LV. Observations on the affinity which earths have for each other

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4. Twenty series in a battery of this kind produce sensible but feeble shocks, and when a single metallic series with a gold wire and two glasses of water is substituted for one of the primary series, hydrogen is given out by the metallic point in the glass of water in the place of the acid, whilst oxygen is evolved from the point in the other glass.

5. In the galvanic batteries with charcoal, sulphuric acid may be substituted for nitric acid; and solution of sulphuret of potash for the water, without any material alteration in the nature of the agency; the solution of the sulphuret indeed, seems, in some measure, to increase its intensity, and combinations containing this substance, dense charcoal, and concentrated nitric acid, appear to be superior in activity to similar combinations containing copper, and the same fluid elements, and to be nearly equal to those composed of zinc, silver, and water.

January 9, 1802.

LV. *Observations on the Affinity which Earths have for each other.* By DARRACQ, Pupil of VAUQUELIN, and his Assistant in the School of Mines*.

THE analysis of stones has long engaged the attention of chemists. The moderns, assisted by more correct instruments, have carried this branch of chemistry to such a degree of perfection, as seems to leave nothing more to be desired; but C. Guyton, in a memoir, in which he treats with minuteness on the different affinities which the earths exercise on each other, relates several observations, printed in the 27th number of the *Annales de Chimie*, which excite great doubt in regard to the exactness of the analyses hitherto made, and which invite all chemists to be on their guard, lest they should take a simple earth for a mixture of several. The embarrassment which these affinities daily gave rise to, determined me to examine, with great care, the different circumstances under which they may take place; for, if it is of importance to point out these new combinations, it is no less so to reduce them to their just value.

Exp. I. C. Guyton having mixed ten centilitres of lime water with two centilitres of barytes water, there were soon formed white clouds, which united, and deposited themselves at the bottom of the vessel containing the mixture. In con-

* From the *Annales de Chimie*, No. 118.

sequence of this experiment he admitted an affinity between lime and barytes.

I repeated the same experiment with great care; but obtained no change in the liquors mixed, nor any sign of precipitation, even after five months. It is to be presumed that the precipitate formed in the experiment of C. Guyton arose from the impurity of the substances employed. In my opinion, it was owing to the presence of some atoms of sulphuric acid contained in the lime. It is almost always found in common lime.

Exp. II. By combining a solution of aluminated potash and filiciated potash, I obtained, as Guyton did, a very thick white precipitate, which soon after formed a gelly. This precipitate, dispersed in water, and filtered, gave, by the tests proper for alumine and flint, evident proofs of the affinity of these two earths dissolved in potash.

Exp. III. Lime water, mixed with a solution of filiciated potash, gave also proofs of a real affinity between these earths by the precipitation, which was instantly effected. This was confirmed also by an analysis of the precipitate.

Exp. IV. Strontian water with filiciated potash produced the same phenomenon as the preceding mixture.

Exp. V. Strontian water and lime water mixed together formed no precipitate, as was observed by Guyton.

Exp. VI. Strontian water and barytes water, when combined, formed no precipitate.

Exp. VII. Carbonates of lime and barytes, dissolved in an excess of their acid, gave no sign of a new combination.

Exp. VIII. This experiment, which begins the series of those made by Guyton on the solution of earths in acids, did not afford me the results announced by that chemist. Having made a mixture of equal parts of a solution of muriate of lime and a solution of muriate of alumine, he observed, 1st, That the liquor immediately became turbid, without the acid of agitation: 2d, That soon after it was opaque, and almost gelatinous: 3d, and in the last place, that this precipitate did not disappear by the addition of an acid.

I repeated this experiment, with all the care possible, to obtain the same phenomena. Very pure muriate of lime, mixed with muriate of alumine equally pure, gave no sign of precipitation: the mixed liquors constantly remained clear.

It is probable, according to some essays which are peculiar to myself, that the precipitate obtained by C. Guyton was occasioned by the sulphuric acid contained in the muriate of alumine, and which at the time of the mixture must have re-acted on the lime; for when alumine has been ex-

tracted

tracted from alum, it is difficult to free it entirely from sulphuric acid.

By extracting alumine from those natural stones which contain it, either by the nitric acid or the muriatic acid, it will be easy to discover the error into which the author was led by muriate of lime prepared with the earth of alum.

Exp. IX. By combining muriate of lime, in solution, with muriate of barytes, Guyton observed an abundant precipitate, which was not dissolved by excess of muriatic acid. The solutions of these two muriates, whether concentrated, or diluted with distilled water, gave no sign of precipitation by mixing together, nor a long time after their combination. In my opinion, the muriate of lime employed by Guyton contained some atoms of sulphuric acid, which, with the barytes, must have formed fulphate of barytes.

Exp. X. Muriate of lime mixed with that of magnesia gave, as Guyton observed, no sign of precipitation.

Exp. XI. When solutions of muriates of lime and of strontian were mixed, no change was produced. This was observed also by Guyton.

Exp. XII. Guyton announces, that the mixture of solutions of muriate of magnesia and muriate of alumine assumed, at the end of some minutes, a slight milky appearance. This experiment, being carefully repeated, exhibited nothing of the kind: my liquors retained their clearness and transparency.

Exp. XIII. The thirteenth experiment, made with a mixture of solutions of muriate of magnesia and muriate of barytes, formed no precipitate, either at the moment or long after; yet Guyton says he obtained an abundant precipitate. It is probable that sulphuric acid was still concealed in the muriate of magnesia.

Exp. XIV. This experiment, which was made with muriate of magnesia and muriate of strontian, gave no sign of any new combination. The same was remarked by Guyton.

Exp. XV. Muriate of barytes and muriate of alumine, both dissolved and even diluted in water, gave to Guyton an abundant precipitate. The same experiment, repeated with the solutions concentrated or diluted with water, did not yield me the same result: the mixture always remained clear, without forming any precipitate.

Exp. XVI. The sixteenth experiment, made by the combination of muriate of strontian with that of barytes, exhibited no change.

Exp. XVII. The seventeenth and last experiment of Guyton, on the affinity of earths in the humid way, was

made by mixing a solution of muriate of strontian with a solution of muriate of alumine. According to his account, the liquor assumed a milky colour, and gave a precipitate which the acid did not redissolve. This experiment, repeated, like all the rest, with a great deal of care, still confirmed the presence of the sulphuric acid in the solution of muriate of ammonia he employed; for I had no precipitate when I repeated the experiment, and the liquor, for five months, lost nothing of its transparency.

By admitting between earthy substances an affinity of which nature affords a thousand examples, I do not however think that the force which attracts them is sufficiently great to make them abandon their solvent, without evaporation, especially if it be acid. There is none indeed but flux dissolved in alkali that has the property of precipitating the other alkaline earths from their aqueous solutions: the other earths produce nothing of the kind; for, if alumine dissolved in an alkali be mixed with solutions of barytes, strontian, lime, &c. no precipitate will be formed; nothing more will take place between the strontian, lime, barytes, &c.

If the experiments of Guyton had really established the facts he announces, we should have had no longer any certain means for analysing earths and stones, and every thing hitherto done on this subject could only have been considered as so many incorrect results.

I therefore think myself authorized to conclude, from the facts announced in this memoir, that the phenomena observed by Guyton were occasioned in many cases by foreign bodies contained in the matters he employed.

LVI. *Experiments concerning the Analysis and Synthesis of Alkalies and Earths, announced by C. GUYTON and DESORMES. By C. DARRACQ, Pupil of and Assistant to C. VAUQUELIN, at the School of Mines*.*

THE third volume of the Memoirs of the Institute of France contains some experiments by C. Guyton and Desormes on the composition and decomposition of the two fixed alkalies, and some of the earths supposed to be simple. The importance of such discoveries, the period of their being made, and their utility to the arts, invite all chemists to repeat them; and such were the motives by which I was guided in my researches. To announce that my experiments were

* From the *Annales de Chimie*, No. 119.