1. A precipitate of ammonated cuprous nitride, of the formula Cu_3N-nNH_3, is formed by the action of potassium amide on a liquid ammonia solution of cupric nitrate in accordance with the equation,

$$3Cu(NO_3)_2 + 6KNH_2 = Cu_3N.nNH_3 + 6KNO_3 + (4-n)NH_3 + N.$$

When heated *in vacuo* at laboratory temperature, the precipitate is converted into cuprous imide, Cu_2NH; when heated to 160° cuprous nitride, Cu_3N, is formed.

2. The products of the general formula, $Cu_3N.nNH_3$, dissolve readily in liquid ammonia solutions of potassium amide to form solutions from which well crystallized specimens of a colorless salt of the composition represented by the formula, $CuNK_2.3NH_3$, have been obtained.

3. This salt, potassium ammonocuprite, with three molecules of ammonia of crystallization or triammonated potassium ammonocuprite, loses one molecule of ammonia, when heated *in vacuo* to laboratory temperature, to form a salt of the composition represented by the formula $CuNK_2.2NH_3$. When diammonated potassium ammonocuprite is heated to higher temperatures it, in turn, loses one molecule of ammonia to form a monoammonated salt of the formula $CuNK_2.NH_3$.

HYGIENIC LABORATORY,
U. S. PUBLIC HEALTH AND MARINE HOSPITAL SERVICE,
WASHINGTON.

AN UNUSUAL CASE OF SPECIFIC GRAVITY.[1]

BY A. L. HYDE.

Received August 30, 1912.

Attention is here called to the unusual behavior of paranitrotoluene when dissolved in carbon bisulfide. The usual rule is that when a solid heavier than a liquid is dissolved in this liquid, the resulting solution has a higher specific gravity than the pure liquid; but when paranitrotoluene, a solid of higher specific gravity than carbon bisulfide, is dissolved in this liquid, the specific gravity of the solution is less than that of pure carbon bisulfide. In other words, the two substances occupy a larger volume when together in solution than their total volume when separate. The following results of a few determinations will show this: The determinations were made with a Westphal balance and a specific gravity bottle. All specific gravities are based on water at 15° and the determinations were made at 20°.

The carbon bisulfide used had a specific gravity at 20° of 1.2660. The

[1] Published by permission of the Director of the Bureau of Mines. Dr. Washburn has called attention to the fact that solutions of lithium nitrate, ammonium chloride, or ammonium bromide in water are in each case lighter than the mean of the specific gravity of the salts and of water. These cases are parallel to the case of carbon bisulfide and sulfur, in which, although the specific gravity is increased by addition of the solid, there is an increase in the volume caused by solution.

p-nitrotoluene had a specific gravity of 1.2856. Five solutions were made and their specific gravity determined. The percentages of para-nitrotoluene present in each solution as given in the following table are shown both as of the total solution and of the solvent present. Solution No. 5 is the saturated solution at 20°:

No. of solution.	Per cent p-nitrotoluene based on total solution.	Per cent p-nitrotoluene based on solvent.	Sp. gr. at 20°.
1	11.4	12.9	1.2488
2	20.9	26.5	1.2370
3	38.4	62.4	1.2156
4	49.3	97.3	1.2035
5	53.0	112.8	1.1988

Inspection of these results shows that the decrease in specific gravity is nearly proportional to the percentage of solid in the solution. A formula which expresses this relation approximately is: Sp. gr. = 1.2660—0.0013a, where a is per cent p-nitrotoluene in the solution.

The volume relations shown by these figures are interesting. If the volume of p-nitrotoluene per 100 volumes of carbon bisulfide in each of the above solutions be calculated and the total volume of both constituents subtracted from the volume of the resulting solution, the difference will be the increase in volume due to the process of solution. Below is the result of this calculation:

No. of solution.	Vols. p-nitrotoluene per 100 vols. CS_2.	Total vol. of constituents.	Vol. of solution.	Increase in vol.	Increase in vol. per vol. of p-nitrotoluene.
1	12.7	112.7	114.4	1.7	0.134
2	26.1	126.1	129.4	3.3	0.126
3	61.4	161.4	169.1	7.7	0.125
4	95.8	195.8	207.5	11.7	0.123
5	111.1	211.1	224.7	13.6	0.122

The figures in the last column of the above table show that the increase in volume is nearly proportional to the quantity of nitrotoluene present, and that it is possible to predict very nearly the volume of the solution when known volumes of carbon bisulfide and p-nitrotoluene are mixed. If b is the number of volumes of p-nitrotoluene added to 100 vols. of carbon bisulfide, then the volume (V) of the resulting solution will be given very nearly by the formula: $V = 100 + b + 0.125b$. That this is a case of true solution and not of chemical reaction is indicated by the cooling effect when the solid is added to the liquid and also by the fact that the p-nitrotoluene may be recovered by evaporating off the solvent.

With a view of finding whether this property of increasing volume by solution was due to the solvent or to the solid dissolved, the specific gravity of several other solutions was determined. A solution containing 100 parts of acetone (sp. gr. at 20°—0.7940) and 58.8 parts of p-nitrotoluene by weight gave a specific gravity of 0.9030. This solution contains 100 parts of acetone to 36.3 parts of nitrotoluene by vol. or a total volume for the two constituents of 136.3. The solution itself has a volume of 139.6. Hence in this case, though the specific gravity of the acetone is increased by addition of the solid, the volume of the solution is greater than the combined volumes of its constituents.

A mixture of acetic acid and water (sp. gr. at 20° —1.0680) was saturated at 20° with *p*-nitrotoluene. This solution contained 3.40% of nitrotoluene and had a specific gravity at 20° of 1.0708. This solution contains 2.9 volumes of nitrotoluene per 100 volumes of the acetic acid water mixture, but its actual volume calculated from its specific gravity is 103.2 volumes, a gain of 0.3 volume. It appears from these tests that, though *p*-nitrotoluene does not always lower the specific gravity of the liquids in which it dissolves, yet the tendency is for the solution to occupy a greater volume than the combined volumes of its constituents.

o-Nitrotoluene, a liquid having a specific gravity at 20° of 1.1650, was dissolved in carbon bisulfide and the specific gravity of the solution determined. Its specific gravity was 1.2060 and it contained 99.3 parts by weight of *o*-nitrotoluene to 100 parts of carbon bisulfide. This is 107.8 volumes of *o*-nitrotoluene to 100 volumes of carbon bisulfide, a total volume of 207.8. The corresponding volume of the solution calculated from its specific gravity is 209.1, an increase of 1.3 volumes.

From the determinations of the specific gravity of solutions of sulfur in carbon bisulfide made by Macagno and given in the tables in the Chemiker Kalender, it appears that a solution containing 37.2% sulfur in carbon bisulfide (sp. gr. at 15°—1.271), has a specific gravity of 1.391. Assuming that the sulfur used had a specific gravity of 2.07 (the value given in the Chemiker Kalender for octahedral sulfur) this would be 22.8 volumes of sulfur in 100 volumes of carbon bisulfide. The volume of the corresponding solution calculated from its specific gravity would be 125.4, an increase of 2.6 volumes.

Thus it appears that the tendency of both carbon bisulfide and *p*-nitrotoluene is to increase the volume of solutions in which they are constituents, though the specific gravity of the solution is not always less than that of the pure solvent. In the particular case where the solution contains both of these substances, this tendency results in an actual lowering of specific gravity.

EXPLOSIVES CHEMICAL LABORATORY.
U. S. BUREAU OF MINES,
PITTSBURGH, PA.

SOME NEW FORMS OF LABORATORY APPARATUS.[1]

BY FRITZ FRIEDRICHS.

Received August 30, 1912.

In the following paragraphs are described several new forms of appara-

[1] Paper read before the Cornell Section of the American Chemical Society.