads to the conclusion that this fluid is one of its constituent parts.

From the statements that have been made, it appears that fulminating platinum is a triple compound, consisting of oxide of platinum, ammonia, and water. The experiments already detailed seem to prove that 100 grains of the powder contain,

Of	platinum -	73·75
	oxygene -	8.75
	ammonia and water	17.50
		100,00

or of	oxide of platinum	82.5
	ammonia and water	17·5
		100.0

Approximations to the respective quantities of ammonia and water, in 100 grains of fulminating platinum, may be gained from calculations made on the results furnished in one of the previous experiments given in detail. In the experiment to which I allude, one grain of the powder afforded 0.18 of a cubic inch of gas, 0.15 of which had the properties of nitrogene, and 0.03 appeared to be ammonia. This, however, is not to be considered as the true quantity that a grain would yield, for reasons already stated; but even on this calculation, 100 grains of the powder would furnish 15 cubic inches of nitrogene, and 3 of ammonia.

15 cubic inches of nitrogene weigh about 4.42 grs. and require
45 cub. in. of hydrogene (to form ammonia) 1.01
3 cubic inches of ammoniacal gas 0.54

5.97 of ammonia in 100 grains of the powder, calculating only from the quantity of gas actually obtained, without taking into account the quantity of ammoniacal gas absorbed by the water present, which must have been saturated with this gas. The water arose from two sources;—it formed a constituent part of the powder, and it was generated from its elements during the explosion. The quantity of water formed would be 8.66 grains. The 1.01 grain of hydrogene would require for this purpose 7.65 grains of oxygene.* I found that $8\frac{1}{4}$ grains of water absorbed about one grain of ammoniacal gas, the thermometer being at 60°, and barometer at 30°; consequently, the 8.66 grains of water generated from 100 grains of the powder, would take up rather more than a grain of ammonia. And if we suppose the water contained in the powder to amount to about $8\frac{1}{2}$ per cent., (and it can scarcely be more,)

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* In estimating the weights of the respective gases, and the proportions in which they combine, I have adopted the statements of Sir HUMPHRY DAVY in his "Elements of Chemical Philosophy."

this quantity would also absorb something more than a grain of the alkali.

Hence, to the quantity of ammonia already obtained from calculations derived from an actual experiment, viz. 5.97 grains per cent., which in round numbers may be called 6 grains per cent., we must add 2 grains per cent. for the alkali absôrbed by the water present; and making a slight allowance for deficiencies arising from the minute portion of the powder that escaped decomposition in the experiment on which these calculations are founded, I do not think the ammonia in the powder can be estimated at less than 9 grains, and the water at 8½ grains per cent.

On these estimates, 100 grains of fulminating platinum will consist of oxide of platinum 82.5

Ammonia -	9.0
Water - -	8.5
	100.0

V. *Theory of the formation and decomposition of Fulminating Platinum.*

From the statements made in the preceding pages, fulminating platinum appears to be composed of oxide of platinum, ammonia, and water. It is formed, as has already been stated, in cases when the ammonia-sulphate of platinum is boiled in a solution of fixed alkali. The theory of its formation is apparently simple, and is founded on the superior affinity of the fixed alkalies, over ammonia and oxide of platinum, for sulphuric acid. An examination of the circumstances connected with the formation and decomposition of the fulminating powder will, I presume, prove the correctness of this opinion.

When the triple compound of oxide of platinum, sulphuric acid and ammonia, is boiled in a solution of potash or soda, some ammonia is expelled, fulminating platinum is formed, and the residual fluid affords a copious white precipitate with the soluble salts of barytes and lead; and if it is evaporated nearly to dryness, crystals of sulphate of potash or soda are obtained. These results appear to be connected with the following changes. The triple compound is decomposed, its sulphuric acid unites with the fixed alkali, the ammonia it contains being in greater quantity than can combine with the oxide of platinum, is in part expelled; the remainder enters into a more intimate union with the oxide, and thus fulminating platinum is formed.

In the decomposition of fulminating platinum by heat in close vessels, nitrogene and ammoniacal gases, platinum and water appear to be the only products; and these results correspond with those derived from the agencies of muriatic and nitrous acids on the powder.

From the close analogy that exists between fulminating platinum and fulminating gold in their properties and constitution, they must be regarded as belonging to the same class of bodies, and the theory which explains in a satisfactory manner the decomposition and fulmination of the latter, will likewise serve to account for similar changes in the former. Whilst the composition of fulminating gold was unknown, various explanations as to the cause of its explosive properties were given by the early chemists; but they were in general, as might have been expected, so vague, and so obscurely developed, as to be at best but unintelligible enigmas. The researches of Bergman fully exposed and refuted all previous opinions on the subject, and led to just views concerning the nature of aurum fulminans. He stated it to be composed of calx of gold and volatile alkali, and he referred its fulmination to the decomposition of the alkali, and the great report and violent explosion to a copious and instantaneous eruption of elastic fluid violently striking the air.* The theory of its decomposition was explained by M. Berthollet in a still more satisfactory manner, when the composition of ammonia was discovered. On this theory, when the fulminating gold is exploded, ammonia is decomposed, its hydrogene unites to the oxygene of the oxide to form water, the gold is reduced, and nitrogene gas disengaged. The sudden expansion of the air and vapour generated in the process, are circumstances connected with the detonation. The decomposition of fulminating platinum admits of a similar explanation; but with the changes already enumerated, we must connect the disengagement of ammoniacal gas, and the instantaneous conversion of the water of composition in the fulminating powder into steam, and these effects are probably intimately connected with the exhibition of its fulminating properties.

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