

partly from errors in the solar tables, and partly from instrumental derangement.

*On some of the Compounds of Chromium.* By Thomas Thomson, M.D. F.R.S. L. and E. Professor of Chemistry, Glasgow. Read March 29, 1827. [*Phil. Trans.* 1827, p. 159.]

The principal object of this paper is to give an account of a singular compound of chromic acid and chlorine, discovered some years ago by the author; but in the investigations to which it gave rise, the author was led to a more careful examination of the oxides of chromium than they had before undergone, and to a knowledge of their composition. An account of these researches he therefore proposes to give in this communication. He begins by describing metallic chromium. That used by him was reduced by Mr. Cooper: it was white, with a shade of yellow, very brittle, not sensibly attracted by the magnet even in fine powder. Its specific gravity was 5.093. Nitric acid boiled on it has no effect, and aqua regia scarcely any, unless the action be very long continued. When heated, however, with a mixture of potash and nitre, it is converted into chromic acid; 3.14 grains of the metal, thus treated, yielded by solution and precipitation 16.23 of chromate of lead, giving for the weight of an atom of chromium 3.966, or in round numbers 4.000. The author's stock of metallic chromium was so small as to prevent the repetition of the experiment.

The author next describes the green oxide of chromium. This is easily produced by the action of de-oxygenizing agents, such as alcohol, sulphurous acid, or sulphuretted hydrogen, on chromate of potash. When thus obtained it is in the state of a hydrate, containing  $1\frac{1}{3}$ ths of its weight of water, and easily soluble in acids. A moderate heat, however, expels the water, and leaves the oxide insoluble in any acid. When further heated nearly to redness, it glows, or becomes of itself suddenly intensely red hot. Its atomic weight cannot be determined from its salts, as it forms none,—at least crystallizable and definite enough for the purpose; but as we know that of chromic acid to be 6.5, if we can determine the number of atoms of oxygen to be abstracted to convert it into green oxide, that of the latter will be known. To this end the author deoxidized the chromate of potash by sulphuretted hydrogen. Hydrosulphuret of chromium, composed of its ingredients, atom to atom, fell in the state of a green powder soluble in acids. The liquor, after driving off the redundant gas by heat, was found to be a solution of hyposulphite of potash. To avail himself of this fact, however, it became necessary to investigate the composition of the hyposulphurous acid. This he effected as follows:—he first analysed a crystallized hydrosulphuret of soda, formed on a large scale in certain soda-leys, which he found to consist of 1 atom bisulphuretted hydrogen, + 1 atom soda, + 6 atoms water. Through a solution of this salt he passed sulphurous acid, which converted it into hyposulphite, and threw down just half

the sulphur contained in the salt. The hyposulphite of soda thus obtained gave by analysis a per-centage of hyposulphurous acid, agreeing with 5 as its atomic number, on which supposition it must be regarded as consisting of 2 atoms sulphur, + 1 oxygen; and this composition he states himself to have verified by direct analysis of several hyposulphites. From this it is easy to derive the composition of the green oxide of chromium, the weight of which thus comes out equal to 5.

After the description of two compounds, the one of chromic acid and oxide of chromium, and the other of sulphur and the same oxide, obtained by a variation of the circumstances under which sulphuretted hydrogen is made to act on the chromic salts, the author proceeds to relate experiments in which protosulphate of iron was used as the deoxidizing matter. When a solution of this salt is mixed with one of chromate of potash, a precipitate falls, consisting of green oxide of chromium and peroxide of iron, which, from considerations and experiments detailed at large in the paper, appeared to consist of four atoms peroxide of iron, and one of green oxide of chromium.

Phosphuret of chromium was formed by subliming phosphorus through red-hot green oxide. It is stated by Dr. Thomson to consist of  $1\frac{1}{2}$  atom of phosphorus, and 1 atom of the metal. This phosphuret, by digestion in nitric acid, was converted into phosphate, consisting, according to the author, of 1 atom protoxide, and  $1\frac{1}{3}$  atom phosphoric acid. No sulphuret could be formed by a similar process. The author devotes the next section of his paper to a detail of several unsatisfactory experiments for determining the atomic weights of chromic acid and the protoxide, by various processes, in which only partial decompositions were effected.

He next treats of the brown oxide. It is prepared by passing sulphurous acid through solution of chromate or bi-chromate of potash. It does not combine with acids; and when treated with acids, alkalies, or even water, resolves itself into chromic acid and protoxide, of which it appears to be either a mixture or a compound, far from intimate, in the proportion of 1 atom acid to 6 atoms oxide.

The next section of this paper is devoted to an account of the chloro-chromic acid, a remarkable compound produced by making sulphuric acid act on a mixture of 190 parts of bichromate of potash, and 225 parts of common salt. From this mixture, on applying heat, it separates in red fumes, and distils over in a liquid of a rich deep crimson colour, of a sweet astringent acid taste, and strong smell of chlorine. Specific gravity nearly twice that of water, with which it does not mix, but which decomposes it, evolving chlorine and producing heat. This liquid dropped into oil of turpentine or alcohol, or when poured on sulphur, sets them on fire; but (what is remarkable) it not only does *not* fire phosphorus, but even extinguishes it when already inflamed. On other combustibles and metallic bodies it acts with great energy, but without producing ignition.

In ammoniacal gas, however, it burns vividly. When heated *per se*, the chlorine escapes, and a substance resembling green oxide re-

mains. Dr. Thomson analysed it by solution in water, saturation with carbonate of soda, and precipitation by solutions of baryta and silver; and states its composition from such analysis, to be chromic acid and chlorine, atom to atom.

The fifth section of this paper is devoted to an account of the salts of chromium. They are formed by the union of the green oxide with acids, and are all uncrystallizable, and of very intense colours. They are not precipitated by sulphuretted hydrogen. Gallic acid precipitates them green. Prussiate of potash only changes their colour to brown, and throws down no precipitate. Ammonia and potash throw down green oxide, which re-dissolves in excess of the latter.

The muriate of chromium always contains an excess of acid, and is deliquescent. When this is driven off it becomes a chloride, and is insoluble in water and in acids.

The nitrate also contains an excess of acid, which cannot be neutralized by adding more oxide. Dried and slowly heated, it is chiefly converted into chromic acid contaminated with a little green oxide.

The sulphate also reddens vegetable blues. It consists of the acid and oxide, atom to atom, and 3 atoms of water.

The precipitate from muriate of chromium by carbonate of soda, is a di-carbonate with 4 atoms of water. When bi-carbonate of potash was the precipitant, a penta-carbonate was obtained, which the author regards as a fact not easily explained.

The bi-phosphate precipitates from the muriate on adding phosphate of soda: it is a lively deep green powder; when dried in a sand heat it contains 5 atoms of water. Neutral phosphate could not be formed. The arseniate is very nearly neutral, but a bin-arseniate also exists.

Chromic acid dissolves protoxide, and forms a chromate. This is precipitated when muriate of chromium and chromate of potash are mixed, and is of a brown colour, and soluble in water.

After describing other salts, as the oxalate, tartrate, and potash-tartrate, Dr. Thomson proceeds to give an account of certain chromates not before described. These are the per-chromate of iron, the di-chromates of lead and silver, and the double chromates of potash and soda and of potash and magnesia.

The author concludes this paper with an account of his analyses of the mineral compound known in cabinets as chromate of iron, which, when examined in a state of purity, he found to consist of 2 atoms of green oxide of chrome, 1 of peroxide of iron, and 1 of alumina, together with a minute admixture of a white matter, apparently a metallic salt, of unknown acid and base, and which, though accompanying specimens from several localities, yet in all was too small in quantity for thorough examination.