benzoic acid. The filtrate was extracted several times with ether. From the ether extract, golden-yellow crystals of quinone were obtained, melting at 116°. The yield of quinone was very small in this case.

### Acetamide.

Persulfate solutions have a hydrolyzing action on acid amides. Acetamide was hydrolyzed when treated with a solution of potassium persulfate into acetic acid and ammonia. A quantity of acetamide was heated in a flask with a very concentrated solution of potassium persulfate for an hour on the water bath. At the end of the operation no acetamide could be detected, the solution containing ammonium acetate and free acetic acid.

### Propionamide.

Propionamide, when similarly boiled with potassium persulfate, underwent hydrolysis and the resulting solution contained a mixture of propionic acid and ammonium propionate.

### Butyramide.

Butyramide, on treatment with potassium persulfate, yielded a mixture of ammonium butyrate and butyric acid.

### Allyl Alcohol.

Allyl alcohol yielded, on treatment with potassium persulfate, mainly acrolein, but at the same time a small quantity of some sticky substance was produced. Allyl alcohol was taken in a flask and to it a large excess of an almost saturated solution of potassium persulfate was added. The whole was kept at incipient boiling on water bath under reflux for nine hours. At the end of the reaction the solution left behind smelled strongly of acrolein. The solution was next extracted with ether, when all the acrolein with an oily viscous substance was extracted. On distillation of the ethereal solution the acrolein was found in the distillate and a viscous oily substance remained behind in the flask. This latter product is under investigation.

CALCUTTA.

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[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF PRESIDENCY COLLEGE.]

# INDIRECT FORMATION OF DOUBLE SALTS VI. THE DOUBLE SILVER, LEAD, BISMUTH, COPPER AND MERCUROUS HALIDES OF SUBSTITUTED AMMONIUM BASES.

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Received February 16, 1917.

It has been shown in previous communications on the subject[1] that the indirect method of double salt formation is particularly suitable for the

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[1] Datta, *J. Chem. Soc.*, 103, 426 (1913); Datta and Mukherjea, *Proc. Chem. Soc.*, 29, 185 (1913); Datta, THIS JOURNAL, 35, 949 (1913); Datta, *Ibid.*, 35, 1185 (1913); Datta and Ghosh, *Ibid.*, 36, 1017 (1914).

general preparation of double salts. Not only can this method be conveniently used for the preparation of those double salts which can also be produced by direct means, but it makes possible the formation of those double salts whose direct production is not possible, due either to the inert nature of the constituent, or to inability to isolate it. For instance, the direct preparation of double silver halides with the highly substituted ammonium halides is not possible directly, as silver halides are perfectly insoluble in solutions of the ammonium halides. The case of lead iodide is similar. Its perfect insolubility in the heavily substituted ammonium iodides does not allow the direct method to be used for the production of double lead halides. Again, the direct method is not applicable in the case of double cupric iodides. Cupric iodide cannot be isolated in the free state and hence the direct method is of no use. It is by the indirect method that the double cupric iodides have been isolated, as described in previous communications on the subject. Besides, the method as has been shown before, is applicable for the formation of double salts generally. The present communication is meant to show more cases of double salt formation by the indirect method and to systematize the method.

## The Double Silver Bromides.

The method of the preparation of double silver bromides consists in adding a strong solution of silver nitrate to strong solutions of substituted ammonium bromides when the double silver bromides are obtained as precipitates. It is to be noticed that in the case of lower members of the substituted ammonium bases, the formation of the double salts does not take place, a precipitate of pure silver bromide being obtained. The method even fails in the case of tetramethyl- and tetraethyl-ammonium bromides, precipitates of pure silver bromide being obtained. This shows the inert nature of silver bromide and its absence of combining property to any significant degree. Double silver bromides can only be prepared with the bromides of the heavy heterocyclic bases. For instance, it has been found that pyridine, quinoline, isoquinoline and picoline bromides yield double bromides of the general type, XBr, AgBr.

**Pyridine Silver Bromide.**—To a very concentrated solution of pyridine hydrobromide in water, a strong solution of silver nitrate was added gradually, when a yellow precipitate was formed, which, on shaking, changed into a mass of white crystals. The salt was decomposed by water into silver bromide and hence the salt is secured by strong suction and washing with a small quantity of water. The salt was dried and analyzed.

0.0560 gave 0.0306 AgBr; Ag, 31.38.
0.1042 gave 0.1120 AgBr; Br, 45.74.
Calc. for $C_5H_5NHBr.AgBr$: Ag, 31.01; Br, 45.95.

The compound thus obtained was perfectly white in color but assumed a yellowish tinge on standing in a desiccator. The substance turned slightly yellow at 120° and melted to a thin yellow liquid at 151°. The first analysis indicated the weight of silver bromide in the salt, obtained by decomposing the salt with nitric acid. The second analysis represented the weight of total bromine obtained by heating the substance in a Carius tube with silver nitrate and forming nitric acid.

**Quinolinium Silver Bromide.**—On adding a concentrated solution of silver nitrate to a strong solution of quinoline hydrobromide a pale yellow flocculent precipitate appeared which, on shaking, changed into a fine, white, crystalline precipitate. The precipitate turned yellow with water, due to decomposition of the salt. It was then washed with a little dilute alcohol. This gave a white powder which did not change in color on standing. It melted to a thick, yellow liquid at 180°.

0.0834 gave 0.0398 AgBr; Ag, 27.41.
0.0996 gave 0.0936 AgBr; Br, 39.98.
Calc. for $C_9H_7NHBr.AgBr$: Ag, 27.13; Br, 40.20.

**Isoquinolinium Silver Bromide.**—On adding silver nitrate to the alkyl ammonium bromide, at first a yellow, flocculent precipitate came down which, on rubbing with a pestle, was transformed to a white precipitate. The precipitate decomposed slowly on treatment with large quantities of water. As thus obtained, it consisted of a white powder melting into a bright yellow liquid at 127°. The salt on keeping turned yellow without any change in composition.

0.1634 gave 0.0768 AgBr; Ag, 27.00.
0.1458 gave 0.1366 AgBr; Br, 39.86.
Calc. for $C_9H_7NHBr.AgBr$: Ag, 27.13; Br, 40.20.

**$\alpha$-Picolinium Silver Bromide.**—As prepared in the above manner, this was obtained as a pale yellow precipitate. The salt is decomposed by water and hence a little alcohol was used for washing the salt. The color of the salt deepened on exposure to air. It melted to a clear liquid at 157°.

0.1440 gave 0.0736 AgBr; Ag, 29.35.
0.1324 gave 0.1364 AgBr; Br, 43.83.
Calc. for $C_5H_4NCH_3HBr.AgBr$: Ag, 29.82; Br, 44.20.

## The Double Lead Iodides.

Unlike silver iodide, lead iodide has been found to possess more combining property with the alkylammonium iodides. They have been prepared by adding lead nitrate to solutions of the substituted ammonium bases.

**Tetraethylammonium Lead Iodide.**—To a saturated solution of the alkylammonium iodide, a strong solution of lead nitrate was added with constant stirring, when a yellow, flocculent precipitate formed. The precipitate was washed with a mixture of alcohol and ether. On drying, the salt was pale yellow, which, on standing, turned gray. It melted at 212° to a clear, thin, bright, orange-yellow liquid.

0.1682 gave 0.0444 PbO; Pb, 24.52.
0.1034 gave 0.1002 AgI; I, 52.36.
Calc. for $3N(C_2H_5)_4I.2PbI_2$: Pb, 24.45; I, 52.54.

**Tetrapropylammonium Lead Iodide.**—On adding lead nitrate to a strong solution of the alkylammonium iodide, a curdy yellow precipitate came down. This was stirred well and then washed with a mixture of alcohol and ether. The substance on drying consisted of a yellow powder, melting at 194° to a red liquid.

0.1260 gave 0.0366 PbO; Pb, 26.97.
0.1028 gave 0.0932 AgI; I, 49.00.
Calc. for $PbI_2.NPr_4I$: Pb, 26.75; I, 49.22.

**Trimethyl-*p*-tolylammonium Lead Iodide.**—This was obtained as a yellow, flocculent precipitate on adding a strong solution of lead nitrate to one of the alkylammonium iodide. The precipitate was stirred well during formation. It was washed as usual with a mixture of alcohol and ether. On drying, this was obtained as a bright yellow substance, having a tendency to turn brown at the ordinary temperature. It does not melt sharply, but gradually turns black on heating.

0.1344 gave 0.0340 PbO; Pb, 23.48.
0.1420 gave 0.1328 AgI; I, 50.54.
Calc. for $3N(CH_3)_3C_7H_7I.2PbI_2$: Pb, 23.62; I, 50.72.

**Quinolinethylammonium Lead Iodide.**—This salt was obtained as a yellow precipitate as usual, according to the above method. The substance consisted of yellow powder which has a tendency to turn brown. It melted at 190° to a clear liquid.

0.1868 gave 0.0566 PbO; Pb, 28.15.
0.0984 gave 0.0924 AgI; I, 50.75.
Calc. for $C_9H_7NC_2H_5I.PbI_2$: Pb, 27.55; I, 51.07.

## The Double Lead Bromides.

These were obtained as usual by the indirect method. A solution of lead nitrate was added to solutions of the substituted ammonium bromides.

**Tetramethylammonium Lead Bromide.**—A concentrated solution of lead nitrate was added to a very strong solution of the alkylammonium bromide when a white precipitate was obtained. This was washed as usual with alcohol and ether. The salt did not melt.

0.1656 gave 0.0613 PbO; Pb, 34.37.
0.1204 gave 0.1328 AgBr; Br, 46.93.
Calc. for $3N(CH_3)_4Br.2PbBr_2$: Pb, 34.61; Br, 46.81.

**Tetraethylammonium Lead Bromide.**—The salt was prepared in exactly the same manner. It is a white substance.

0.1734 gave 0.0566 PbO; Pb, 30.30.
0.1760 gave 0.1712 AgBr; Br, 41.39.
Calc. for $3N(C_2H_5)_4Br.2PbBr_2$: Pb, 30.35; Br, 41.06.

**Pyridinium Lead Bromide.**—This was obtained as white, flocculent precipitate. At 130°, the salt suddenly turned yellow, after which no further change took place.

0.1146 gave 0.0488 PbO; Pb, 39.53.
0.1876 gave 0.1988 AgBr; Br, 45.10.
Calc. for $C_5H_5NHBr.PbBr_2$: Pb, 39.28; Br, 45.54.

**Quinolinium Lead Bromide.**—This was obtained as a white substance. On heating it began to decompose at 320°.

0.1392 gave 0.0540 PbO; Pb, 36.01.
0.1791 gave 0.1744 AgBr; Br, 41.40.
Calc. for $C_9H_7NHBr.PbBr_2$: Pb, 35.88; Br, 41.59.

**$\alpha$-Picolinium Lead Bromide.**—This was obtained as usual as a white, flocculent precipitate on adding a solution of lead nitrate to a solution of $\alpha$-picolinium bromide. On heating it turned yellow at 100° and melted to a thick, black liquid at 168–169°.

0.2076 gave 0.0858 PbO; Pb, 38.37.
0.1892 gave 0.1968 AgBr; Br, 44.26.
Calc. for $C_5H_4NCH_3HBr.PbBr_2$: Pb, 38.26; Br, 44.36.

## The Double Lead Chlorides.

Similar to the preparation of double lead iodides and bromides, these have been prepared by adding a strong solution of lead nitrate to strong solutions of the alkylammonium chlorides. The following lead chlorides have been prepared:

**Pyridinium Lead Chloride.**—To an excess of a strong solution of pyridine lead chloride, a solution of lead nitrate was gradually added. Each drop produced a precipitate which at once dissolved. After a short time a mass of small, shining crystals appeared in the liquid. This was washed with a mixture of alcohol and ether.

0.0764 gave 0.0435 PbO; Pb, 52.85.
0.1548 gave 0.1684 AgCl; Cl, 26.93.
Calc. for $C_5H_5NHCl.PbCl_2$: Pb, 52.61; Cl, 27.07.

**$\alpha$-Picolinium Lead Chloride.**—This was prepared in exactly the same manner as the pyridine salt. It was a white substance which did not melt and which could be heated to a high temperature without decomposition.

0.2174 gave 0.1188 PbO; Pb, 50.74.
0.1032 gave 0.1098 AgCl; Cl, 26.33.
Calc. for $C_5H_4NCH_3HCl.PbCl_2$: Pb, 50.81; Cl, 26.14.

**Quinolinium Lead Chloride.**—This was also obtained as a white precipitate. This was washed and dried as usual.

0.1404 gave 0.0699 PbO; Pb, 46.23.
0.1048 gave 0.1024 AgCl; Cl, 24.17.
Calc. for $C_9H_7NHCl.PbCl_2$: Pb, 46.68; Cl, 24.02.

**Diethylphenylbenzylammonium Lead Chloride.**—On adding lead nitrate to a strong solution of the chloride a white precipitate was immediately formed which settled at the bottom. The salt obtained was of a gray-brown color.

0.1034 gave 0.0414 PbO; Pb, 37.17.
0.1302 gave 0.1004 AgCl; Cl, 19.08.
Calc. for $N(C_2H_5)_2C_6H_5C_7H_7Cl.PbCl_2$: Pb, 37.41; Cl, 19.24.

## The Double Bismuth Iodide.

These double salts have been prepared as usual by the indirect method of double decomposition, *viz.*, adding a solution of bismuth nitrate to solutions of the substituted ammonium iodides.

**Tetraethylammonium Bismuth Iodide.**—This was obtained as a red precipitate which turns brown on shaking, by adding a solution of bismuth nitrate to a saturated solution of tetraethylammonium iodide. It was washed with a mixture of alcohol ether. As thus obtained it consisted of a yellow-brown powder.

0.1104 gave 0.0322 $Bi_2O_3$; Bi, 24.39.
0.1202 gave 0.1330 AgI; I, 59.80.
Calc. for $N(C_2H_5)_4I.BiI_3$: Bi, 24.59; I, 60.05.

**Tetrapropylammonium Bismuth Iodide.**—On the addition of bismuth nitrate to the alkylammonium iodide as usual, a red precipitate came down which rapidly changed to dark brown. The salt was washed and dried as usual.

0.1326 gave 0.0334 $Bi_2O_3$; Bi, 22.58.
0.1348 gave 0.1396 AgI; I, 55.97.
Calc. for $N(C_3H_7)_4I.BiI_3$: Bi, 23.06; I, 56.32.

**Trimethyl-*p*-tolylammonium Bismuth Iodide.**—This was obtained as usual as a scarlet precipitate which turned brown gradually. The salt on drying consisted of a dark red solid which gradually darkened in air.

0.1246 gave 0.0331 $Bi_2O_3$; Bi, 23.82.
0.0896 gave 0.0970 AgI; I, 58.51.
Calc. for $N(CH_3)_3C_7H_7I.BiI_3$: Bi, 24.02; I, 58.66.

**Quinolinethylammonium Bismuth Iodide.**—This was obtained as a gray precipitate which had a tendency to decompose. As dried it consisted of a dark gray substance.

0.1678 gave 0.0448 $Bi_2O_3$; Bi, 23.94.
0.1320 gave 0.1422 AgI; I, 58.21.
Calc. for $C_9H_7NC_2H_5I.BiI_3$: Bi, 23.80; I, 58.13.

## The Double Bismuth Bromides.

These have been obtained as precipitates by the addition of a solution of bismuth nitrate to solutions of the alkylammonium bromides.

**Tetramethylammonium Bismuth Bromide.**—On the addition of a solution of bismuth nitrate in nitric acid to a strong solution of tetramethylammonium bromide, a pale yellow precipitate was obtained. This was washed with alcohol. The solid consisted of a faint yellowish white substance. When heated it turned yellow without melting.

0.0942 gave 0.0290 $Bi_2O_3$; Bi, 27.60.
0.1540 gave 0.1920 AgBr; Br, 52.91.
Calc. for $2N(CH_3)_4Br.BiBr_3$: Bi, 27.52; Br, 52.91.

**Tetraethylammonium Bismuth Bromide.**—This was obtained as usual as a pale yellow precipitate. It consisted of a yellowish white substance.

0.2818 gave 0.0756 $Bi_2O_3$; Bi, 24.05.
0.0954 gave 0.1028 AgBr; Br, 45.84.
Calc. for $2N(C_2H_5)_4Br.BiBr_3$: Bi, 23.96; Br, 46.09.

**Pyridine Bismuth Bromide.**—This was obtained as a yellow precipitate on adding bismuth nitrate to the iodide solution. The substance had a pale yellow color. At 210° it turned red suddenly.

0.0874 gave 0.0259 BiO; Bi, 26.57.
0.0932 gave 0.1136 AgBr; Br, 51.88.
Calc. for $2C_5H_5NHBr.BiBr_3$: Bi, 27.08; Br, 52.08.

**Quinolinium Bismuth Bromide.**—This was obtained as a pale yellow precipitate.

0.1136 gave 0.0300 $Bi_2O_3$; Bi, 23.68.
0.1054 gave 0.1143 AgBr; Br, 46.13.
Calc. for $2C_9H_7NHBr.BiBr_3$: Bi, 23.96; Br, 46.13.

## The Double Bismuth Chlorides.

On adding a solution of bismuth nitrate to the alkylammonium chloride, no immediate precipitate was formed, but crystals separated on allowing to stand in a desiccator over sulfuric acid.

**Pyridine Bismuth Chloride.**—On adding bismuth nitrate solution to pyridine chloride no precipitate was formed. On keeping the clear solution in a desiccator, fine, colorless needles were found to separate. This was collected, washed with a little alcohol and dried. The substance consisted of colorless needles melting at 245° with slight decomposition.

0.2302 gave 0.0964 $Bi_2O_3$; Bi, 39.55.
0.1246 gave 0.1633 AgCl; Cl, 32.43.
Calc. for $2C_5H_5NHCl.BiCl_3$: Bi, 38.14; Cl, 32.54.

**Quinolinium Bismuth Bromide.**—In this case there was no precipitate at first, but on shaking a white precipitate came out which was washed and dried as usual. The substance consisted of a white solid.

0.0988 gave 0.0364 $Bi_2O_3$; Bi, 33.03.
0.0896 gave 0.0993 AgCl; Cl, 27.42.
Calc. for $2C_9H_7NHCl.BiCl_3$: Bi, 32.22; Cl, 27.50.

**Diethylphenylbenzylammonium Chloride.**—At first there was a white precipitate which soon disappeared and a dirty yellow-gray oil separated.

This was freed from water as far as possible and allowed to stand in a vacuum desiccator. The substance did not solidify and consisted of a very thick liquid of a pale yellow color.

0.2486 gave 0.0867 $Bi_2O_3$; Bi, 34.86.
0.1210 gave 0.1168 AgCl; Cl, 23.89.
Calc. for $N(C_2H_5)_2C_6H_5C_7H_7Cl.BiCl_3$: Bi, 35.26; Cl, 24.06.

## The Double Cuprous Iodide.

Double cuprous iodides have been prepared by adding an hydrochloric acid solution of cupric chloride to solutions of the alkylammonium iodides, when the double salts precipitated out. Kohn[1] has recently obtained a double cuprous iodide with quinoline methiodide, $C_9H_7N,CH_3I,CuI$, by the use of the direct method. The method of double decomposition failed in the case of the lower substituted ammonium bases, there being only a precipitate of cuprous iodide. The salts were decomposed by water to cuprous iodide.

**Tetrapropylammonium Cuprous Iodide.**—When an acid solution of cuprous chloride was added to a saturated solution of the iodide, a pale yellow, flocculent precipitate was formed. This was decomposed with water and hence could not be freely washed with water. It can be washed with a little alcohol.

0.3625 gave 0.0559 CuO; Cu, 12.33.
0.1764 gave 0.1644 AgI; I, 50.36.
Calc. for $N(C_3H_7)_4I.CuI$: Cu, 12.52; I, 50.49.

**Trimethyl-*p*-tolylammonium Cuprous Iodide.**—This was obtained as a thick, brownish yellow, creamy precipitate, which solidified on stirring with a glass rod. This was washed and dried as usual. The salt was obtained as a brownish yellow powder.

0.3170 gave 0.0522 CuO; Cu, 13.14.
0.1024 gave 0.1028 AgI; I, 54.24.
Calc. for $N(CH_3)_3C_7H_7I.CuI$: Cu, 13.49; I, 54.39.

**Quinolinium Cuprous Iodide.**—This was obtained as a red precipitate which was washed with a little dilute alcohol. The salt decomposed on washing with water, the red color of the compound gradually giving place to lighter colors; it was ultimately changed to cuprous iodide.

0.2731 gave 0.0476 CuO; Cu, 13.92.
0.1242 gave 0.1302 AgI; I, 56.63.
Calc. for $C_9H_7NHI.CuI$: Cu, 14.09; I, 56.82.

**Quinolinemethylammonium Cuprous Iodide.**—This has been prepared by the direct method by Kohn[2] as indicated before. It has been found that the same salt can be obtained as a brick-red precipitate by adding an acid solution of cuprous chloride to a strong solution of quinolinemethyl iodide. The salt was washed with a little alcohol.

[1] *Monatsh.*, **33**, 912 (1912).

[2] *Loc. cit.*

0.2510 gave 0.0401 CuO; Cu, 13.37.
0.1468 gave 0.1492 AgI; I, 54.93.
Calc. for $C_9H_7N.CH_3I.CuI$: Cu, 13.66; I, 55.02.

**Triethylsulfonium Cuprous Iodide.**—When an acid solution of cuprous chloride was added to a saturated solution of triethylsulfonium iodide, the cuprous iodide was first precipitated as a white powder. The white precipitate gradually turned brown-red on stirring, due to the gradual double decomposition taking place. The precipitate was washed and dried as usual.

0.3104 gave 0.0522 CuO; Cu, 14.20.
0.2124 gave 0.2282 AgI; I, 58.06.
Calc. for $S(C_2H_5)_3I.CuI$: Cu, 14.44; I, 58.25.

## The Double Cuprous Bromides.

These have been prepared as usual by adding an hydrochloric acid solution of cuprous chloride to substituted ammonium bromide.

**Tetramethylammonium Cuprous Bromide.**—This was obtained as a white precipitate by adding an hydrochloric acid solution of cuprous chloride to the allylammonium bromide. The precipitate was washed with a small quantity of water.

0.0454 gave 0.0160 CuO; Cu, 28.09.
0.0750 gave 0.0957 AgBr; Br, 54.29.
Calc. for $N(CH_3)_4Br.2CuBr$: Cu, 28.63; Br, 54.54.

**Tetraethylammonium Cuprous Bromide.**—This was obtained as a white, crystalline precipitate. The salt had a tendency to turn brown in the air. It melted at 130°.

0.1550 gave 0.0500 CuO; Cu, 25.68.
0.0652 gave 0.0743 AgBr; Br, 48.50.
Calc. for $N(C_2H_5)_4Br.2CuBr$: Cu, 25.40; Br, 48.39.

**Diethylphenylbenzylammonium Cuprous Bromide.**—This was obtained as a pale yellow, viscous oil. It had a tendency to decompose when kept at the ordinary temperature. It did not solidify.

0.0970 gave 0.0162 CuO; Cu, 13.31.
0.1304 gave 0.1054 AgBr; Br, 34.41.
Calc. for $N(C_2H_5)_2C_6H_5C_7H_7Br.CuBr$: Cu, 13.60; Br, 34.55.

**Pyridinium Cuprous Bromide.**—The addition of cuprous chloride did not produce an immediate precipitate, but on stirring the solution vigorously and rubbing the sides and bottom of the vessel the whole turned into a mass of yellow, glistening plates. The crystals, on keeping, turned brown, due to gradual decomposition.

0.1758 gave 0.0458 CuO; Cu, 20.77.
0.1432 gave 0.1766 AgBr; Br, 52.48.
Calc. for $C_5H_5NHBr.CuBr$: Cu, 20.81; Br, 52.80.

**Quinolinium Cuprous Iodide.**—This was obtained in exactly the same way as a yellow, crystalline precipitate, which gradually decomposed when kept at the ordinary temperature.

0.0684 gave 0.0152 CuO; Cu, 17.70.
0.1280 gave 0.1357 AgBr; Br, 45.11.
Calc. for $C_9H_7NHBr.CuBr$: Cu, 17.86; Br, 45.32.

**Isoquinolinium Cuprous Bromide.**—At first, a yellow, viscous oil separated which, on shaking, soon became crystalline. This was washed and dried as usual.

0.1138 gave 0.0254 CuO; Cu, 17.79.
0.1502 gave 0.1585 AgBr; Br, 44.9.
Calc. for $C_9H_7NHBr$: Cu, 17.86; Br, 45.32.

**α-Picolinium Cuprous Bromide.**—This was obtained as glistening brown crystals.

0.1002 gave 0.0246 CuO; Cu, 19.58.
0.1128 gave 0.1330 AgBr; Br, 50.19.
Calc. for $C_5H_4NCH_3HBr$: Cu, 19.87; Br, 50.47.

### The Double Mercurous Iodides.

The double mercurous iodides have been prepared by adding a solution of mercurous nitrate to the substituted ammonium iodides when the double salts were obtained as precipitates. The reaction was successful with the heavily substituted ammonium bases.

**Trimethyl-*p*-tolylammonium Iodide.**—To a strong solution of trimethyl-*p*-tolylammonium iodide, a solution of mercurous nitrate was added when a white emulsion was produced which on shaking deposited a gray precipitate. This was washed and dried.

0.4122 gave 0.1059 HgS; Hg, 22.13.
0.1410 gave 0.1124 AgI; I, 43.07.
Calc. for $2N(CH_3)_3C_7H_7I.HgI$: Hg, 22.70; I, 43.24.

**Tetrapropylammonium Mercurous Iodide.**—This was obtained as a grayish white precipitate. The salt on drying appeared white with a very faint yellow tinge.

0.3560 gave 0.0865 HgS; Hg, 20.93.
0.1246 gave 0.0918 AgI; I, 39.81.
Calc. for $2N(C_3H_7)_4I.HgI$: Hg, 21.03; I, 39.97.

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[CONTRIBUTION FROM THE CHEMICAL LABORATORY, UNIVERSITY OF COLORADO.]

# ON THE SALTS OF PHTHALIC ACID.

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Received February 12, 1917.

## Introduction.

The decomposition of calcium phthalate under dry distillation has been studied by Miller,[1] and by Panaotovits.[2] The former states that the main products obtained are benzophenone and benzol, together with small

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[1] *J. Russ. Chem. Soc.*, 11, 256 (1879).

[2] *Ber.*, 17, 312 (1884).