QUALITATIVE ANALYSIS.

(PART 1.)

(1) See Art. **1.**

(2) (*a*) Chromium; (*b*) cobalt; (*c*) manganese. See also Arts. **55, 59,** and **66.**

(3) Aqua regia is a mixture of concentrate nitric and hydrochloric acids. See Art. **23,** 5.

(4) See Art. **2.**

(5) $AgNO_3 + HCl = AgCl + HNO_3$.

(6) See Art. **101.**

(7) Silver, lead, and mercury in the mercurous condition.

(8) (*a*) and (*b*) See Art. **8.**

(9) (*a*) and (*b*) See Art. **8.**

(10) Strontium. See also Art. **73.**

(11) Silver, lead, mercurous, mercuric, and copper.

(12) See Art. **108.**

(13) Manganese. See Art. **67.**

(14) Ferrous, black; ferric, black; cobalt, black; nickel, black; chromium, green; manganese, flesh color; aluminum, white; zinc, white.

(15) Lead, mercurous, barium, strontium, and calcium.

(16) Both metals are precipitated by sodium hydrate, and the precipitate is dissolved in an excess of the reagent. From this solution aluminum is reprecipitated by ammonium chloride, but not by hydrogen sulphide; while zinc is reprecipitated by hydrogen sulphide, but not by ammonium chloride. See Arts. **52,** 2 and **63,** 2.

Another good method of distinguishing between them is to add ammonium chloride and ammonium hydrate to the solution. Aluminum will thus be precipitated from this solution, while zinc will not.

(17) $BaCl_2 + H_2SO_4 = BaSO_4 + 2HCl.$

(18) See Art. **92.**

(19) (*a*) and (*b*) See Art. **4.**

(20) See Art. **94.**

(21) Heating with concentrate sulphuric acid. See Art. **127.**

(22) A sulphide. See Art. **4.**

(23) Aluminum and chromium.

(24) See Art. **146,** 2.

(25) See Art. **93.**

(26) Antimony, stannous, stannic, ferric, and aluminum.

(27) Heating with sodium hydrate. See Art. **81,** 3.

(28) Bismuth and antimony.

(29) Cadmium, arsenious, arsenic, and stannic. Sometimes the sulphide of antimony has a yellowish color.

(30) See Art. **94.**

(31) See Art. **145.**

(32) See Arts. **58,** 6 and **104.**

(33) (*a*) Red.

(*b*) $2SbCl_3 + 3H_2S = Sb_2S_3 + 6HCl.$

(34) This indicates that the compound is a salt of one of the acids of sulphur.

(35) If a solution of calcium sulphate is added, barium, if present, will be precipitated at once, strontium after a little time, and calcium will not be precipitated at all. The solution may be made very dilute, and sulphuric acid used, instead of calcium sulphate, with the same results. The colors imparted to the flame serve well to distinguish between them; or, they may be identified by the method used to separate them. See Art. **105.**

(36) See Art. **146,** 8.

(37) Only manganese and zinc or one of these metals can be present.

(38)

$$\underset{\text{magnesium sulphate}}{MgSO_4} + \underset{\text{sodium phosphate}}{Na_2HPO_4} + \underset{\text{ammonium hydrate}}{NH_4OH} = \underset{\substack{\text{magnesium}\\\text{ammonium}\\\text{phosphate}}}{MgNH_4PO_4} + \underset{\substack{\text{sodium}\\\text{sulphate}}}{Na_2SO_4} + \underset{\text{water}}{H_2O}$$

(39) (*a*) Ag_2O, brown.

(*b*) $Pb(OH)_2$, white.

(*c*) Hg_2O, black.

(*d*) HgO, yellow.

(*e*) $Cu(OH)_2$, blue.

(40) Yellowish green.

(41) See Art. **25,** 5. The intermediate colors may not be seen unless the reagent is added carefully, but the white and the black precipitates are always seen.

(42) Oxalic acid. See Art. **126,** 4.

(43) From acid solutions, copper is precipitated by hydrogen sulphide, while nickel is not.

(44) See Arts. **118,** 1 and **146,** 11.

(45) $2Na_2HAsO_3 + 3H_2S + 4HCl$

sodium arsenite — hydrogen sulphide — hydrochloric acid

$= As_2S_3 + 4NaCl + 6H_2O$

arsenious sulphide — sodium chloride — water

(46) Aluminum and zinc. Manganese gives a light-colored precipitate, but it is not white.

(47) By the addition of an oxidizing agent, such as nitric acid, bromine water, a permanganate, etc.

(48) To hold the metals of the succeeding groups in solution.

(49) The alkalies and alkaline earths.

(50) Mercury, arsenic, tin, and iron. In one sense chromium also forms two series of salts, as it acts both as a base and an acid, forming chromium salts and chromates. The same may be said of manganese.

(51) (*a*) The sharp, disagreeable odor of acetic acid.

(*b*) The pleasant odor of acetic ether.

(52) Lead and mercury.

(53) (*a*) Yellow arsenious sulphide As_2S_3.

(*b*) Ammonia, ammonium sulphide, ammonium carbonate, and hot concentrate nitric or sulphuric acid, but is insoluble in hydrochloric acid.

(54) $Hg_2(NO_3)_2 + 4H_2SO_3 = Hg_2 + 4H_2SO_4 + 2NO.$

(55) It fuses easily to a bright, metallic globule, giving the flame a pale, bluish tinge, and deposits a yellow volatile incrustation on the charcoal.

(56) Cadmium.

(57) See Arts. **111** and **146,** 1.

(58) Arsenic, or one of its compounds.

(59) (*a*) White barium sulphate $BaSO_4$.
(*b*) White barium thiosulphate BaS_2O_3.
(*c*) White barium sulphite $BaSO_3$.

(60) When treated with hydrochloric acid, barium sulphate is not attacked; barium thiosulphate dissolves, giving off sulphur dioxide and throwing out free sulphur, which gives the liquid a yellowish color; and barium sulphite dissolves with the evolution of sulphur dioxide.

(61) Chromic acid and chromates are generally reduced by heating with hydrochloric acid and alcohol, or with sulphurous acid; but other reducing agents may be used.

(62) (*a*) Black mercuric sulphide HgS, together with some free mercury.
(*b*) It dissolves slowly in hot concentrate hydrochloric acid, and readily in aqua regia.

(63) See Art. **9**.

(64) (65) (66) (67) These solutions should be tested for single metals. They are intended to test the student's knowledge of the section on the "Deportment of the Metals with Reagents."

(68) (69) (70) These solutions should be treated as directed for the "Analysis of Mixed Solutions." No. 69 does not contain members of Division B of Group II, and No. 70 does not contain members of Division A of Group II.

(71) (72) (73) (74) (75) Each of these compounds contains one metal and one acid. The metal should be determined by making use of the reactions described under "Deportment of the Metals with Reagents," and the acid by means of the reactions described for the common acids.