

830. Give the characters of disulphate of quinine.
 831. Describe the tests for quinine.
 832. How is the adulteration of disulphate of quinine by salicin detected?
 833. Show how the sulphates of quinine or cinchonine may be proved to be present in commercial quinine.
 834. How are cinchonine and quinine distinguished from morphine?
 835. Whence is strychnine obtained?
 836. Describe the official process for the isolation of strychnine.
 837. Give the characters of strychnine.
 838. Enumerate the tests for strychnine, and describe their mode of application.
 839. By what reagent is brucine distinguished from strychnine?
 840. Distinguish between brucine and morphine.
 841. By what general methods would you distinguish common alkaloids from each other?

Analytical Exercises.—Analyze small quantities of alkaloids, their salts, and various "scale" compounds by aid of the annexed Tables, I. and II.

ALKALOIDS OF LESS FREQUENT OCCURRENCE.

ACONITINE, ACONITINA, or ACONITIA is an alkaloid obtained from aconite (*Aconitum Napellus*) leaves (*Aconiti Folia*, B. P.) and root (*Aconitum*, U. S. P.). The alkaloid itself is only slightly soluble in water; it occurs in the plant in combination with a vegetable acid, forming a soluble salt.

Process.—The process for the preparation of *Aconitine*, B. P., consists in dissolving out the natural salt of the alkaloid from the root by rectified spirit, recovering the latter by distillation, mixing the residue with water, filtering, precipitating the aconitine by ammonia, drying the precipitate and digesting it in ether (in which some of the accompanying impurities are insoluble), recovering the ether by distillation, dissolving the dry residue in the retort in water acidulated by sulphuric acid, again precipitating the alkaloid by ammonia, and finally washing and drying.

Properties.—Aconitine usually occurs as a white powder, but has been obtained and studied in the crystalline state by Groves, Wright, Williams, and others. It is very slightly soluble in cold water, more so in hot, and is much more soluble in alcohol and ether. It is one of the most violent poisons known. "When rubbed on the skin it causes a tingling sensation, followed by prolonged numbness."

The thousandth part of a grain on the tip of the tongue produces, after a minute or so, a characteristic tingling sensation and numbness; larger quantities rubbed into the skin cause numbness and loss of feeling. Sulphuric acid turns it to a yellowish, and afterward dirty-violet, color.

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TABLE FOR THE IDENTIFICATION OF OFFICIAL ALKALOIDS, GLUCOSIDES, ETC.

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(Compiled by F. W. SHORT.)

Dissolve a grain or so in a few drops of water, or dilute hydrochloric acid, and add a drop of Mayer's solution (Mercuric Iodide in Iodide of Potassium), or of Iodide of Bismuth and Potassium.

A precipitate indicates the presence of an alkaloid. No precipitate indicates the absence of an alkaloid. Search must then be made for a glucoside.

A. If the substance is colorless, or nearly so, then :—

To a small quantity on a porcelain plate add strong nitric acid.	Purple-red color,	Apomorphine.	Confirm by ferric chloride and by bicarbonate of sodium and chloroform.
	Blood-red "	Brucine.	" addition of SnCl ₂ .
	Orange-red "	Morphine.	" ferric chloride and other tests.
	" "	Codeine.	" sulphuric acid and ferric chloride.
To another portion add strong sulphuric acid.	Dirty-red "	Veratrine.	See next section.
	Red or brown on plate, deep red if warmed in tube,	Veratrine.	Confirm by heating with strong HCl.
	Bluish tinge,	Codeine.	See previous section.
	Blood-red color,	Salicin (glucoside).	Confirm by oxidation.
If not found by preceding sections, heat a little in a dry tube.	Red vapors,	Quinine.	" thalleioquin, etc.
		Quinidine.	" "
		Cinchonine.	" ether test, etc.
		Cinchonidine.	" "

If not found by aid of the preceding sections, test specially as follows :—

1st. If an alkaloid—

- Strychnine . . . Sulphuric acid and red chromate of potassium.
 Caffeine . . . Murexid test.
 Atropine . . . Alcoholic sol. added to alcoholic sol. of mercuric chloride and warmed—red precipitate.
 Cocaine . . . Permanganate—purple precipitate. Boiled with potash, then *slightly* acidified with hydrochloric acid and cooled—crystalline precipitate.
 Aconitine . . . Make a dilute solution and place a drop on the tongue (numbing and tingling).
 Physostigmine . Warmed with potash gives red color which becomes bluish on evaporation to dryness; the residue dissolved in acid gives a dichroic solution.

2d. If not an alkaloid—

- Santonin . . . Almost insoluble in water, but soluble in alkalies. Dilute ferric chloride with an equal volume of strong sulphuric acid—gives a red or violet color.
 Elaterin . . . With phenol and strong sulphuric acid—a crimson color, changing to scarlet.
 Jalapin . . . (purified).
 Jalap Resin . . Insoluble in water or turpentine. Soluble in alkalies or alcohol, partly in ether. Acrid taste.

Note.—Acids are sought by the ordinary reactions carefully applied on small quantities of the substance.

B. If the substance is colored, seek the aid of the following memoranda :—

1st. If an alkaloid—

- Beberine . . . Very bitter; soda gives yellow precipitate, soluble in ether.

2d. If not an alkaloid—

- Aloin . . . Very bitter; nitric acid gives a red color (sac-aloin a brown). Dissolved in strong sulphuric acid, with addition of a few drops of nitric, and diluted with water, it gives an orange or red color, which is changed to deep claret on addition of ammonia in excess.
 Chrysarobin . . Scarcely soluble in water, soluble in alkalies with fine red color. Strong sulphuric acid gives red-brown color.
 Podophyllin . . Soluble in alcohol and precipitated by water. Soluble in ammonia and precipitated by acids. Taste slightly bitter.
 Jalap Resin . . See above (may be almost white).
 Santonin . . . " (white when fresh, but yellow after exposure to light).

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I. TABLE FOR THE IDENTIFICATION OF THE FOLLOWING ALKALOIDS, ACIDS, ETC.
(Compiled by A. SENIER, M. D.)

MORPHINE. BRUCINE.		SALICIN. STRYCHNINE.		QUININE. QUINIDINE.		CINCHONINE. CINCHONIDINE.		ACIDS. { SULPHURIC. HYDROCHLORIC. PHOSPHORIC.			ACETIC. MECONIC. CITRIC.		
To a small quantity on a white plate add strong nitric acid.		If no Morphine or Brucine, moisten a small quantity on a white plate with strong sulphuric acid.		If Morphine, Brucine, Salicin, and Strychnine are absent, make a saturated solution in hot water and cool down to about 60° F., removing the crystals which have deposited by filtration. If the substance is an alkaloid or an acid salt, it must be neutralized. To one volume of this solution in a test-tube add exactly half a volume of ether and then ammonia solution in slight excess. Agitate and set aside for a quarter of an hour.					Make a solution with a slight excess of nitric acid, divide it into three portions, and test as follows:—			Make a neutral solution, divide it into two portions, and test as follows:—	
An Orange Color, de- colorized by SnCl ₂ , Na ₂ S ₂ O ₃ , or NaHS = Morphine.* Confirm by— Fe ₂ Cl ₆ (neut.), which gives with mor- phine or its salts a blue color. HIO ₃ is de- composed by morphine or its com- pounds, with liberation of iodine, which may be re- cognized by starch.	A Red Color. To a few grains in a test-tube add a drop or two of HNO ₃ ; warm to boil- ing and dilute with water; then add a few drops of stannous chlo- ride. A violet col- or = Brucine.	A deep red color = Salic- cin. Confirm by boiling the substance with water to which has been added a few drops of dilute H ₂ SO ₄ . Then make solution alkali- ne and ex- amine for glu- cose.	No color, or only a slight color. Draw a mois- tened crystal of K ₂ Cr ₂ O ₇ across the acid film when a transient play of colors, violet to red = Strychnine.	Precipitate entire- ly soluble in the ether. To a portion of the saturated aqueous solution add rather more than an equal bulk of ammonia solu- tion (sp. gr. 0.96) and agitate. The precipitate dis- solves completely = Ordinary Sul- phate of Quinine. If precipitate does not dissolve completely, add to another portion of the aqueous solu- tion (NH ₄) ₂ C ₂ O ₄ and agitate (no precipitate at once with ordinary sul- phate of quinine). A bulky crystal- line precipitate = Quinine. Confirm by other reactions (see Quinine).	A crystalline layer between the ethereal and aqueous solu- tions. To a portion of the aqueous solu- tion add Na ₂ C ₄ - H ₄ O ₆ and agitate. A bulky crystalline precipitate = Cin- chonidine. Confirm by other reactions (see Cin- chonidine). If no precipitate or only a trace, add to another portion of the aqueous solu- tion KI. A heavy white precipitate = Quinidine. If the precipitate be semi-liquid, it contains cinchon- idine or other alkalo- ids, the hydro- dates of which are soluble in weak spirit.	Precipitate insoluble in ether = Cin- chon- ine. Confirm by other reactions (see Cin- chonine).	First por- tion. Add BaCl ₂ . A precipitate = Sulphuric Acid.	Second por- tion. Add AgNO ₃ . A precipitate = Hydro- chloric Acid.	Third por- tion. Boil for a time and then add a few drops of an excess of solu- tion of molyb- date of am- monium in HNO ₃ and boil. A yel- low pulveru- lent precipi- tate = Phos- phoric Acid.	First por- tion. Add neutral Fe ₂ Cl ₆ . A red color indicates acetic or me- conic acid. Distinguish. Decolorized by boiling = Acetic Acid. Not decolor- ized by boil- ing = Meconic Acid.	Second por- tion. If no ace- tic or meco- nic acid, add AgNO ₃ . Precipitate (white, with a tendency to darken) sol- ible in HNO ₃ = Citric Acid. Confirm by adding CaCl ₂ to a neutral conc. solution and boiling, when a white precipitate of citrate of cal- cium sepa- rates.		
* Strychnine of commerce often gives an orange or red color, due to contamination with brucine.													

* Strychnine of commerce often gives an orange or red color, due to contamination with brucine.

II. TABLE FOR THE QUALITATIVE ANALYSIS OF ORDINARY SCALE COMPOUNDS.

(Compiled by A. SENIER, M. D.)

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ALKALOIDS. { QUININE. QUINIDINE. BEBERINE.		CINCHONINE. CINCHONIDINE. STRYCHNINE.		ACIDS. { PYROPHOSPHORIC. HYPOPHOSPHOROUS (generally converted into pyrophosphoric). SULPHURIC. HYDROCHLORIC (as a contamination). TARTARIC. CITRIC.		INORGANIC BASES. { AMMONIUM (often as a contamination). FERRIC IRON. POTASSIUM. SODIUM.			
Dissolve a portion in H ₂ O, and add NH ₄ HO cautiously (Precipitate = Alkaloids (except Strychnine) and sometimes Fe ₂ 6HO). Agitate the mixture with a little ether, and separate, by means of a pipette, the ethereal solution, aqueous solution, and insoluble precipitate.				Ignite a small quantity of the scale. Heat the ash with HNO ₃ , and add to an excess of solution of ammonium molybdate in HNO ₃ , and boil.					
ETHEREAL SOLUTION.		INSOLUBLE PRECIPITATE.		AQUEOUS SOLUTION.		A YELLOW PRECIPITATE.		NO YELLOW PRECIPITATE.	
May contain quinine, quinidine, or beberine. To solution in a test-tube add H ₂ O, very slightly acidulated with HC ₂ H ₃ O ₂ and boil, burning off the ether. To a portion of the acetic solution add Cl or Br water and afterward NH ₄ HO.		Is cinchonine, cinchonidine, or Fe ₂ 6HO. Saturate a drop or two of acetic acid in a little water with the precipitate, and to part of the solution add Na ₂ C ₄ H ₄ O ₆ , when a precipitate occurs in the case of cinchonidine, and no precipitate in that of cinchonine.		May contain strychnine. Agitate with CHCl ₃ and separate chloroformic solution. Evaporate chloroformic solution, and moisten residue with concentrated H ₂ SO ₄ . Draw across the acid film a small moistened crystal of K ₂ Cr ₂ O ₇ when a transient play of colors—violet to red—strychnine. No colors = no strychnine. In case of doubt add NH ₄ HO to original solution. Agitate with chloroform, and proceed as before.		Pyrophosphoric or hypophosphorous acid. Precipitate some of the aqueous solution with KHO, filter, neutralize with HNO ₃ and add AgNO ₃ . White precipitate soluble in nitric acid = <i>Pyrophosphoric Acid</i> . White to black precipitate, soluble in nitric acid = <i>Hypophosphorous Acid</i> .		Precipitate some of the aqueous solution with KHO, filter, and add to a portion of the filtrate a slight excess of HNO ₃ and divide into two parts. To one add BaCl ₂ (precipitate = <i>Sulphuric Acid</i>). To the other add AgNO ₃ (precipitate = <i>Hydrochloric Acid</i>). Neutralize another portion of the KHO filtrate with HNO ₃ and add AgNO ₃ .	
GREEN COLOR (thalleioquin).		NO GREEN COLOR.				PRECIPITATE GRAY TO BLACK.		PRECIPITATE WHITE.	
Solution is fluorescent, and contains either quinine or quinidine. Concentrate the remainder of the solution and divide into two parts. To one add KI, and to the other add (NH ₄) ₂ C ₂ O ₄ . KI precipitates quinidine, not quinine. (NH ₄) ₂ C ₂ O ₄ precipitates quinine, not quinidine. For another method, see the third division of the annexed Table (I.) for alkaloids, using 40 or 50 grains of material.		To a portion of the acetic solution add KHO, a yellowish-white precipitate = <i>Beberine</i> .				Add very little NH ₄ HO (not sufficient to dissolve the whole precipitate) and heat. A silver mirror = <i>Tartaric Acid</i> . CaCl ₂ and Ca ₂ HO precipitate neutral solution (if concentrated) in the cold, the precipitate redissolving on boiling.		Citric acid gives no mirror. CaCl ₂ and Ca ₂ HO do not precipitate citric acid in the cold, but upon boiling (if solution be sufficiently concentrated) precipitation occurs.	
						Confirm Tartaric or Citric Acid.—To slightly acidified KHO filtrate add NH ₄ HO in slight excess and considerable quantity of NH ₄ Cl and CaCl ₂ . Tartrates are precipitated completely in the cold with agitation and rest for about ten minutes. To the solution (or filtrate if tartrates are present) add three volumes of spirit of wine, when Citrates are precipitated. If sulphates have been found, disregard slight precipitate with spirit of wine.			

Ammonium.—Boil aqueous solution of scale with KHO and test vapor for NH₃. Filter and dissolve precipitate in HCl, and test the solution for Iron by K₄FeCy₆, KCyS, etc.

Potassium and Sodium.—Ignite a small quantity of the scale, and moisten the residue with water. Test moistened residue with litmus-paper. If alkaline, examine for potassium and sodium by the color imparted to flame, and for potassium by HCl and PtCl₄.

According to Wright, who, in conjunction with Groves and Williams, worked by aid of grants from the British Pharmaceutical Conference, *Aconitum napellus* yields crystalline *aconitine*, $C_{33}H_{43}NO_{12}$, crystalline *pseud-aconitine*, $C_{36}H_{49}NO_{12}$, and a non-crystalline alkaloid.

According to Jürgens, the formula of aconitine is $C_{33}H_{43}NO_{12}$. On allowing an acetic solution containing iodide of potassium to evaporate to dryness, and then adding water, crystals of hydriodate of aconitine of characteristic appearance remain.

The tuberous roots of *Aconitum ferox* and other species constitute the *bish* or *bikh* of India (*Aconiti feroxis Radix*, P. I.). It chiefly contains the variety of aconitine termed *pseud-aconitine*. Some of the aconitine of pharmacy is *pseud-aconitine*. According to Paul and Kingzett, the alkaloid of Japanese aconite has the formula $C_{29}H_{43}NO_9$, while Wright and Menke state that the formula is $C_{66}H_{88}N_2O_8$, and name it *japaconitine*.

Aconitum heterophyllum Atis, or *Atees*, or *Wakhuma* (*Aconiti heterophylli Radix*, P. I.), contains no aconitine, but an alkaloid, *ateesine*, having the formula $C_{46}H_{74}N_2O_5$.

ASPIDOSPERMINE is an alkaloid of *Quebracho blanco* bark (Fraude). Another and different alkaloid is *quebrachine* ($C_{21}H_{26}N_2O_4$) (Hesse). The latter chemist has isolated four other closely-related alkaloids, and two from *Quebracho colorado* bark.

ATROPINE, or **ATROPIA** ($C_{17}H_{23}NO_3$).—This alkaloid has hitherto been considered to exist only in the *Belladonna*, or *Deadly Nightshade* (*Atropa belladonna*; *Belladonnæ Folia et Radix*, U. S. P.), as soluble acid malate of atropine. But the observations of Messrs. Schering and the researches of Will indicate that not atropine, but an isomer of atropine—namely, *hyoscyamine*—is the alkaloid chiefly and solely present, and that the alkaline treatment during the process of extraction converts the *hyoscyamine* into atropine. *Hyoscyamine* solutions rotate a plane polarized ray to the left; atropine has no optical rotatory power. Each similarly affects the eye.

Process.—Atropine is obtained by exhausting the root with spirit, precipitating the acid and some coloring-matter by lime, filtering, adding sulphuric acid to form sulphate of atropine (which is somewhat less liable to decomposition during subsequent operations than the alkaloid itself), recovering most of the spirit by distillation, adding water to the residue, and evaporating till the remaining spirit is removed; solution of carbonate of potassium is then poured in till the liquid is nearly but not quite neutral, by which resinous matter is precipitated; the latter is filtered away, excess of carbonate of potassium then added, and the liberated atropine dissolved out by shaking the liquid with chloroform. The latter solution, having subsided, is removed, the chloroform recovered by distillation, the residual atropine dissolved in warm spirit, coloring-matter separated by digesting the liquid with animal charcoal, the solution filtered, evaporated, and set aside to deposit crystals.

Solubility.—Atropine is sparingly soluble in water, the liquid giving an alkaline reaction—more soluble in alcohol and ether.

Tests.—Atropine solutions give with perchloride of gold a yellow