

these two objections the first does not seem to me weighty. Indeed, I am inclined to think that the metric system would come into more general use if its nomenclature were simpler. The tendency in this direction is shown by the common use in Germany of the *Scheffel* (50 liters), the *Schoppen* (0.5 liter), the *Centner* (50 kilograms), and the *Pfund* (0.5 kilogram). If scientific men do not themselves adopt more convenient names, it is to be feared that in time the populace will make other propositions as unfortunate as *Centner*.

The second objection seems to me more weighty. Nevertheless, the same argument might be applied to the word *liter*. Why do we not call this volume a cubic decimeter? Simply because the founders of the metric system realized that the term was too cumbersome for convenient use. They were willing to sacrifice the advantage of having the dimension of length appear in the name, for the sake of convenience. When it is remembered, moreover, that in this country the volume is very often designated in writing, speaking and thinking by the unfortunate abbreviation "cc.", it is doubtful if the word milliliter will convey a less definite sense of dimension to many students than their present term.

On the whole, therefore, it seems to me that the arguments in favor of using the word milliliter are greater than those against it; and this note is written in order that the question may be brought for consideration before those who at present most use this unit of volume. Of course, general usage must in the end determine nomenclature, but it may not have occurred to every one that the word milliliter is not only a permissible term, but is also more exact and less cumbersome than the present usage of the phrase "cubic centimeter."

CAMBRIDGE, February 2, 1904.

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## THE ACTION OF LIQUEFIED AMMONIA ON CHROMIC CHLORIDE.

BY W. R. LANG AND C. M. CARSON.

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JØRGENSEN describes a number of compounds derived from chromic chloride by the action on chromous chloride of aqueous ammonia, ammonium chloride and subsequent oxidation.

The authors have obtained similar substances by the direct action of dry liquid ammonia on violet chromic chloride at low temperatures. Violet chromic chloride is not acted upon by aqueous ammonia nor by dry ammonia gas, but liquid ammonia acts upon it readily, completely transforming it into a salmon-colored powder.

*Experimental.*—Three grams of powdered chromic chloride were placed in a vessel made of combustion tubing, closed at the lower end and drawn out at the neck to allow of the tube being sealed at the blowpipe. The whole was placed in a freezing-mixture, consisting of solid carbonic acid and ether, and ammonia, dried over potassium hydroxide, was passed in. No action took place until liquefaction began, when the chromic chloride swelled up and became pasty, the color changing at the same time to a dark salmon-pink. Ammonia in considerable excess was allowed to accumulate on the top of the mass and the tube was then sealed. The tube containing the salmon-colored material was set aside for a week at the room temperature, being shaken occasionally to insure thorough mixing. Subsequent experiments showed the action of the ammonia to have been complete from the first, so in preparing further quantities this was omitted. The liquid ammonia on standing separated out colorless. The tube was then cooled to  $-35^{\circ}$  and opened, the temperature raised gradually to  $0^{\circ}$ , at which it was kept constant for twenty-four hours, and the dry powder remaining kept for investigation. Further quantities were prepared in the same way and left standing at  $0^{\circ}$  for two and four days respectively. Another portion of the powder was left at  $15^{\circ}$  C. for two days, and yet another portion was heated to  $110^{\circ}$  C. for the same length of time when the color became more distinctly pink. Analyses of the powder obtained at  $0^{\circ}$ ,  $15^{\circ}$ , and  $110^{\circ}$  respectively yielded:

	(A) At $0^{\circ}$ . Per cent.	(B) At $15^{\circ}$ . Per cent.	(C) <sup>1</sup> At $110^{\circ}$ . Per cent.
Chromium .....	20.1	20.6	21.7
Chlorine .....	41.1	41.6	44.1
Ammonia .....	38.6	37.8	34.1
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	99.8	100.0	99.9
Corresponding to molecules of $\text{NH}_3$ per molecule of $\text{Cr}_2\text{Cl}_6$ .....	11.7	11.2	9.7

<sup>1</sup> This analysis was done by Mr. J. A. M. Dawson.

Further heating continued for twenty-four hours to  $130^{\circ}$  brought about the separation of a small amount of chromic oxide but complete decomposition into chromic oxide did not take place until a temperature of  $180^{\circ}$  was reached.

From the analytical results it was evident that the powders contained a mixture of substances, and the following investigation led to the isolation of two definite compounds therefrom.

I. The powder which had remained at  $0^{\circ}$  was treated with a small quantity of cold water, 5 cc. to every gram of the substance. Partial solution took place, and on filtering off from the undissolved solid, a clear solution of a brown color was obtained, which on standing in the air for even a short time, evolved ammonia and deposited chromium hydroxide. On removing the precipitated chromium hydroxide and rapidly evaporating *in vacuo*, yellow crystals separated out, which were collected and dried between filter-paper (for convenience let  $\alpha$  indicate the yellow crystals). The residue from this first extraction with water was treated in the cold with a further quantity of the solvent and filtered. Evaporation *in vacuo* yielded, when carefully conducted, red crystals ( $\beta$ ). When the concentration in the vacuum desiccator was conducted too slowly, slight decomposition into gelatinous chromium hydroxide took place with the evolution of ammonia, but if rapidly conducted in shallow evaporating dishes, the crystals separated readily from the solution and no ammonia was evolved. Analysis of the yellow compound and the red compound gave:

	$\alpha$ -Salt. Per cent.	$\beta$ -Salt. Per cent.
Chromium .....	18.7	21.52
Chlorine .....	38.0	43.20
Ammonia .....	36.6	35.00
Water (by difference) .....	6.7	0.00
	100.00	99.72

The composition of the yellow  $\alpha$ -compound thus corresponds with the formula  $\text{Cr}_2\text{Cl}_6, 12\text{NH}_3, 2\text{H}_2\text{O}$ , and that of the red  $\beta$ -compound with  $\text{Cr}_2\text{Cl}_6, 10\text{NH}_3$ .

II. The powder obtained by keeping the original substance at  $15^{\circ}$  was similarly extracted with water, and from it were obtained yellow and red crystals, whose composition and properties were identical with the  $\alpha$ - and  $\beta$ -compounds obtained in I.

III. Treatment of the original pink substance with cold water,

which had been maintained for two days at  $100^{\circ}$  C., yielded no  $\alpha$ -crystals, but the red  $\beta$ -compound only.

PROPERTIES OF THE  $\alpha$ -AND  $\beta$ -CRYSTALS.

The yellow crystals are soluble in water, but insoluble in hydrochloric acid and in alcohol. From the aqueous solution all the chlorine is precipitated in the cold by silver nitrate. On standing at  $110^{\circ}$  for two days, the yellow crystals are changed partly into a red powder, with separation of chromic oxide. These crystals evidently correspond with the *luteochromium* compounds obtained by Jørgensen<sup>1</sup> of the general formula  $\text{Cr}_2\text{I}_2\text{NH}_3\text{X}_6$ .

The red compound crystallizes in small perfectly formed cubes and octahedra. They dissolve in cold water slowly, while hot water causes a separation of chromium hydroxide. Hydrochloric acid and alcohol exert no solvent action on them. Further, when the crystals are treated with liquid ammonia, no change takes place, and on addition of a small quantity of violet chromium chloride to the mixture of the salt and ammonia the chromic chloride reacts at once with the ammonia, yielding a pink powder from which the  $\beta$ -crystals may be separated mechanically. On treating the mixed crystals and powder with cold water, the latter readily dissolved away, leaving the red crystals untouched. The composition of this  $\beta$ -compound,  $\text{Cr}_2\text{I}_0\text{NH}_3\text{Cl}_6$ , points to its being *chlor-purpureochromium chloride*.

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## NOTE ON THE ACTION OF METHYLAMINE ON CHROMIC CHLORIDE.

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A SOLUTION of methylamine was gently heated and the gas conducted through drying towers filled with potassium hydroxide to a glass tube containing chromium chloride and immersed in a freezing-mixture at a temperature of  $-10^{\circ}$ . As soon as the liquid methylamine collected in the tube, combination between it and the chromic chloride took place and a substance of a pale pink color, closely resembling the ammonia compound (Lang and Carson), was formed. The excess of methylamine was allowed to pass off

<sup>1</sup>*J. prakt. Chem.*, [2] 30, 1.