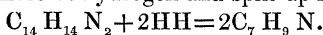
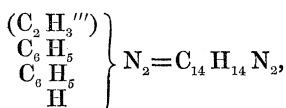


hoped that by continued treatment with nascent hydrogen it might have taken up four atoms more of hydrogen and split up into benzylamine,—



Up to the present time I have not succeeded in effecting this transformation, although I have continued the action of zinc and hydrochloric acid for several days. I do not, however, by any means consider this transformation impossible.

It is worthy of remark that the base here described, and for which I also refrain from proposing a name until its constitution is better ascertained, is isomeric with a body which I formerly obtained*. Ethenyldiphenyldiamine,



formed by the action of trichloride of phosphorus on one molecule of acetic acid and two molecules of aniline with separation of two molecules of water, has not only the same composition and the same molecular weight, but is monacid like the base derived from the sulphur body. It requires however, scarcely more than a cursory comparison of the two substances to be convinced that this is a case of isomerism and not of identity. The crystalline forms, both of the two bases and also of their salts, differ widely from one another. Besides the previously mentioned salt, I have also compared the nitrate of the new base, which is, though with difficulty, obtained in six-sided tables, with the beautiful nitrate of the previously studied base. Ethenyldiphenyldiamine is quite neutral, whilst the alcoholic solution of the unnamed base has a distinctly alkaline reaction. The melting-points also of the two bases differ widely; the old one melts at 137° and the new at 71° . Lastly, the behaviour of the two bodies with concentrated sulphuric acid leaves no doubt but that they are different; ethenyldiphenyldiamine is changed under these circumstances without blackening into sulphanilic acid and acetic acid. The base derived from thiobenzamide is charred with evolution of sulphurous acid.

I am indebted to Mr. K. Sarnow for his valuable assistance in prosecuting the above researches.

III. "Contributions to the History of the Acids of the Sulphur Series.—I. On the Action of Sulphuric Anhydride on several Chlorine and Sulphur Compounds." By HENRY E. ARMSTRONG, Ph.D. Communicated by E. FRANKLAND, Ph.D., F.R.S. Received May 2, 1870.

Kuhlmann †, in a comprehensive memoir on the formation of ether, mentions incidentally the direct combination of sulphuric anhydride with

* Hofmann, Proc. Roy. Soc. vol. xv. p. 55.

† Ann. Ch. Pharm. xxxiii. p. 108.

ethylic chloride to a liquid, which fumes strongly in the air ; this treated with water yielded him an oily product, which, however, could not be distilled without undergoing decomposition.

Robert Williamson * also made experiments on the formation of this compound, and, from the amount of anhydride and ethylic chloride entering into the reaction, came to the conclusion that it was the ethylic compound, homologous with Williamson's sulphuric chlorhydrate, which he also, by an analogous process, succeeded in obtaining by the action of hydric chloride on sulphuric anhydride.

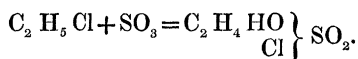
Excepting these two short notices, nothing was known of the properties and constitution of this body ; and it therefore appeared to me of interest to submit it to a more close examination.

Whilst occupied therewith, a paper of Pourgold's † appeared on the same subject, by the series of reactions described in which it is proved that the formula ascribed to it by Robert Williamson is in reality the rational one.

Thus further experiments of mine in this direction were rendered unnecessary.

According to my observations, however, the simple formation of this one chloride is not the only phase of the reaction. One always obtains, as Pourgold also mentions, considerable quantities of products of higher boiling-point ; and I have found that, by heating the same some time with water in a sealed tube at 120° C., afterwards evaporating to drive off the hydric chloride formed, and neutralizing with baric carbonate, a permanent salt was obtained, which by analysis was proved to have the composition of baric isethionate.

The formation of the chloride from which this salt has resulted is certainly remarkable, although easily explicable, as seen by the following equation :—



Again, on one occasion the impure liquid obtained directly by passing the ethylic chloride into a flask containing the sulphuric anhydride, kept cool by being surrounded with ice, had, on standing over night, deposited a quantity of large, irregular, prismatic needles, of an exceedingly decomposable nature, the composition of which I unfortunately did not succeed in fixing, and on no future occasion was I able to obtain the same again. I intend, however, shortly to renew the study of these by-products, and also of the analogous reactions on employment of methylic and amylic chlorides.

The extension of these experiments to the chlorinated chlorides of the $\text{C}_n \text{H}_{2n+1}$ series was full of interest, as, commencing with carbonic tetrachloride, there was a certain possibility of arriving by this means at a trichlormethylic alcohol. I therefore entered upon the investigation with

* Chem. Soc. Quart. Journ. x. p. 100.

† Comp. Rend. lxvii. p. 452.

the intention of applying the reaction to members of the several series of organic haloid compounds. In the following are contained the results of most of the experiments hitherto made; and although in a less complete form than I could wish, I am induced to make them now public, as for several reasons it will be some time before I shall be enabled to continue my experiments in this direction.

Action of Sulphuric Anhydride on Carbonic Tetrachloride.

In this, as in all the following experiments, the liquid was added to the sulphuric anhydride by means of a drop-funnel provided with a glass stop-cock. The anhydride was prepared by distillation of Nordhausen sulphuric acid, and condensed in a wide-mouthed flask. This flask was connected, by means of a cork provided with two borings, with an inverted Liebig's condenser, and with the drop-funnel.

The action set in immediately on allowing the carbonic tetrachloride to drop on to the anhydride, and was accompanied from the beginning by a constant evolution of gas. The smell and suffocating properties of this gas characterized it at once as carbonic oxychloride; it was entirely absorbed by absolute alcohol, the absorption being accompanied by a great rise in temperature. On the subsequent addition of water a heavier layer was precipitated, which was separated from the wash-water and dried over calcic chloride. It was then obtained as a colourless, mobile liquid, boiling between 90° and 95° C., traces of which exercised a most irritating action on the eyes. The B.P. of chlorocarbonic ether, with which it agrees in all its properties, is given as 94° C.

The rise in temperature on adding CCl_4 to the anhydride was very considerable; and after one equivalent of the former to two of the latter was present, it was only necessary to apply the heat of a water-bath for a short time in order to complete the reaction; there then remained a heavy, dark brown-coloured liquid in the flask, on subjecting which to distillation a small quantity CCl_4 first passed over, whereupon the thermometer rose rapidly, and between 130° and 150° the whole distilled over. After repeated rectification the pure product was obtained of B.P. 141° – 145° (uncorrected) under a normal pressure. Thus prepared it is a colourless, heavy, mobile liquid, constantly fuming in the air, and which refracts light strongly.

On analysis, the following numbers were obtained:—

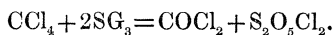
·342 grm. gave ·7366 grm. $\text{BaSO}_4 = 29\cdot56$ S.

·296 grm. gave ·3922 grm. $\text{AgCl} = 32\cdot8$ Cl.

which results correspond with the formula $\text{S}_2\text{O}_5\text{Cl}_2$, as is evident from the following comparison of the analytical with the calculated numbers:—

	Calculated.	Found.
S ₂ = 64.....	29·7	29·56
Cl ₂ = 71.....	33·0	32·80
O ₅ = 80.....	—	—
<hr/>		
	215	

The formation of this chloride, and of carbonic oxychloride, is explained by the following equation :—



This body, which I, for reasons to be mentioned later on, call pyrosulphuric chloride, was first discovered by H. Rose, who, in his description of its properties, especially calls attention to its being but slowly decomposed in contact with water at ordinary temperatures,—a statement which I can thoroughly endorse.

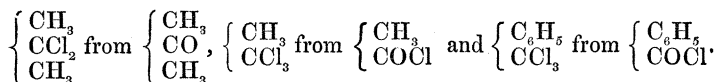
Schützenberger*, however, who in the meantime has also published a series of observations on this reaction, with which on the whole mine agree, differs very considerably in his description of this chloride, which, according to him, boils at 130° C.†, and is decomposed *immediately* by water. On this he lays particular stress, and draws the conclusion that either his substance is isomeric with Rose's, or that Rose worked with an impure substance.

It seems to me, however, that the contrary is the case,—that Rose describes the properties of the pure substance, although, to judge from his analyses, his was not a chemically pure one. To make the chlorine and sulphur estimations, I broke a very thin glass bulb, filled with a weighed quantity of the liquid, under water; but so great is the relative stability of the chloride, that a considerable time elapsed before the small quantity employed was decomposed, even when I used a dilute potassa solution, which was warmed to 50°–60° C.

The direct substitution of two chlorine atoms by one oxygen atom, which has taken place in carbonic tetrachloride, is, as far as I know, the first instance of this nature among organic compounds. The formation of phosphoric oxychloride from phosphoric chloride by means of sulphuric anhydride is, I believe, the only analogous reaction,—



The contrary substitution is often enough met with—is, in fact, one of the general reactions of phosphoric chloride. Thus we have :—



It may be predicted that carbonic tetrabromine treated in the above

* Compt. Rend. lxi. p. 350.

† Rose gives 145° C. as the B.P.

manner will give rise to carbonic oxybromide, together with sulphurous anhydride and free bromine. I do not believe that a pyrosulphuric bromide will be formed.

Action of Sulphuric Anhydride on Chloroform.

The experiment was made under exactly the same conditions as the former one. The action set in immediately on addition of the chloroform, and was also accompanied by a rise in temperature and an evolution of gas, which gas proved to be pure carbonic oxide, and, as was ascertained by experiment, free from hydric chloride, whose formation by the reaction was not impossible.

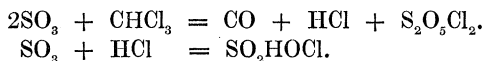
The reaction was easily completed by aid of a gentle heat, and the liquid remaining in the flask was then subjected to distillation. After repeated rectification the greater part boiled constantly at 139° – 140° , and was obtained as a colourless, mobile liquid, differing only in B.P. from the chloride obtained by the action of the anhydride on the tetrachloride.

The analysis yielded the following results :—

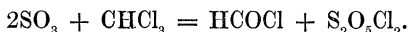
·1051 grm. gave ·138 grm. AgCl = 32·4 Cl.			
·1150 grm. gave ·242 grm. BaSO ₄ = 28·8 S.			
	Found.	Calculated for SO ₂ HOCl.	Calculated for S ₂ O ₅ Cl ₂ .
S =	28·8	27·46	29·7
Cl =	32·4	30·47	33·1

It is evident from the above comparison of the numbers obtained with those calculated for each of the formulæ SO₂HOCl and S₂O₅Cl₂, that they lie midway between the two, and there is therefore no doubt that this liquid is a mixture of both.

Pyrosulphuric chloride and sulphuric chlorhydrate are therefore derived from sulphuric anhydride and chloroform, as is explained by the following equations,—



There was a probability of formylic chloride, HCOCl, instead of the products of its decomposition, CO + HCl, being obtained by this reaction, as is evident from the equation,—



This is not the case, however, as is proved, 1, by the fact that carbonic oxide is evolved immediately on adding chloroform to the anhydride, which is also the case on reversing the experiment, and allowing sulphuric anhydride vapour to act on an excess of chloroform; 2, had it resulted it must have been detected on distillation, either as such, or if it became decomposed, by an evolution of CO and HCl; but the distillation only yielded the above-mentioned chloride, and was not accompanied by any further disen-

gement of gas. If it be formed at all, which I certainly do not hold to be the case, it is immediately decomposed again in contact with the anhydride into carbonic oxide and sulphuric chloride.

Action of Sulphuric Anhydride on Hexachlorbenzol.

This experiment was instituted in the hope of obtaining tetrachlorquinon, which, as is known, Graebe * succeeded in converting into hexachlorbenzol by the action of phosphoric chloride. The first step in the reaction would be the formation of the body C_6Cl_4O , which probably, by the intervention of another molecule of the anhydride, would then be converted into $C_6Cl_4\begin{smallmatrix} O \\ \diagup \quad \diagdown \\ O \end{smallmatrix}$. I say probably, because there seems no tendency in the benzol series to form derivatives in which two of the monovalent hydrogen atoms are replaced by a single divalent atom.

However, no action whatever took place on heating the hexachlorbenzol in sealed tubes with sulphuric anhydride alone, or with addition of pyrosulphuric chloride as dissolvent, to a temperature over $200^\circ C$. The tubes burst frequently, but in all cases it was possible to separate out the hexachlorbenzol perfectly unaltered on addition of water. Possibly better results might be obtained with tri- or tetrachlorbenzol in which is still replaceable hydrogen.

Experiments were also made with chlorobenzol, benzoetrichlorid, and dichlorhydrin, from the first two of which respectively benzoic aldehyde and chlorbenzol might have been formed,—a view which was favoured by Oppenheim's † having obtained benzoic aldehyde by the action of concentrated sulphuric acid on chlorobenzol and after-treatment with water.

Dichlorhydrin was perfectly carbonized by the action of the anhydride, HCl and SO_2 being evolved, and the other two chlorides were converted, also with evolution of HCl , into that peculiar resin-like substance which is a so characteristic product in many reactions with these bodies.

There seems, therefore, to be no doubt, as was indeed probable, that the substitution of Cl_2 by O can only be effected in such compounds as are capable of resisting the action of the pyrosulphuric chloride formed thereby, and that consequently it is only attainable in its purity in those cases where the whole or greater part of the hydrogen is replaced by chlorine.

Action of Sulphuric Anhydride on Perchlorinated Chloride of Ethylene.

On bringing these two bodies together and slightly warming, the reaction soon set in, the latter melting; a disengagement of gas also took place, an examination of which proved it to be a mixture of carbonic oxychloride and sulphurous anhydride. On continuing the application of heat, the contents of the flask gradually became liquefied, and on subjecting afterwards to distillation, the liquid commenced to boil at about $60^\circ C$.; the thermometer

* Ann. Ch. Pharm. cxlvi. p. 12.

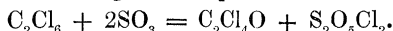
† Berichte d. Deutschen. Chem. Ges. ii. p. 213.

rose, however, rapidly, and but a small quantity had passed over under 130°C . The portion boiling from 130° upwards consisted entirely of pyrosulphuric chloride.

The more volatile portion was now treated with ice-cold water, in order to free it as much as possible from pyrosulphuric chloride, quickly separated from the water, dried over calcic chloride, and distilled, when it was found to boil between 100° and 140° . With the small quantity at my disposal (at the most 5 grm.) it was impossible to attempt to purify it by rectification; I therefore, as I suspected it to be trichloracetylic chloride (chloraldehyde), attempted to convert it into the corresponding ether; but unfortunately, through an accident, lost it all in so doing.

The following are the observed properties of the above product:—In contact with water it became gradually decomposed, hydric chloride being formed; it acted very violently on alcohol, also on aqueous ammonia, and the solution here obtained yielded on evaporation long prismatic needles of ammonic trichloracetate (?).

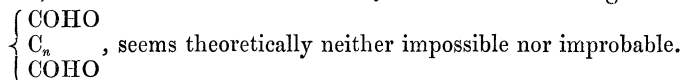
Had the reaction taken a normal course, the formation of chloraldehyde was to be expected, according to the equation,—



The properties of the substance obtained also agree in so far with those given for chloraldehyde, and I have therefore little doubt but that it has really resulted; the yield is, however, very small, in consequence of secondary reactions taking place.

Unfortunately I am not in possession of the necessary material to repeat the experiment and place its formation beyond all doubt.

Thus far have I studied the substitution of Cl_2 by O up to the present moment, but I intend prosecuting my researches in this direction, which seems to me to present a number of interesting points. It is a question whether the compounds C_2Cl_4 and C_2HCl_3 , isologous with CCl_4 and CHCl_3 , will give rise to C_2OCl_2 and C_2O , isologous respectively with COCl_2 and CO; the formation of such bodies, and of acids of the general formula



Will the action on chlorpicrin be analogous with that on carbonic tetrachloride or on chloroform?

The production of a silicic oxychloride from silicic chloride by the same means is also to be expected.

Action of Sulphuric Anhydride on Carbonic Disulphide.

The extraordinary mobility of the one oxygen atom in sulphuric anhydride, evident in all the preceding experiments, gave rise to the hope that in sulphur compounds a substitution of sulphur by oxygen might be realized, and thus the interesting gas carbonic oxysulphide be directly obtainable from carbonic disulphide.

According to Genther *, carbonic disulphide and sulphuric anhydride are without action on one another, a simple solution of the anhydride taking place. Notwithstanding this I thought it advisable to repeat the experiment, and have by so doing found that a reaction does take place exactly in the sense I had expected.

If equivalents of the two are mixed together, action sets in, even at common temperatures, after a short time, but at once on warming the mixture, and is accompanied by a continuous evolution of gas, which, by alternate heating or cooling, can be regulated at will.

The escaping gas was first passed through a wash-bottle containing water, and then, to free it from carbonic-disulphide vapour, through tubes filled with pieces of unvulcanized caoutchouc placed in a freezing-mixture of ice and salt †, and, finally, to remove the last traces of sulphurous anhydride, over plumbic peroxide. Thus purified, it possessed all the properties described by Than ‡ and others as characteristic of carbonic oxysulphide, and its identity therewith was further proved by a gasometric analysis, which gave the following data :—

	Vol.	Pressure.	Temp. C.	Vol. at 0° C. and 1 min. press.
Gas employed, dry	92·1	·2551	13·8	22·33
After addition of oxygen	290·7	·4566	13·8	126·35
After explosion	276·9	·4377	13·8	115·40
Gas employed			22·33	
Contraction observed			10·95	

A contraction to one-half the original volume is required on the assumption that 1 vol. COS + 3 vol. O = 1 vol. CO₂ + 1 vol. SO₂; and this, as is evident, is nearly the case.

Ammoniac sulphocarbamate, formed by the direct union of carbonic oxysulphide with ammonia, and first described by Berthelot, I found to be produced in quantity on passing the gas and ammonia together into absolute alcohol, it separating out from the concentrated solution, on standing, in long prismatic needles.

Than, by decomposing carbonic oxysulphide over mercury in the one limb of a V tube provided with platinum wires, found that a separation into an equal volume of carbonic oxide and sulphur, which appears as a thick cloud on the tube every time on passing the spark, took place. On repeating his experiment with my gas, I found exactly the same to be the case.

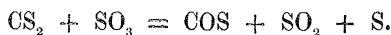
The residue in the flask, after the evolution of gas had ceased, was obtained, after washing with water, as a yellow friable mass, consisting entirely of sulphur.

* Jahresbericht; J. Chemie, 1858, p. 85.

† Bender's modification of Than's original plan, Ann. Ch. Pharm.

‡ Ann. Ch. Pharm. Supp. Band v. p. 236.

The following simple equation, therefore, explains the reaction which has taken place:—

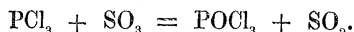


Action of Sulphuric Anhydride on Phosphorous Chloride.

The ease with which the foregoing reaction had taken place led me to try the action of the anhydride on a compound which, possessing latent affinities and a predisposition to combine with oxygen, it was to be expected would cause the separation of the “extraradical” oxygen atom, as I term the atom which is signalized by its great mobility. The compound chosen was phosphorous chloride.

On adding this to the anhydride, which must be in a flask surrounded by ice, a violent reaction takes place, attended by a copious evolution of sulphurous anhydride. No further action is observable after equal equivalents have been employed; and on distilling the resulting liquid and fractioning two or three times, two products are obtained, the one boiling from 110° to 114° , which, from all its properties, is undoubtedly phosphoric oxychloride.

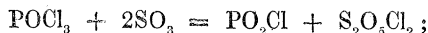
The reaction has therefore partly taken place as was expected, and according to the equation—



The second product, which is obtained in varying quantity, according as more or less anhydride is employed, the more being formed, the greater the proportion of the latter*, boils at the first distillation between 120° and 170° , and cannot be obtained of constant B.P., even by repeated rectification, by each of which it only suffers further decomposition, a thick varnish-like residue remaining every time. This product contains phosphorus, chlorine, and sulphur.

H. Rose, who also studied this reaction, though without observing the formation either of phosphoric oxychloride or of sulphurous anhydride, which latter he only remarked was given off on subsequent distillation, also describes this second product; he ascribes to it, however, an exceedingly complicated formula.

It is very possible that a further substitution of chlorine by oxygen has taken place, as explained by the equation—



and this compound can be viewed as metaphosphoric chloride, which it is to be expected would be of a very unstable nature. The above product is then, on this supposition, a mixture of two chlorides, to decide which it will be first necessary to institute experiments with pure phosphoric oxy-

* It is probable that only phosphoric oxychloride would be formed were the experiment reversed, and the anhydride allowed to act on an excess of the phosphorous chloride.

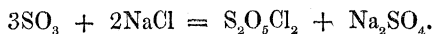
and sulphochlorides; it may then be possible to separate the products of the reaction by means of distillation under reduced pressure.

The formation of phosphoric oxychloride in this reaction can be considered as the result of the simple addition of oxygen to phosphorous chloride, the triatomic phosphorus becoming pentatomic*.

On the Properties and several Reactions of Pyrosulphuric Chloride.

Pyrosulphuric chloride was first obtained by H. Rose by the action of sulphuric anhydride on chloride of sulphur S_2Cl_2 , and later on by simple distillation of chloride of sulphur saturated with chlorine with Nordhausen sulphuric acid.

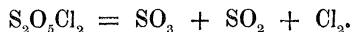
Rosenstiehl prepared it by heating sodic chloride with sulphuric anhydride,—



According to him, acetylic chloride is formed by heating it with sodic acetate, and chlorochromic acid by its action on potassic chromate, sodic and potassic pyrosulphates being formed at the same time, as he proved by analysis,—



On passing its vapour through a tube heated to dull redness, I have found the following decomposition to take place :—During the whole operation chlorine and sulphurous anhydride escaped, and in the receiver, which was kept cold by ice, sulphuric anhydride and a liquid layer were condensed. The latter yielded on distillation two products, the one boiling below 100° and the other consisting of the pyrosulphuric chloride which had escaped decomposition. The first portion was found to be sulphuric anhydride contaminated with traces of pyrosulphuric chloride; for on passing a stream of dry carbonic anhydride through it the whole solidified. The decomposition is therefore expressed by the equation—



The result of a vapour-density determination, according to Dumas's method, also speaks for the above decomposition. The following are the observations recorded :—

	mm.
Weight of globe + dry air at $14^\circ.7$ and 758.9	50.513
Weight of globe + vapour at 202° and 758.6	50.732
Capacity of globe	249 cub. centim.
Residual air	1 „ „

which gave a specific gravity = 5.06 .

The calculated number for $S_2O_5Cl_2 = 2$ vol. is 14.89 ; a splitting up into $SO_3 + SO_2Cl_2$ being admitted, it is 7.44 ; and if the decomposition go further,

* Experiments were also made to oxidize carbonic oxide; but the anhydride was found to be without action on it up to a temperature of 200° . I have no doubt, however, that the employment of a somewhat higher temperature will effect the combination.

and SO_3 , SO_2 , and Cl_2 are the final products obtained on heating, 4.96 is the theoretical number.

The experimental number, however, lies between the two latter, and it is therefore to be supposed that already, at a temperature of 200° , the dissociation was almost complete.

I intend making a series of determinations at varying temperatures and pressures, especially as H. Rose and Rosenstiehl have obtained numbers very different from mine; the former gives 8.96 as the mean of 5 concordant experiments all made at about 200° , and the latter 7.52, the temperature at which the determination was made not being given in this case.

The action of phosphoric chloride on the chloride is somewhat remarkable. On bringing the two together a violent action takes place, and sulphurous anhydride and chlorine escape; after adding slightly more than 1 equivalent of the chloride and 1 equivalent phosphoric chloride, and warming a short time, the latter had entirely disappeared. On distilling but little passed over below 130° , the greatest portion between 130° and 140° , and from 140° to 150° about one-third of the whole. Under all circumstances the formation of phosphoric oxychloride was to be expected, and it was therefore remarkable that so little had distilled over within the limits of its boiling-point. The analysis of the three fractions, however, has shown that they are all mixtures of POCl_3 and $\text{S}_2\text{O}_5\text{Cl}_2$ in varying proportions.

From fraction 1 (130°),—

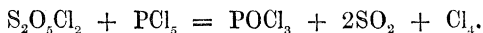
- 1655 grm. gave .409 grm. AgCl = 61.1 Cl.
- 4027 grm. gave .1395 grm. BaSO_4 = 4.75 S.
- 165 grm. gave .0777 grm. $\text{Mg}_2\text{P}_2\text{O}_7$ = 13.15 P.

The amount of phosphorus shown by analysis corresponds to 65.1 POCl_3 ; but the amount of chlorine remaining after deduction of that required by the phosphorus and the sulphur are not in the proportion required either by sulphuric chloride or by pyrosulphuric chloride: it is therefore probable that a mixture of both is present.

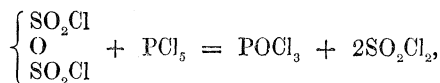
The second fraction still contained 20.8 POCl_3 .

The third ,, ,, 12.5 POCl_3 .

The decomposition is accordingly expressed by the equation—



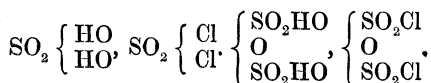
Sulphuric chloride, which it at first seemed probable would be the sole product beside phosphoric oxychloride,—



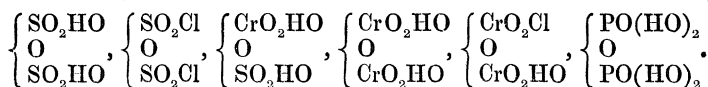
has, if at all, only been formed in very small quantity, it seems.

As to the constitution of the body $\text{S}_2\text{O}_5\text{Cl}_2$, all seems to speak for its

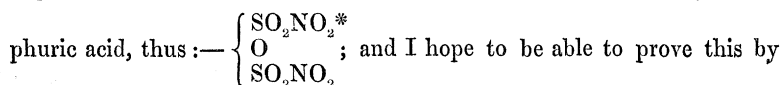
being the chloride of pyrosulphuric acid (so-called Nordhausen), to which it bears the same relation as sulphuric chloride to sulphuric acid,—



The old view of considering Nordhausen sulphuric acid as merely a solution of sulphuric anhydride in ordinary sulphuric acid has now probably but few partisans among chemists, it being looked upon as a true chemical compound, although of a very unstable nature, for the reason that on one side definite (sodic and potassic) salts of it are known, and on the other it presents analogies with certain chromium and phosphorus compounds, in which groups we are acquainted with the following series :—



The peculiar crystalline compound which plays an important part in the sulphuric-acid manufacture is also very possibly a derivative of pyrosulphuric acid, thus :—



the action of sulphuric anhydride on $\text{CH}(\text{NO}_2)_3$ or $\text{C}(\text{NO}_2)_4$.

IV. "On some of the more important Physiological Changes induced in the Human Economy by change of Climate, as from Temperate to Tropical, and the reverse." By ALEXANDER RATTRAY, M.D. (Edinb.), Surgeon R.N., H.M.S. 'Bristol.' Communicated by GEORGE BUSK, F.R.S. Received May 3, 1870.

Besides its obvious bearing on the long-vexed and still unsettled question of the unity of the human species, and on the closely related one of acclimatization, the present inquiry is of great medical importance. Tropical pathology, whether of native or foreign races, cannot be fairly studied until we thoroughly know its physiology; nor can we recognize and properly estimate disturbed action of organs till we understand their healthy functions. Otherwise natural phenomena may be mistaken for symptoms of sickness. Many so-called tropical diseases are merely exaggerations of the ordinary effects of climate, physiological merged into pathological phenomena; a knowledge of the one is the first step to an accurate acquaintance with and philosophical method of treating or preventing the other.

No inconsiderable part of our present knowledge of the vital phenomena

* Frankland, Journ. Chem. Soc. xix. p. 392.