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aside the feeling of respect. His name is coupled in my mind with that of Laplace when I think of capillary attraction. He has many other honours, and I am happy to know that he will soon have more. Professor Leslie is too far above an anonymous writer to be affected either by his praise or blame, but for that very reason I deem his errors dangerous. Now-a-days every great mind is bent on extending the boundaries of science. The questions and disputes of philosophy that surround its entrance are disregarded; and error, when recommended by *authority*, is apt to be received by the multitude without due examination. In such a state of things the contributions of a humble individual may not be unacceptable.

March 19, 1825.

Σ.

XXXIII. *Method of extracting Titanium from Minerals, and of separating it completely from the Substances with which it is found combined.* By M. PESCHIER.

WHEN I made known in 1821 and 1822 the results of my analytical researches on the micas (*Journal de Physique*), and communicated in the following year to M. Vauquelin those which I had obtained from the talcs, I could not suppose that the process which I had followed was not exact, and that the proportions of titanium which I had stated were exaggerated; for the properties analogous to those of silica, alumina, magnesia, and lime, which this principle possesses, were not known to me: these earths also have sometimes been looked upon as pure when it was found united with them, and at other times that which was believed to be pure titanium was a mixture of titanium and of one or the other of these earths.

But having since discovered these different properties and the means of separating these principles with exactness, I occupied myself in rectifying several of my analyses. I communicated some of them this spring to our Society of Natural Philosophy and Natural History, and should not have made them known prior to the publication of the work on titanium with which I am occupied, if the note of M. Vauquelin on the presence of titanium in micas, inserted in the September Number of the *Annales de Chimie et de Physique*, p. 67, had not obliged me to anticipate this period; for, in discovering titanium in all the micas, this philosopher informs us *that those which contain the greatest quantity of it did not yield him a hundredth part.*

I shall first describe the order of the processes to be fol-

* From *Annales de Chimie*, vol. xxvii. p. 281.

lowed in the analysis of a mineral with a base of titanium, and then relate some of the important results with which it has furnished me.

1. I treat the porphyrised mineral with two parts of potash: withdrawing the vessel from the fire when the mass is at a white heat, I mix the product in water, throw it on a filtre, and wash the insoluble residuum till the liquid no longer acts on test paper. To separate from the washings the small portion of titanium which is dissolved with the silica, I slightly supersaturate them, evaporate them to a humid saline consistence in a porcelain vessel, moisten the saline product in water, and receive it on a filtre, where the silica becomes deposited; then, after having washed and dried it, I expose it to the action of diluted oxalic or hydrochloric acid, to separate from it the titanium or any other substance which might be deposited with it. I next add the liquid from which I have separated the silica to the acid solution with which it had been acted upon; I treat them with the infusion of galls, render them slightly alkaline, concentrate them; and if they take the red-brown colour which characterizes titanium, I put them by, to examine at the end of the operations.

2. I submit the insoluble residuum in the potash to the action of hydrochloric acid, diluted with six or eight parts of water, with the aid of boiling: if a greater quantity of insoluble substance remains than would be expected, I treat it a second time with potash, and pursue with it the operations above stated. I then saturate the acid solutions with an alkaline subcarbonate; and after having separated the precipitate from it, I evaporate the liquid to a moist saline consistence, proceed with the deposit which may be formed there by the solution of the product in water, as with that of § 1; and finding the action of the infusion of galls on the washings as has been mentioned, I add them to the former solutions of the same nature, if it indicates the presence of titanium.

3. I expose the precipitate formed in the acid solution to the action of potash; and as the titanium dissolves wholly or in part with the alumine, and the hydrochlorate of ammonia, in leaving a portion of dissolved titanium, precipitates a great part of it with the alumine,—to avoid this cause of error, which was formerly unknown, I use in its place sulphate of ammonia, in which I have discovered the property of precipitating the alumine only; and when I have received and washed this earth on a filtre, I evaporate the liquids to a humid saline consistence; I separate, by solution of the product in water, some little of the silica which was dissolved in it; I throw some

infusion of galls on the washings, and mix them with the two before mentioned.

4. The titanium not dissolving so easily in the potash as the alumine every time they meet, the insoluble residuum preserves a gelatinous character; and in order to separate it from the substances with which it is mixed, this residuum is dissolved in hydrochloric acid, by which treatment some portions of silica are also separated: the iron of this solution is precipitated by the hydrocyanate of potash and of iron; the liquid is then saturated with an alkaline subcarbonate, and it is carried to ebullition. The precipitate which becomes formed is white, bulky, and has the aspect of alumina: as it may consist of a mixture of titanium, magnesia, and lime, the first is rendered insoluble in acids by being strongly heated, and the earths are dissolved by digestion for some hours in a weak acid—say distilled vinegar. The insoluble parts are separated by a filtre; the liquid is treated with ammonia, in order to remove the magnesia, with oxalate of ammonia for the lime: and we know that the operation has been well conducted, if it does not afterwards undergo any change with the infusion of galls. To the liquids which have been put aside is then also added that from which the iron and other substances have been separated.

5. Lastly, as titanium forms double salts with all acids, and as the tannate of titanium is easily re-dissolved by the infusion of galls, we next obtain that which by these two causes always escapes analysis, by evaporating to dryness all the liquids which have been put aside, igniting the residuum, dissolving in water the resulting saline mass, throwing the solution on a filtre, washing the insoluble parts, heating them to redness in order to destroy the carbonaceous matter, and washing afresh in acidulated water the white powder they give, which is the titanium sought for. If it is found to be coloured by iron or manganese, it is easily rendered pure by digestion in nitromuriatic acid, after having exposed it to a very strong heat. By repeating this series of operations twice upon the washings, and adding each time some infusion of galls, all the titanium contained in the mineral under examination is extracted. I may state by the way, that considering its property of forming double salts, I have always separated several grains from the salts obtained in the examination of the alkaline principle in minerals of this kind; that its presence is known by the spongy state that the hydrochlorates of potash or of soda take, which, thoroughly deprived of ammonia and strongly ignited, do not enter into fusion; and that several solutions,

lutions, evaporations, and exposures to a very strong heat, are necessary to effect this purpose completely.

Such is the series of minute operations which I found it indispensable to follow in the analysis of minerals with a base of titanium (of which the number is much greater than is commonly supposed), and by the aid of which the black foliated mica of Siberia—which, according to Klaproth, is composed of silica 42·50, alumina 11·50, magnesia 9, oxide of iron 22, manganese 2, potash 10, loss by ignition 1; total 98—has furnished me silica 24, alumina 8·50, magnesia 5, peroxide of iron 30, manganese 0·70, titanium 21, potash 5·70, loss by ignition 2·75; total 97·65. The talcs, the chlorites, and the steatites gave me, by following the same process, from 0·19 to 0·30 of a substance which, like that I have designated by the name of titanium in mica, forms also, like the titanium extracted from rutile, a gelatinous mass, transparent and yellowish, by the evaporation at a moderate heat of its solution in the hydrochloric acid; furnishes like that, by the saturation of its solution in an acid, a white, gelatinous and very bulky precipitate; by the infusion of galls a yellowish precipitate, which augments by a slight supersaturation of the acid; becomes brown, and is in great measure dissolved by the addition of the re-agent, giving to the liquid the colour of blood; is soluble in the pure alkalies; forms double salts with all the acids; becomes insoluble in acids by the effect of a strong heat, and consequently possesses all the characters of titanium, with the difference only that with the infusion of galls it does not furnish an abundant orange-red precipitate, and does not always take a lemon-coloured tint by heat: but these anomalies, which appear to me of little importance, may be classed with many others which this substance presents.

Such are the reasons which have induced me to communicate this process. But as I am fully sensible of the force of an opinion given by a philosopher of M. Vauquelin's merit, I submit it to the experience of chemists more used to this species of research than I am, and shall gratefully receive any information on the subject that may be transmitted to me.

XXXIV. *Additional Experiments and Observations on the Application of Electrical Combinations to the Preservation of the Copper Sheathing of Ships, and to other Purposes.* By Sir HUMPHRY DAVY, Bart. P. R. S.*

I HAVE already had the honour of communicating to the Royal Society the results of my first researches on the

* From the Phil. Trans. for 1824, Part II. Read June 17, 1824.