Experiments on the Alcohol of Sulphur, or Sulphuret of Carbon. By J. Berzelius, *M.D. F.R.S. Professor of Chemistry at Stockholm; and* Alexander Marcet, *M.D. F.R.S. one of the Physicians to Guy's Hospital.* Read May 13, 1813. [*Phil. Trans.* 1813, *p.* 171.]

The great diversity of opinions entertained by several of the most celebrated of the French chemists regarding the nature of this compound, which was originally noticed by Lampadius in the distillation of a mixture of pyrites and charcoal, induced the authors to undertake the present analysis, without any knowledge that it was again nearly at the same period under examination in France. The original opinion of Lampadius was, that it consisted of sulphur and hydrogen, and his opinion was also supported by Vauquelin, Robiquet, and the younger Berthollet. The elder Berthollet had supposed it to be a compound of sulphur, hydrogen, and carbon; but, according to Messrs. Clement and Desormes, hydrogen had appeared not to be one of its constituents, a result which is now adopted in a late report of Messrs. Berthollet, Thenard, and Vauquelin, and is here further confirmed by the inquiries of Professor Berzelius and Dr. Marcet.

Their joint paper is divided into four parts, the first of which describes the preparation and general properties of the compound; in the second, the authors examine whether hydrogen be present in it; in the third, the presence of carbon is ascertained; and in the fourth, the proportion of its constituents is determined.

The preparation consists in distilling sulphur through a red-hot tube of porcelain containing well burned charcoal, condensing the oily product in water, and subsequently rectifying it by very slow distillation at a heat between 100° and 110°, by which it is freed from a redundant quantity of sulphur which it always contains when first procured. The fluid is then perfectly transparent and colourless. It has an acrid, pungent, somewhat aromatic taste, with a smell that is nauseous and fetid. Its specific gravity is 1·272. It boils between 105° and 110°, and does not congeal at 50° below zero. It is soluble in alcohol, in ether, and in all oils whether fixed or volatile, and in alkalies; but it does not unite with water, with acids, or with any metallic substances, and even suffers no change when heated in contact with potassium.

For the purpose of determining whether hydrogen was present, the vapour of it was exploded with oxygen in the first instance. In the next, a current of oxymuriatic gas was passed through the oily liquid. Thirdly, attempts were made to burn it in oxymuriatic gas. Fourthly, the vapour of it was passed through liquefied muriate of silver; and Lastly, through various metallic oxides; but in no instance was there any appearance of water being produced, or any other evidence of the presence of hydrogen in the compound.

The presence of carbon was ascertained by the formation of carbonic acid in the combustion of the vapour with oxygen. When the oil itself was set on fire in oxygen gas, the heat was sufficiently

intense to melt a wire of platina. The presence of carbon was also proved by the slow action of barytic-water and of lime-water on the oily fluid, and consequent formation of carbonates of those earths.

When the authors endeavoured to determine the proportion in which the two constituents, carbon and sulphur, are united in this compound, considerable difficulties occurred from its volatility, and from the little affinity which it appeared to possess for the generality of chemical agents. The danger of explosion was an obstacle to the oxidation of it by direct combustion; and where attempts were made to analyse it by means of nitro-muriatic acid, the result proved to be a new and curious compound, that gave rise to a separate course of experiment. By means of alkaline solutions a new and unequivocal proof was obtained of the presence of carbon; but the decomposition was too imperfect for the accurate determination of proportional quantities. Recourse was therefore had to distillation of the oil through red hot oxide of iron, by which means the carbon was converted into carbonic acid, and the sulphur partly retained in the state of a sulphuret, and partly converted into sulphurous acid gas. By careful examination of these products, and by repetition of the process with corresponding results, the proportion of the constituents was found to be 84·83 sulphur and 15·17 carbon,—a result which accords extremely well with the hypothesis of two atoms of sulphur to one atom of carbon; and since the quantities obtained in this analysis corresponded with the quantity submitted to examination, this agreement tended much to confirm the opinion, that the compound does not contain any other element.

An appendix to this paper, written by Professor Berzelius, alone, contains the details of two experiments, from which the above proportions of sulphur and carbon are determined; and a statement of certain laws of determinate proportions, from which the same inference might be drawn.

The author's observation is, that when two combustible bodies unite, the quantities of oxygen which they are disposed to absorb are either equal, or one is a simple multiple of the other. In the present case the quantity of oxygen necessary to convert the sulphur into sulphurous acid is so nearly double of that which would be requisite to convert the carbon into carbonic acid, that the result obtained by supposing that to be the real proportion would not differ by one third per cent. from the proportion gained by experiment.

If Mr. Dalton's opinion be correct, that both the carbonic and sulphurous acids consist of one atom of base with two atoms of oxygen, then this sulphuret must contain two atoms of sulphur to one of carbon; but it is possible that carbonic oxide may contain two atoms of base to one of oxygen, and in that case carbonic acid must consist of one atom of each. If so, the sulphuret of carbon will accord with other sulphurets which contain one atom of sulphur to one of base. The author observes, however, that according to Sir H. Davy, there are other sulphurets consisting of two portions of sulphur to one of base; and accordingly a similar doubt occurs in

these cases, between the single or double portion of sulphur, which of them is to be regarded as the elementary atom, according to Mr. Dalton's view of the subject.

Professor Berzelius next examines various compounds, which may be termed carbo-sulphurets of the alkalies and earths. The carbo-sulphuret of ammonia sublimes unchanged in close vessels; but when exposed to air, the carbon is deposited, and hydro-sulphuret is produced; and, in the same manner, the carbo-sulphurets of lime, barytes, and strontia are decomposed when moisture is present, and hydro-sulphurets of these earths are formed.

The remainder of this appendix contains the analysis of a solid white crystalline compound, having the appearance and volatility of camphor, formed by exposure of the sulphuret of carbon during three weeks to the fumes of strong nitro-muriatic acid. It is insoluble in water, but dissolves in alcohol, ether, and in oils, whether fixed or volatile. When this compound was sublimed through a red-hot tube containing iron wire, it was decomposed, and found to consist of muriatic acid, 48·74; sulphurous acid, 29·63; and carbonic acid, 21·63.

On the Means of procuring a steady Light in Coal Mines without the danger of Explosion. By William Reid Clanny, *M.D. of Sunderland. Communicated by* William Allen, *Esq. F.R.S.* Read May 20, 1813. [*Phil. Trans.* 1813, *p.* 200.]

The author having resided several years near the coal mines in the county of Durham, has paid much attention to the circumstances of those explosions which so frequently occasion the death of many industrious people, and has contrived a lamp, which he thinks likely to answer the purpose of illumination, without any danger attending its use.

He is of opinion, that ventilation, as at present practised, has little or no effect in preventing explosions; since it has no tendency to diminish the quantity of inflammable gas emitted by the old workings, which must always be in danger of exploding wherever it comes into contact with atmospheric air, if light be applied to it. The partitions and folding doors put up at the entrances of old workings appear to be very inadequate to prevent the occurrence of such explosive mixtures; and their frequency is shown by the number of accidents which the author enumerates as having taken place in his own neighbourhood alone in the course of the last seven years. The number of explosions in the course of that time has been six; and these have destroyed more than two hundred pit-men, who have left wives and children in a state of poverty and distress. In some instances, large pumps have been erected at the top of the shaft, worked by steam-engines, for the purpose of drawing off the inflammable gas from those parts where it most abounds; but even these have been found insufficient, since the engine will not, in all instances, be applied to the part where it is most wanted: and it is estimated, that wherever