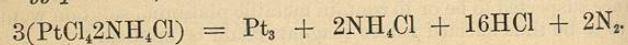


a high degree a quality common to many substances, but largely possessed by platinum, namely, that of absorbing or *occluding* gases. In its ordinary state, after well washing and drying, it absorbs from the air and retains many times its bulk of oxygen. A drop of ether or alcohol placed on it is rapidly oxidized, the platinum becoming hot. This action may be prettily shown by pouring a few drops of ether into a beaker (one having portions of the top and sides broken off answers best), loosely covering the vessel with a card, and suspending within the beaker a platinum wire, one end being attached to the card by passing through its centre, the other terminating in a short coil or helix near the surface of the ether; on now warming the helix in a flame and then rapidly introducing it into the beaker, it will become red hot, and continue to glow so long as there is ether in the vessel. In this experiment real combustion goes on between the ether vapor and the concentrated oxygen of the air, the products of the oxidation revealing themselves by their odor.

Third Analytical Reaction.—To solution of perchloride of platinum add solution of chloride of ammonium; a yellow granular precipitate of double chloride of platinum and ammonium ($\text{PtCl}_4 \cdot 2\text{AmCl}$) falls. When slowly formed in dilute solutions, the precipitate is obtained in minute orange prisms.

Chloride of potassium (KCl) gives a similar precipitate ($\text{PtCl}_4 \cdot 2\text{KCl}$). Platinic chloride having been stated to be a test for potassium and ammonium salts, the reader is prepared to find that potassium and ammonium salts are tests for platinic salts. The double sodium compound ($\text{PtCl}_4 \cdot 2\text{NaCl}$) is soluble in water.

Collect the precipitate, dry, and heat in a small crucible; it is decomposed, and metal, in the finely divided state of *spongy platinum*, remains.



Heat decomposes the potassium salt into $\text{Pt} + 2\text{KCl} + \text{Cl}_2$, the chlorine escaping and the chloride of potassium remaining with the platinum.

In working up the platinum residues of laboratory operations, the mixture should be dried, burnt, boiled successively with hydrochloric acid, water, nitric acid, water, then dissolved in aqua regia, excess of acid removed by evaporation, chloride of ammonium added, the precipitate washed with water, dried, ignited, and the resulting spongy platinum retained or converted into perchloride for use as a reagent for alkali metals. It is by this process that the native platinum is treated to free it from the rare metals palladium, rhodium, osmium, ruthenium, and iridium. The spongy platinum is converted into the massive condition by a refinement on the blacksmith's process of *welding* (German *wellen*, to join), or by fusing in a flame of pure oxygen and hydrogen gases, the oxyhydrogen blowpipe.

Occlusion by Spongy Platinum.—Spongy platinum has great power of occlusion. A small piece held in a jet of hydrogen causes

ignition of the gas, owing to the close approximation of particles of oxygen (from the air) and hydrogen. Döbereiner's lamp is constructed on this principle—the apparatus being essentially a vessel in which hydrogen is generated by the action of diluted sulphuric acid on zinc, and a cage for holding the spongy platinum.

CADMIUM.

Symbol Cd. Atomic weight 111.8.

In most of its chemical relations cadmium (*Cadmium*, U. S. P.) resembles zinc. In nature it occurs chiefly as an occasional constituent of the ores of that metal. In distilling zinc containing cadmium, the latter, being the more volatile, passes over first. In analytical operations, cadmium, unlike zinc, comes down among the metals precipitated by sulphuretted hydrogen; that is, its sulphide is insoluble in dilute hydrochloric acid, while sulphide of zinc is soluble. It is a white malleable metal nearly as volatile as mercury. Sp. gr. 8.7.

Beyond the occasional employment of the sulphide as a pigment (*jaune brillant*), and the iodide in photography, cadmium and its salts are but little used. The atom of cadmium is bivalent (Cd^{++}).

REACTIONS.

Iodide of Cadmium.

First Synthetical Reaction.—Digest together in a flask metallic cadmium, water, and iodine until the color of the iodine disappears; solution of iodide of cadmium (CdI_2) remains. Pearly micaceous crystals may be obtained on evaporating the solution.

This salt is employed, with other iodides, in iodizing collodium for photographic purposes. It melts when heated, and is soluble in water or spirit, the solution reddening litmus-paper.

Sulphate of Cadmium.

Second Synthetical Reaction.—Dissolve cadmium in nitric acid; pour the resulting solution of nitrate of cadmium ($\text{Cd}(\text{NO}_3)_2$) into a solution of carbonate of sodium; dissolve the precipitate of carbonate of cadmium (CdCO_3) in dilute sulphuric acid, separate and crystallize. Sulphate of cadmium (CdSO_4) is a white crystalline salt soluble in water.

First Analytical Reaction.—Through solution of a cadmium salt (CdI_2 or CdCl_2) pass sulphuretted hydrogen; a yellow precipitate of sulphide of cadmium (CdS) falls, resembling in appearance arsenious, arsenic, and stannic sulphides. Add sulphhydrate of ammonium; the precipitate, unlike the sulphides just mentioned, does not dissolve.

Sulphides of cadmium and copper may be separated by solution of cyanide of potassium, in which sulphide of copper is soluble and sulphide of cadmium insoluble.

Second Analytical Reaction.—To a cadmium solution add solution of potash; white hydrate of cadmium (Cd_2HO) is precipitated, insoluble in excess of the potash.

Hydrate of zinc (Zn_2HO), precipitated under similar circumstances, is soluble in solution of potash; the filtrate from the hydrate of cadmium may therefore be tested for any zinc occurring as an impurity by applying the appropriate reagent—sulphydrate of ammonium.

Before the blowpipe-flame, on charcoal, cadmium salts give a brown deposit of oxide of cadmium (CdO).

BISMUTH.

Symbol Bi. Atomic weight 209.

Source.—Bismuth occurs in the metallic state in nature. It is freed from adherent quartz, etc. by simply heating, when the metal melts, runs off, and is collected in appropriate vessels (*Bismuthum*, B. P.). It is also met with in combination with other elements. Bismuth is grayish-white, with a distinct pinkish tinge.

Purification.—Arsenicum may be removed from melted bismuth by a rod of iron, arsenide of iron rising to the surface of the mass; antimony, by stirring in some oxide of bismuth, when oxide of antimony separates. Other metals in bismuth, especially copper, are converted into sulphides, while bismuth is not affected on fusing the crude metal with about 5 per cent. of cyanide of potassium and 2 per cent. of sulphur, the whole being well stirred for a quarter of an hour with a clay rod (stem of a tobacco-pipe). On pouring off the metal from the flux, and melting and stirring it with about 5 per cent. of a mixture of the carbonates of potassium and sodium, sulphur and traces of the impurities are removed and the metal obtained pure (*Bismuthum Purificatum*, B. P.).—*Tamm.*

Uses.—Beyond the employment of some of its compounds in medicine, bismuth is but little used. Melted bismuth expands considerably on solidifying, and hence is valuable in taking sharp impressions of dies. It is a constituent of some kinds of type-metal and of pewter-solder.

The position of bismuth among the metals is close to that of arsenicum and antimony. Its atom is rarely quinquivalent (Bi^V), but in most compounds trivalent (Bi^{III}).

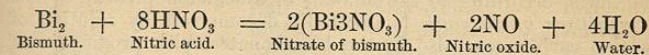
REACTIONS HAVING (a) SYNTHETICAL AND (b) ANALYTICAL INTEREST.

(a) Reactions having Synthetical Interest.

Nitrate of Bismuth.

First Synthetical Reaction.—To a few drops of nitric acid

and an equal quantity of water in a test-tube add a little powdered bismuth, heating the mixture if necessary; nitric oxide (NO) escapes, and solution of *nitrate of bismuth* (Bi_3NO_3) results.

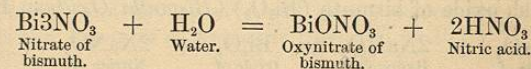


The solution evaporated gives crystals ($\text{Bi}_3\text{NO}_3 \cdot 5\text{H}_2\text{O}$), any arsenicum which the bismuth might contain remaining in the mother-liquor.

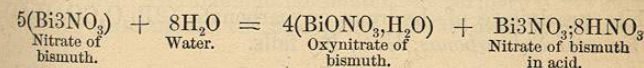
To make *nitrate* of bismuth and other salts on a larger scale, 2 ounces of the metal, in small fragments, are gradually added to a mixture of 4 fluidounces of nitric acid and 3 of water, and, when effervescence (due to escape of nitric oxide) has ceased, the mixture is heated for ten minutes, poured off from any insoluble matter, evaporated to 2 fluidounces to remove excess of acid, and then either set aside for *crystals* to form, or poured into a half gallon of water to form the *oxynitrate* of bismuth, or into a solution of 6 ounces of carbonate of ammonium in a quart of water to form the *oxycarbonate*, as described in the following reactions. The precipitates should be washed with cold water and dried at a temperature not exceeding 150°F . Exposed in the moist state to 212° for any length of time, they undergo slight decomposition.

Subnitrate or Oxynitrate of Bismuth.

Second Synthetical Reaction.—Pour some of the above solution of nitrate into a considerable quantity of water; decomposition occurs, and oxynitrate of bismuth (BiONO_3) in a hydrous state ($\text{BiONO}_3 \cdot \text{H}_2\text{O}$) (*Bismuthi Subnitratis*, U. S. P.) is precipitated:—



Filter, and test the filtrate for bismuth by adding excess of carbonate of sodium; a precipitate shows that some bismuth remains in solution. The following equation, therefore, probably more nearly represents the decomposition:—



Decomposition of nitrate of bismuth by water is the process of the Pharmacopœia for the preparation of oxynitrate or "subnitrate" of bismuth for use in medicine. For this purpose the original metal must contain no arsenicum. In manufacturing the compound, therefore, before pouring the solution of nitrate into water, the liquid should be tested for arsenicum by one of the hydrogen tests; if that element be present, the solution must be evaporated and only

the deposited crystals be used in the preparation of the oxynitrate. For on pouring an arsenical solution of nitrate of bismuth into water, the arsenicum is not wholly removed in the supernatant liquid, unless the oxynitrate be redissolved and reprecipitated several times, according to the amount of arsenicum present.

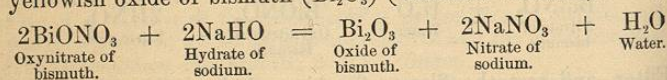
Subnitrate of bismuth is gradually decomposed by solution of alkaline carbonates; also by the bicarbonates, with production of carbonic acid gas, oxycarbonate of bismuth and nitrate of the alkali-metals being formed. It is used as a cosmetic under the name of *Pearl-white* (*Blanc de Perle*).

Oxysalts of Bismuth.—It will be noticed that the formula for subnitrate of bismuth (BiNO_3) does not accord with that of other nitrates, the characteristic elements of which are NO_3 . Analogy would seem to indicate, however, that the fourth atom of oxygen has different functions from the three in the NO_3 ; for on pouring solution of chloride of bismuth (BiCl_3) into water, oxychloride is produced (BiOCl) (a white powder used as a cosmetic, also in enamels, and in some varieties of sealing-wax). The bromide (BiBr_3) and iodide (BiI_3) similarly treated yield oxybromide (BiOBr) and oxyiodide (BiOI). The subnitrate (BiNO_3) is, therefore, probably an analogous compound, an oxynitrate (BiONO_3). The sulphate (Bi_2SO_4) also decomposes when placed in water, giving what may be termed an oxysulphate ($\text{Bi}_2\text{O}_2\text{SO}_4$).

It is difficult to prove whether or not the water in the "subnitrate" or hydrous oxynitrate of bismuth ($\text{BiONO}_3 \cdot \text{H}_2\text{O}$) is an integral part of the salt. If it is, the compound is simply the hydrate-nitrate ($\text{BiNO}_3 \cdot 2\text{HO}$) of bismuth.

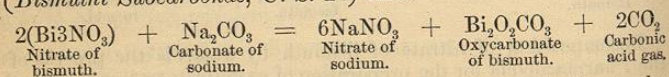
Oxide of Bismuth.

Third Synthetical Reaction.—Boil subnitrate of bismuth with solution of soda for a few minutes; it is converted into yellowish oxide of bismuth (Bi_2O_3) (*Bismuthi Oxidum*, B. P.).



Subcarbonate or Oxycarbonate of Bismuth.

Fourth Synthetical Reaction.—To solution of nitrate of bismuth add carbonate of ammonium or carbonate of sodium; a white precipitate of hydrous oxycarbonate ($2\text{Bi}_2\text{O}_2\text{CO}_3 \cdot \text{H}_2\text{O}$) (*Bismuthi Subcarbonas*, U. S. P.) falls.



This compound may be regarded as similar in constitution to the oxysalts just described. In Bi_2CO_3 one scarcely recognizes the characteristic elements of carbonates; but considering the preparation to be an oxycarbonate ($\text{Bi}_2\text{O}_2\text{CO}_3$), its relations to carbonates and oxides are evident. These subsalts may all be viewed as normal

bismuth salts in which an atom of oxygen displaces an equivalent proportion of other acidulous atoms or radicals:—

Chloride	Bi_3Cl	Oxychloride . .	BiOCl
Bromide	Bi_3Br	Oxybromide . .	BiOBr
Iodide	Bi_3I	Oxyiodide . . .	BiOI
Nitrate	Bi_3NO_3	Oxynitrate . . .	BiONO_3
Sulphate	Bi_2SO_4	Oxysulphate . .	$\text{Bi}_2\text{O}_2\text{SO}_4$
Carbonate (unknown)	Bi_2CO_3	Oxycarbonate . .	$\text{Bi}_2\text{O}_2\text{CO}_3$

They may be viewed, in short, as salts in process of conversion to oxide; continue the substitution a little further, and each yields oxide of bismuth (Bi_2O_3). They have also been considered to be salts of a hypothetical univalent radical, bismuthyl (BiO).

Citrate of Bismuth.

Fifth Synthetical Reaction.—Heat ten parts of oxynitrate of bismuth, seven of citric acid crystals, and thirty to forty of water together for a few minutes, until a drop of the mixture forms a clear solution with ammonia-water. Dilute the crystalline mass with eight to ten times its volume of water, and set aside for a short time to let the citrate deposit; decant the clear liquid. Wash the crystalline sediment three or four times in a similar manner, drain and dry, either on a water-bath or by mere exposure. The yield is $13\frac{2}{3}$ parts, showing that the salt is anhydrous, and that its formula is $\text{BiC}_6\text{H}_5\text{O}_7$ (Rother). This is the *Bismuthi Citras*, U. S. P.

Sixth Synthetical Reaction.—Mix citrate of bismuth with water, add sufficient solution of ammonia to form a clear liquid, filter if necessary, evaporate to a syrupy consistence, spread on glass plates, and dry slowly until pearly scales are obtained. This is the *Bismuthi et Ammonii Citras*, U. S. P.

(b) Reactions having Analytical Interest (Tests).

First Analytical Reaction.—Through solution of a bismuth salt (a slightly acid solution of nitrate, for example) pass sulphuretted hydrogen; a black precipitate of sulphide of bismuth (Bi_2S_3) falls. Add ammonia (to neutralize acid), and then sulphhydrate of ammonium; the precipitate, unlike As_2S_3 and Sb_2S_3 , is insoluble.

Second Analytical Reaction.—Concentrate almost any acid solution of a bismuth salt and pour into water; a white salt is precipitated.

This reaction is characteristic of bismuth salts; it has already been amply explained. The precipitate is distinguished from one formed by antimony under similar circumstances by being insoluble in solution of tartaric acid.

Third Analytical Reaction.—To a solution of a bismuth salt add an alkali; hydrate of bismuth (Bi_3HO) is precipitated, insoluble in excess.

Fourth Analytical Reaction.—A small quantity of the following reagent, including both supernatant liquid and precipitated scales, is transferred to a test-tube and gradually heated until solution takes place. Any liquid containing or supposed to contain bismuth is then added, and the whole allowed to cool. The separated scales will show a distinct change in color to dark orange or crimson according to the quantity of bismuth present.

The reagent may be prepared by adding to a boiling solution of acetate of lead (half a grain to the ounce) a few drops of acetic acid and solution of iodide of potassium in considerable excess. On cooling, iodide of lead is deposited in the characteristic scales.

Test for Phosphate of Calcium in Bismuth Salts.—Dissolve the powder in nitric acid; add about twice its weight of citric acid, and sufficient ammonia to give decided alkalinity; then boil, keeping the mixture faintly alkaline with ammonia: bismuth remains in solution and phosphate of calcium is precipitated.

The reader is again advised to trace out the exact nature of each of the foregoing reactions, chiefly by aid of equations or diagrams.

QUESTIONS AND EXERCISES.

343. Enumerate the fifteen metals, salts of which are frequently employed in pharmacy.
344. Mention the twelve rarer metals interesting to pharmacists.
345. Name the sources and official compounds of lithium.
346. Show by an equation the formation of Citrate of Lithium.
347. What is the strength of *Liquor Lithice Effervescens*?
348. On what chemical hypothesis are lithium compounds administered to gouty patients?
349. Describe the relation of lithium to other metals.
350. What is the chief test for lithium?
351. Write a paragraph on strontium, its natural compounds, chemical relations, technical applications, and tests.
352. What are the formulæ and properties of oxalate of cerium?
353. Name the commonest ores of manganese, and give an equation descriptive of its reaction with hydrochloric acid.
354. Explain the formation of permanganate of potassium, employing diagrams or equations.
355. How do the manganates of potassium act as disinfectants?
356. What are the chief tests for manganese?
357. What are the chief uses of the compounds of cobalt?

358. How is cobalt analytically distinguished from nickel?
359. Mention applications of nickel in the arts.
360. What is the general color of nickel salts?
361. State the method of making red chromate of potassium.
362. Give the formulæ of red and yellow chromates of potassium.
363. How is red chromate of potassium obtained?
364. Describe the action of sulphuretted hydrogen on acidified solutions of chromates.
365. What is the formula of chrome alum?
366. Mention the chief tests for chromium and chromates.
367. How would you detect iron, chromium, and aluminium in a solution?
368. Define tinstone, stream-tin, block-tin, grain-tin, tin-plate.
369. Describe the position of tin in relation to other metals.
370. How does stannic acid differ from metastannic acid?
371. State the applications of tin in the arts.
372. Mention the chief tests for stannous and stannic salts.
373. Name the best antidote in cases of poisoning by tin solution.
374. How is gold-dust separated from the earthy matter with which it is naturally associated?
375. How much pure gold do English coin and jeweller's gold contain?
376. State the average thickness of gold-leaf.
377. What is the weight of a sovereign?
378. Explain the term "fineness" as applied to gold.
379. What effect is produced on gold by hydrochloric, nitric, and nitro-hydrochloric acids respectively?
380. How may metallic gold be precipitated from solution?
381. How is Purple of Cassius prepared?
382. Whence is platinum obtained?
383. Why are platinum utensils peculiarly adapted for use in chemical laboratories?
384. How is perchloride of platinum prepared?
385. Name the chief tests for platinum.
386. What is "platinum black"?
387. Describe an experiment demonstrative of the large amount of attraction for gases possessed by metallic platinum.
388. How is "spongy platinum" produced?
389. By what process may platinum be recovered from residues?
390. What is *occlusion* in chemistry?
391. In what condition does cadmium occur in nature?
392. By what process may iodide of cadmium be prepared?
393. Mention the chief test for cadmium.
394. Distinguish cadmium sulphide from other yellow sulphides.
395. How is cadmium separated from zinc?
396. How does bismuth occur in nature?
397. What is the quantivalence of bismuth?
398. Write down equations descriptive of the actions of nitric acid on bismuth, and water on nitrate of bismuth.
399. How may arsenicum be excluded from bismuth salts?
400. Give a diagram of the process for Carbonate of Bismuth.

401. Write formulæ showing the accordance in composition of the official Subnitrate and Carbonate with the other salts of Bismuth, and with ordinary Nitrates and Carbonates.
402. How is *Bismuthi et Ammonii Citras* prepared?
403. What are the tests for Bismuth?

Practical Analysis.

Bismuth is the last of the metals whose synthetical or analytical relations are of general interest. The position of the rarer among the common metals, and the influence which either has on the other during the manipulations of analysis, will now be considered. These objects will be best accomplished, and a more intimate acquaintance with all the metals be obtained, by analyzing, or studying the methods of analyzing, solutions containing one or more metallic salts.

Of the following Tables, the first (1) includes directions for the analysis of an aqueous or only slightly acid solution, containing but one salt of any of the metals hitherto considered. Here the color of the precipitate or precipitates afforded by a metal under given circumstances must largely be relied on in attempting the detection of the various elements.

The long Table (2) is intended as a chart for the analysis of solutions containing salts of more than one of the common and rarer metals. It is a compilation from the foregoing reactions—an extension of the scheme for the analysis of salts of the ordinary metals. It often may be altered or varied in arrangement to suit the requirements of the analyst.

That on p. 256 is a mere outline of the other two Tables. It gives the position of the metals in relation to each other, and will much aid the memory in recollecting that relation.

The analysis of solutions containing only one metal will, as already stated, serve to impress the memory with the characteristic tests for the various metals and other radicals, and familiarize the mind with chemical principles. Medical and junior pharmaceutical students seldom have time to go further than this. More thorough analytical and general chemical knowledge is only acquired by working on such mixtures of bodies as are met with in actual practice, beginning with solutions which may contain any or all of the members of a group (see previous pages), then examining solutions containing more than one group, and finally analyzing liquids in which are dissolved several salts of any of the common or rarer metals.

The Author cannot too strongly recommend students thoroughly to master the art of analysis, not only on account of its direct value, but because its practice enables the learner rapidly and soundly to acquire a good knowledge of chemistry, and greatly to improve his general mental faculties.

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BIBLIOTECA

1. TABLE OF SHORT DIRECTIONS FOR THE ANALYSIS OF AN AQUEOUS OR ONLY SLIGHTLY ACID SOLUTION OF ORDINARY SALTS OF ONE OF THE COMMON AND RARE METALS HITHERTO CONSIDERED.
Add hydrochloric acid.

Precipitate H ₂ G(ous) Pb Ag. Collect, wash, and add NH ₄ HO.		If HCl gave no precipitate the metal is still in the liquid; pass H ₂ S through the solution.		
Hg ppt., blackened. Pb ppt., still white. Ag ppt., dissolved. Sb and Bi may also be precipitated by HCl, but are dissolv- ed on adding more HCl.	Precipitate Cd Cu H ₂ G(ie) Pb Bi As Sb Sn Au Pt. Collect wash, add NH ₄ HS. Insoluble Soluble. Cd, yellow. As(ous & ie) Cu Sn(ie) Hg(ie) Sb, orange. Pb Sn(ous) Bi Pt } black. }	If H ₂ S gave no precipitate add NH ₄ Cl, NH ₄ HO, and NH ₄ HS.		
Apply special tests for each to the original solution. For these, see the previous pages.		Precipitate Zn Mn Co Ni Al Fe Cr. Zn } white. Al } Cr, green. Mn, skin-tint. Ni } black. Co } Fe }	If NH ₄ HS gave no precipitate, add (NH ₄) ₂ CO ₃ .	
Test specially for each in orig- inal solution. See previous pages.		Precipitate Ba Sr Ca. Collect, wash, dis- solve in HCl, H ₂ O, add K ₂ CrO ₄ .	If (NH ₄) ₂ CO ₃ gave no precipitate, add (NH ₄) ₂ HAsO ₄ .	
Ppt. Ba.		Sol. Sr Ca. Add dil. H ₂ SO ₄ .	If no precip- itate, test orig- inal solution in flame on loop of Pt wire. L, crimson. Na, yellow. K, violet. If neither, test orig. sol. for NH ₄ .	
Ppt. Bi.		Ppt. Cd. Yel- low.	Ppt. Mg.	

2. TABLE OF SHORT DIRECTIONS FOR APPLYING SOME
SA

Add hydrochloric acid.

Precipitate Hg(ous) Pb Ag. Wash, boil with water, filter.			
Precipitate Hg(ous) Ag. Wash, add NH_4HO .	Filtrate Pb. Add H_2SO_4 . White ppt.	Cd Cu Hg(i) Collect, wash	
Ppt. Hg (ous). Black ppt.	Filtrate Ag Add HNO_3 . White ppt.	Precipitate Cd Cu Hg(i) Pb Bi. Wash, boil in HNO_3 , filter.	
See also p. 257.			
Ppt. Hg (ic). Black. Confirm by Cu test in original solution.		Filtrate Cd Cu Pb Bi. Add NH_4HO , filter.	
		Precipitate Pb Bi. Wash, add a few drops HNO_3 , dilute, filter.	Filtrate Cd Cu. Add KCy and H_2S .
		Ppt. Bi.	Filt. Cu. Acidify with $\text{HC}_2\text{H}_3\text{O}$ Brown ppt.
		Filt. Pb. Dilute, add H_2SO_4 , set aside. White ppt.	Ppt. Cd. Yel- low.
See also pp. 257-258.			

3. OUTLINE OF THE ANNEXED ANALYTICAL TABLES.

HCl	H ₂ S	NH ₄ HS	(NH ₄) ₂ CO ₃	(NH ₄) ₂ HAsO ₄	
Hg (as mercurous salt)	Cd	Zn	Ba	Mg	K
Pb (partially)	Cu	Mn*	Sr		Na
	Hg (as mercuric salt)	Co	Ca		NH ₄
Ag	Pb (entirely)	Ni			
	Bi	Al			
	As (as arsenious or arsenic salt)	Fe			L
	Sb				
	Sn (as stannous or stannic salt)	Cr			
	Au				
	Pt				

The laboratory student should practise the examination of aqueous solutions of salts of the above metals until able to analyze with facility and accuracy.

GENERAL AND SPECIAL MEMORANDA RELATING TO THE PRECEDING ANALYTICAL TABLES.

General Memoranda.

These charts are constructed for the analysis of salts more or less soluble in water.—The student has still to learn how substances insoluble in water are to be brought into a state of solution; but, once dissolved, their analysis is effected by the same scheme as that just given. The Tables, especially the second (No. 2), may therefore be regarded as fairly representing the method by which metallic

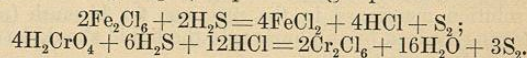
constituents of chemical substances are separated from each other and recognized.—The methods of isolation of the complementary constituent of the salt (the reactions of non-metals and acidulous radicals) will form the next object of practical study.

The general memoranda given in connection with the first Table (p. 219) are equally applicable to the extended second Table, and should again be carefully read through.

Special Memoranda.

The hydrochloric-acid precipitate may at first include some antimony and bismuth as oxychlorides, readily dissolved, however, by excess of acid.—If either of these elements be present, the washings of the precipitate will probably be milky; in that case add a few drops of hydrochloric acid, which will clear the liquid and make way for the application of the test for lead.

The sulphuretted-hydrogen precipitate may be white, in which case it is nothing but sulphur; for, as already indicated, ferric salts are reduced to ferrous, and chromates to the lower salts of chromium by sulphuretted hydrogen, sulphur being deposited:—



But the precipitate may also be colored, or even white when only lead or mercury is present, through an insufficiency of sulphuretted hydrogen having produced a peculiar oxysulphide or hydrato-sulphide. The gas should be passed through the liquid until, even after well shaking, it smells strongly of sulphuretted hydrogen.

The portion of the sulphuretted-hydrogen precipitate dissolved by sulphhydrate of ammonium may include a trace of copper, sulphide of copper being not altogether insoluble in sulphhydrate of ammonium.—On adding hydrochloric acid to the sulphhydrate-of-ammonium solution, a white precipitate of sulphur only may be produced, the sulphhydrate of ammonium nearly always containing free sulphur.—Strong hydrochloric acid does not readily dissolve small quantities of sulphide of antimony out of much sulphide of arsenicum; and, on the other hand, the strong hydrochloric acid takes into solution a small quantity of sulphide of arsenicum if much sulphide of antimony is present. The precipitate or the original solution should therefore be examined by the other (hydrogen) tests for these elements if doubt exists concerning the presence or absence of either. Tin remains in the hydrogen-bottle in the metallic state, deposited as a black powder on the zinc used in the experiment. The contents of the bottle are turned out into a dish, ebullition continued until evolution of hydrogen ceases, and the zinc is taken up by the excess of sulphuric acid employed; any tin is then filtered out, washed, dissolved in a few drops of hydrochloric acid, and the liquid tested for tin by the usual reagents.—Tin may be detected in the mixed sulphides of tin, arsenicum, and antimony by the blowpipe reaction (*vide Index*).

The portion of the sulphuretted-hydrogen precipitate not dissolved by the sulphhydrate of ammonium may leave a yellow semi-