Physiological Effects.—In small quantities it occasions nausea, vomiting, and ptyalism. Taken into the nostrils it excites sneezing, and sometimes salivation. Stenzel (Wibmer, *Wirk. d. Arzneim.* iii. 66.) mentions a fatal case from its internal use.

Uses.—It is sometimes used as an emetic in cases of swelled testicle, to promote absorption by its nauseating and emetic action. (*Observ. on the Dublin Pharmacopœia.*) It was formerly given at the commencement of a mercurial course. As an errhine it has been administered in chronic ophthalmia and affections of the brain; as incipient hydrocephalus. As an alterative it has been given in the scaly diseases (lepra and psoriasis.)

Administration.—As an alterative, the dose should not exceed half a grain, or at most a grain. As an emetic, it is given to the extent of five grains; in which dose it causes violent vomiting. As an errhine, a grain should be mixed with four or five of some mild powder, as starch or liquorice powder. It is rarely given for any other purposes.

## Order XXII.—COPPER AND ITS COMPOUNDS.

### 1. CU'PRUM.—COPPER.

History.—*Cuprum*, or *Copper*, received its name from Κυπρος, from the island of Cyprus, where it was first discovered, or at least worked to any extent. It seems to have been known in the most remote ages of antiquity, for Moses (Job, ch. xxviii.) speaks of brass (an alloy of copper and zinc.) The alchymists called it *Venus*.

Natural History.—It is found in both kingdoms of nature.

α. In the Inorganized Kingdom.—Copper is found in the metallic or reguline state, combined with oxygen, with sulphur, with selenium, with chlorine, or with oxygen and an oxyacid (carbonic, arsenic, phosphoric, sulphuric, or silicic.)

β. In the Organized Kingdom.—It has been discovered in the ashes of most plants, as of Stavesacre, Rhatany, Flax, Nux-vomica, Hemlock, &c. Sarzeau has detected it in the blood of animals. (*Ann. de Chim.* xliv. 334.)

Preparation.—The copper of commerce is usually prepared from *copper pyrites* (the double sulphuret of copper and iron.) The greater part of the ore raised in Cornwall is of this kind. It is roasted and then smelted, by which *coarse metal* is produced. This is calcined and again smelted, by which we obtain *fine metal*, or, when cast in sand, *blue metal*. By re-roasting and smelting, *coarse copper* is produced. These processes, of roasting and smelting, effect the expulsion of the sulphur and the oxidizement of the iron. The copper thus produced is melted and exposed to the air, to drive off any volatile matters by which *blistered copper* is obtained. It is *refined* or *toughened* by melting it and stirring with a birchpole. (J. H. Vivian, *Ann. of Philosophy*, N. S. vol. v. p. 113.)

Properties.—It is a brilliant, red metal, crystallizable in regular octohedra and cubes, having a specific gravity of 8·86 to 8·89; malleable and ductile; it has a nauseous, styptic taste, and a peculiar and disagreeable smell. It fuses at 1996° F. (*Daniell;*) at a higher temperature it may be volatilized. Its equivalent is 32. It is combustible, and is readily oxidated. Acid, alkaline, saline, and fatty bodies, when placed in contact with it in the air, promote its union with oxygen; and, by dissolving a portion of the newly-formed oxide, acquire poisonous properties.

*Characteristics.*—Copper is easily recognised by its colour, and by its communicating a green tinge to flame. It dissolves in diluted nitric acid: the solution possesses the following properties:—It is blue, or greenish-blue; with potash or soda it yields a blue precipitate (*hydrated oxide of copper;*) a small quantity of

ammonia produces with it a similar bluish-white precipitate, but an excess redissolves it, forming a deep blue liquid (*cuprate of ammonia:*) ferrocyanide of potassium occasions in it a reddish-brown precipitate (*ferrocyanide of copper;*) the hydrosulphurets throw down a precipitate (*sulphuret of copper;*) and, lastly, a polished iron plate plunged into the liquid, becomes coated with metallic copper.

Physiological Effects. *α.* **Of Metallic Copper.**—Metallic copper appears to produce no pernicious effects when taken internally, so long as it retains its metallic state, as many cases are recorded where coins of this metal have been swallowed, and retained for a considerable time, without any ill effects arising; and Drouard (*Exper. et Observ. sur l'Empoisonnem. par l'Oxide de Cuivre.* Paris, 1802.) gave as much as an ounce of finely-powdered copper to dogs of different ages and sizes, but none of them experienced any inconvenience therefrom.

Notwithstanding these facts, however, various effects have been attributed to it. Thus, Cothenius (Voigtel, *Arzniemittellehre.*) says, copper filings operate by stool, urine, and saliva; and the late Professor Barton (Chapman, *Elem. of Therap.* ii. 457.) was accustomed to relate an instance of a child, who, having swallowed a cent, continued for some time to discharge several pints of saliva. Lastly, Portal (Orfila, *Toxicol. Gén.*) mentions a case in which copper filings, incorporated with crumb of bread, acted powerfully on the system. I have no doubt but that the effects here mentioned arose from the oxidation of the metal by the acids of the alimentary canal.

*β.* **Of the Cupreous Compounds.**—Most, if not all, the preparations of copper are poisonous in large doses. The sulphuret and ferrocyanide are doubtful exceptions to this statement. If the cupreous preparations be used in *very small* doses, they sometimes give relief in certain diseases (principally of the nervous system,) without obviously disordering the functions; in other words, in these instances the only apparent effect is the modification observed in the morbid condition. These are cases in which these preparations have been termed *tonic*, *antispasmodic*, or *alterative*, according to the nature of the disease; thus, in ague they have been termed tonic, in epilepsy antispasmodic, in dropsy alterative. The beneficial operation is presumed to be owing to some influence exerted by the remedy over the nervous system. The effects produced by the long-continued use of small doses of the preparations of copper have not been satisfactorily determined; they are said to be various affections of the nervous system (such as cramps or paralysis,) alteration of the colour of the skin, chronic inflammation of the respiratory and digestive apparatus, slow fever, and wasting of the body. These symptoms constitute what has been termed *slow*, or *chronic poisoning by copper*. The smelters and workers in copper do not suffer from the vapour or emanation of this metal, as the workmen employed in the preparation of mercury, of arsenic, or of lead do, from the vapours of these metals: this, indeed, might be expected, when we consider how much more volatile the latter and their preparations are, than copper and its compounds. In *larger*, or full medicinal doses, these remedies act as *emetics*, exciting speedy vomiting, with less nausea than tartar emetic produces. In *still larger* quantities, these bodies act as poisons, giving rise to gastro-intestinal inflammation, and disordering the functions of the nervous system (especially the cerebro-spinal portion,) constituting *acute poisoning by copper*. The usual symptoms are, a coppery taste, eructations, violent vomiting and purging, griping pains, cramps in the legs and thighs, headach, giddiness, convulsions, and insensibility: jaundice is occasionally observed. In some cases the cerebro-spinal symptoms precede those which indicate inflammation of the alimentary canal. In experiments made on animals, it has been observed that death was sometimes produced without any marks of local irritation; the symptoms being those indicative of a disordered condition of the nervous system. By some toxicologists these preparations are ranked among the

*irritant* poisons, though Buchner, (*Toxicologie.*) judging from Reiter's experiments, terms them astringent.

Drouard, and others, were of opinion that the preparations of copper did not become absorbed, but Lebkuchner (Christison, *Treatise on Poisons*, 3d ed. 433.) has detected copper in the blood of the carotid artery of a cat, into whose bronchial tubes he had injected four grains of the ammoniacal sulphate; and Wibmer (*Wirk. d. Arzn.* ii. 244.) has found it in the liver of animals to whom he had given the acetate for several weeks.

*Post-mortem appearances.*—In animals killed rapidly by these poisons, no morbid appearances are found, in consequence of death being produced by their action on the nervous system: but when the death was slow, marks of gastro-intestinal inflammation, and occasionally indications of inflammation of the brain, have been observed.

Uses. *α.* **Of Metallic Copper.**—Copper filings, in doses of three or four grains, were formerly used in rheumatism, and also as an antidote against the effects of the bite of a mad dog.

*β.* **Of the Cupreous Compounds.**—These preparations are used both as external and as internal remedies; externally, as stimulants, astringents, styptics, and caustics; internally, as emetics, tonics or antispasmodics, and astringents. The particular cases will be noticed when treating of the individual preparations.

Antidotes.—The chemical antidote for the cupreous preparations is *albumen;* hence, the whites of eggs, and in the absence of these, milk, or even wheaten flour, should be employed. *Iron filings* have been proposed by Navier, by Payen and Chevallier, and subsequently by Dumas and Milne Edwards. The iron decomposes the cupreous salt, and precipitates the copper in the metallic (and, therefore, in an inert) state. The *ferrocyanide of potassium* is also said to be a good antidote: a drachm or two of it may be taken with safety, for it is not so poisonous as was at one time imagined. *Sugar* was proposed by Marcelin Duval as an antidote; its efficacy, though denied by Orfila and Vogel, has been lately reasserted by Postel. The alkaline sulphurets formerly used are worse than useless, since they are active poisons. The inflammatory symptoms are of course to be subdued by the usual means. (For farther details on this subject consult Christison's *Treatise on Poisons.*)

### 2. CU'PRI SUL'PHAS, *L. E. D.* (U. S.)—SULPHATE OF COPPER.

History.—This substance was probably employed by Hippocrates, (*De ulceribus.*) under the name of χαλκιτις κυανη (*Chalcitis cærulea,*) to promote the healing of ulcers. Pliny (*Hist. Nat.* xxxiv. 32.) also was doubtless acquainted with it, though he seems to have confounded it with sulphate of iron. His *Chalcanthum Cyprium* was, perhaps, sulphate of copper. This salt has had various other names, such as *Blue Vitriol* (*Vitriolum cæruleum,*) *Roman Vitriol, Blue Copperas, Blue Stone, Bisulphate of Copper.*

Natural History.—It occurs in copper mines (as those of Cornwall, &c.) and is formed from sulphuret of copper by the joint agency of air and water. The cupreous solutions of copper mines are termed *waters of cementation.*

Preparation.—It may be prepared by evaporating the water found in, or issuing from, copper mines. It is also produced by roasting copper pyrites, lixivating the residuum to dissolve the sulphate, and evaporating so as to obtain crystals. In this process both the sulphur and the copper of the pyrites abstract oxygen from the air, and become, the one sulphuric acid, the other oxide of copper: these by their union constitute the sulphate of copper.

Sulphate of copper is "occasionally prepared by dissolving in sulphuric acid an oxichloride of copper made for the purpose, by exposing sheet copper to the joint action of air and hydrochloric acid." (Brande's *Manual of Chemistry*, 5th edit.) It is also obtained in large quantities in certain processes for refining gold and silver.

For the following information respecting its production at the Mint I am indebted to the kindness of Professor Brande:—

"A large quantity of sulphate of copper is occasionally obtained here, as follows:—When ingots of silver are found to contain a certain quantity of gold, they are melted, granulated, and boiled in sulphuric acid, by which sulphate of silver is formed, and the gold remains in a pulverulent form: the sulphate of silver is then decomposed by the immersion of copper plates; the silver is precipitated in a fine crystalline powder, washed, pressed into masses, and melted, and so affords pure silver, which is afterwards made standard by alloying it with copper, and used for the coinage: the resulting sulphate of copper is then crystallized and sold.

"When gold ingots contain a certain quantity of silver, they undergo a similar process. Suppose a certain number of ingots of gold to contain 2 or 3 per cent. of silver,—instead of leaving it, as formerly, to constitute a part of the standard alloy, it pays to extract it, and substitute copper in its place. To get the silver out of the said ingots they are melted with about 3 parts of silver,—the resulting alloy is granulated and boiled in sulphuric acid,—the gold remains untouched,—and all the silver is dissolved and converted into sulphate, which is decomposed by copper as before; so that here again sulphate of copper is obtained.

Properties.—This salt occurs in fine blue crystals, whose form is the doubly oblique prism. Its sp. gr. is 2·2. It has a styptic metallic taste, and reacts on litmus as an acid. By exposure to the air it effloresces slightly, and becomes covered with a greenish-white powder. When heated it loses its water of crystallization, and becomes a white powder (*pulvis sympatheticus.*) By a very intense heat it is decomposed,—sulphurous acid and oxygen are evolved, and oxide of copper left. It dissolves in about 4 parts of water at 60°, and two parts of boiling water. It is insoluble in alcohol.

*Characteristics.*—Its characteristics are those of the sulphates (*vide* p. 406,) and of the cupreous compounds (*vide* p. 638.)

Composition.—Its composition is as follows:—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Thomson.* | *Berzelius.* |
|---|---|---|---|---|---|
| Oxide of Copper | 1 | 40 | 32 | 32 | 32·13 |
| Sulphuric Acid | 1 | 40 | 32 | 32 | 31·57 |
| Water | 5 | 45 | 36 | 36 | 36·30 |
| Crystallized Sulphate of Copper | 1 | 125 | 100 | 100 | 100·00 |

Impurity.—The commercial sulphate of copper sometimes contains traces of sulphate of iron. It may be detected by excess of ammonia, which throws down the oxide of iron, but dissolves the oxide of copper.

In the air it becomes slightly pulverulent, and of a greenish colour. It is totally soluble in water. Whatever ammonia throws down from this solution an excess of ammonia dissolves. *Ph. Lond.*

Physiological Effects. α. *On Vegetables.*—It is poisonous to plants: (De Candolle, *Phys. Vég.* 1335.) hence its use in preventing dry rot (*Merulius lachrymans,*) by soaking timber in it, according to Mr. Margary's patent; and in destroying or preventing the Smut (*Uredo segetum,*) or Bunt (*U. caries,*) in corn, by immersing the grain in a weak solution of it: the solution is not made sufficiently strong to injure the seed.

β. *On Animals.*—This salt operates as a poison to animals. Six grains killed a dog in half an hour, without producing any appearance of inflammation (Drouard.) Applied to a wound it destroyed the animal in twenty-two hours, and the body was every where in a healthy state. (Duncan, in Christison *on Poisons*, 432.) Orfila (*Toxicol. Gén.*) also found that it proved fatal in a few hours when applied to wounds. The only symptoms mentioned are dulness, loss of appetite, and sometimes purging. Inflammation of the mucous membrane of the stomach and rectum was found after death.

γ. *On Man.*—In *very small doses* it has no sensible operation on the body, though it occasionally ameliorates certain diseases, such as epilepsy and ague: in these cases it has been denominated an antispasmodic and tonic. The local

action on the alimentary tube is that of an astringent. Dr. Elliotson (*Lond. Med. Gaz.* xii. 557.) has known a patient to take it for three years, for a particular kind of diarrhœa, without any constitutional effect. I have administered six grains thrice a-day for several weeks, in an old dysentery, without any other obvious effect than slight nausea and amelioration of the disease for which it was given. In *larger doses* it is a safe and useful emetic, acting very speedily, and without exciting any great disorder of the general system. In *excessive doses* it becomes a poison, producing inflammation of the alimentary canal, and disordering the functions of the nervous system, as noticed when describing the action of the cupreous preparations generally. In a case mentioned by Dr. Percival, (*Transactions of the London College of Physicians*, iii. 88.) two drachms proved fatal; the patient was violently convulsed. In a more recent case (*Lond. Med. Gaz.* xviii. 624 and 742.) there were vomiting and insensibility, but no convulsions or purging: the child died in four hours.

Its topical action is stimulant, astringent, styptic, and caustic. Its causticity depends on its union, either as a neutral or basic salt, with one or more of the constituents of the tissues. Thus it combines with albumen to form a pale bluish green compound, which produces with caustic potash a violet-coloured solution. (Dr. C. G. Mitscherlich, *Brit. Ann. of Med.* i. 751 and 817, and ii. 51.) According to Lassaigne (*Journal de Chim. Méd* t. vi. 11e Séries.) the bluish white precipitate which sulphate of copper occasions in a solution of albumen, is composed of *albumen* 90·1, and *sulphate of copper* 9·9.

Uses.—Where speedy vomiting without much nausea is required, as in cases of narcotic poisoning, sulphate of copper is a tolerably sure and valuable *emetic*. It has also been used, with success, to provoke vomiting in croup, and thereby to promote the expulsion of the false membrane. (*Brit. and For. Med. Rev.* i. 568.)

As an *astringent* it has been used with great benefit in chronic diarrhœa and dysentery. (Elliotson, *Lond. Med. Gaz.* viii. 378, and xii. 577; also *Med. Chir. Trans.* xiii. 451.) It often succeeds where the ordinary vegetable astringents fail. It should be given in doses of from half a grain to two or more grains twice or thrice a-day, in combination with opium. I have employed it with most excellent effects in the old diarrhœas of infants, in doses of $\frac{1}{12}$ of a grain. The largest dose I have given to an adult is six grains, as above mentioned. It is also used as an astringent to check excessive secretion from the bronchial and urino-genital mucous membranes. Dr. Wright (*Lond. Med. Journ.* i. and x.) found it serviceable in dropsy.

As a *tonic* or *antispasmodic* it has been given in intermittent diseases, as the ague; and in some maladies of the nervous system (epilepsy and chorea.) In epilepsy it has recently been strongly recommended by Dr. F. Hawkins. (*Lond. Med. Gaz.* viii. 183.)

As a *topical* agent, it is often employed in substance as an application to ulcers, either for the purpose of repressing excessive soft and spongy granulations, commonly denominated "proud flesh," or of hastening the process of cicatrization: and for either of these purposes it is one of the best agents we can employ. Solutions of it are frequently applied to mucous membranes, to diminish excessive secretion: thus to the conjunctiva, in chronic ophthalmia, and to the mucous lining of the vagina or urethra, in discharges from these parts. In superficial ulcerations of the mucous membranes (especially of the mouth) one or two applications of the sulphate of copper, in substance, are generally sufficient to heal them.

As a *styptic* a solution of this salt is sometimes used to repress hemorrhages from a number of small vessels. Rademacher applied with good effect brandy impregnated with sulphate of copper in a case of alopecia, or baldness, which occurred in a young man; but it failed in the hands of Dr. T. J. Todd. (*Cyclop. of Pract. Med.* i. 52.)

Administration.—The dose of it, as an *emetic*, is from three or four grains to fifteen; as an *astringent*, or *tonic*, from a quarter of a grain to one, two, or more grains, given so as not to occasion vomiting. Solutions used for external purposes vary considerably in their strength in different cases, but usually from one or two grains to eight or twelve, dissolved in an ounce of water, are employed.

Antidotes.—Vide *Cuprum*.

### 3. AMMONIÆ CUPRO-SULPHAS.—CUPRO-SULPHATE OF AMMONIA.

{Cupri Ammonio-Sulphas, *L.*—Cuprum Ammoniatum, *E. D.*)—[U. S.]

History.—Boerhaave was acquainted with an ammoniacal solution of copper. In 1757 Weissman gave imperfect directions for its preparation. In 1799 Acoluth published a better process. Dr. Cullen introduced this substance into practice in this country. It is usually called *Ammoniated Copper*, or *Ammoniuret of Copper* (*Cupri Ammoniaretum.*)

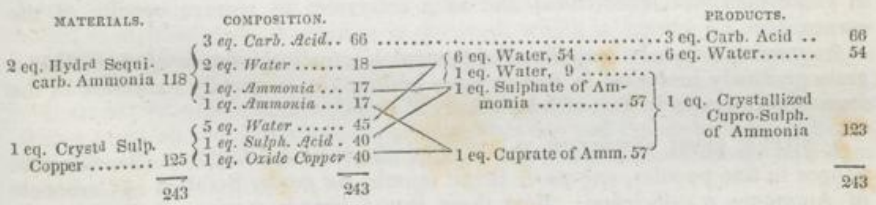
Preparation.—All the British Colleges give directions for its preparation.

The *London College* orders of Sulphate of Copper, ℥j.; Sesquicarbonate of Ammonia, ʒiss. Rub them together until Carbonic Acid ceases to evolve; then dry the Ammonia-sulphate of Copper, wrapped in bibulous paper, in the air. [The same proportions are directed by the U. S. Pharmacopœia.]

The directions of the *Edinburgh College* are essentially similar; with the addition that the product is to be preserved "in closely-stoppered bottles."

The *Dublin College* employs of Sulphate of Copper, *two parts*; Carbonate of Ammonia, *three parts*.

The *theory* of the process is imperfectly understood. The proportions of ingredients employed are about two equivalents of sulphate and three and one-fifth equivalents of sesquicarbonate. When rubbed together, these salts give out part of their water of crystallization, by which the mass becomes moist; and, at the same time, a portion of carbonic acid of the sesquicarbonate escapes, producing the effervescence alluded to; and the compound becomes of a deep azure-blue colour. This colour is probably owing to cuprate of ammonia; for oxide of copper with caustic ammonia forms a similarly-coloured liquid. If this notion be correct, the decomposition may be thus explained:—Two equivalents or 118 parts of hydrated sesquicarbonate of ammonia react on one equivalent or 125 parts of crystallized sulphate of copper, and produce one equivalent or 57 parts of sulphate of ammonia, seven equivalents or 63 parts of water, and three equivalents or 66 parts of carbonic acid. The cuprate and sulphate of ammonia with one equivalent of water represent the crystallized cupro-sulphate of ammonia (*Cuprum ammoniacale* of some authors.)




Properties.—It has a deep azure-blue colour, a styptic metallic taste, and an ammoniacal odour. It reacts on vegetable colours as an alkali: thus it reddens turmeric, and restores the blue colour of litmus, which has been reddened by an acid. By exposure to the air, ammonia is evolved, and a green powder is left, composed of sulphate of ammonia and carbonate of copper. To prevent this, therefore, it should be preserved in a well-stoppered bottle. It is soluble in water; but unless excess of sesquicarbonate of ammonia be present, the solution, when much diluted, lets fall a subsulphate of copper. Cupro-sulphate of am-

monia crystallizes in large, right rhombic prisms, which Dr. Kane (*Elements of Chemistry*, p. 833. Dublin, 1841.) considers to be macles.

*Characterstics.*—Dissolved in water it forms a green precipitate (*arsenite of copper*) with a solution of arsenious acid. When heated, all its constituents are dissipated, save the oxide of copper. Boiled with caustic potash a solution of sulphate of potash is obtained, the hydrated oxide of copper is thrown down, and ammonia is disengaged. Sulphuric acid may be recognised in the solution by the barytic salts.

By heat it is converted into oxide of copper, evolving ammonia. Dissolved in water, it changes the colour of turmeric, and solution of arsenious acid renders it of a green colour. *Ph. Lond.*

Composition.—The essential part of this compound is the cupro-sulphate of ammonia. This, in the crystalline state, has the following composition:—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Berzelius.* | *Brandes.* |
|---|---|---|---|---|---|
| Oxide of Copper | 1 | 40 | 32·52 | 34·00 | 33·017 |
| Ammonia | 2 | 34 | 27·64 | 26·40 | 21·410 |
| Sulphuric Acid | 1 | 40 | 32·52 | 32·25 | 31·753 |
| Water | 1 | 9 | 7·32 | 7·35 | 13·358 |
| Crystd Cupro-sulphate of Ammonia | 1 | 123 | 100·00 | 100·00 | 99·538 |

Ammoniated Copper of the pharmacopœias usually contains some undecomposed sesquicarbonate (bicarbonate?) of ammonia, and probably some sulphate (subsulphate?) of copper.

Physiological Effects.—Its action is, for the most part, similar to sulphate of copper. Wibmer (*Wirk. d. Arzneim.* ii. 256.) examined its effects on horses and dogs. Four grains dissolved in water, and injected into the veins, killed a dog. The respiration and circulation were quickened by it. In some cases vomiting and purging were produced; weakness, tremblings, and paralysis, indicated its action on the nervous system. Its general effects on man are like those of sulphate of copper, but it is thought to be less disposed to occasion nausea and vomiting. An over-dose, however, readily acts as an emetic. Its action is probably somewhat more stimulant to the general system than the sulphate. It is employed in medicine as a tonic and antispasmodic.

Uses.—*Internally* it has been principally employed in chronic spasmodic affections; such as epilepsy, chorea, hysteria, spasmodic asthma, and cramp of the stomach. In epilepsy it has been much esteemed, and was found useful by Dr. Cullen, (*Treat. on Mat. Med.*) and other accurate observers; but, like all other remedies for this disease, it frequently fails. It has also been used in ague and dropsy. As a *topical* remedy, a solution of it has been employed as an injection in gonorrhœa and leucorrhœa; and as a collyrium to remove opacity of the cornea.

Administration.—It may be administered internally in doses of from half a grain gradually increased to five or more grains. It is usually exhibited in the form of pill; rarely in that of solution.

1. PILULÆ CUPRI AMMONIATI, E. *Pills of Ammoniated Copper.* (Ammoniated copper in fine powder, *one part;* Bread crumb, *six parts;* Solution of Carbonate of Ammonia, *a sufficiency.* Beat them into a proper mass; and divide it into pills, containing each half a grain of ammoniated copper.) Dose from one to five or six pills in the before-mentioned cases.

2. LIQUOR CUPRI AMMONIO-SULPHATIS, L.; *Cupri Ammoniati Solutio*, E.; *Cupri Ammoniati Aqua*, D.; *Solution of Ammoniated Copper; Aqua Sapphirina.* (Ammonio-sulphate of Copper, 3j.; Distilled Water, Oj. Dissolve the Ammonio-sulphate of Copper in the water, and strain. *L. E.*—The *Dublin College* uses of Ammoniated Copper, *one part;* Distilled Water, *one hundred parts.*) This

solution is applied to indolent ulcers as a stimulant and detergent; and, when diluted, to the eye, to remove slight specks of the cornea.

### 4. CU'PRI SUBACE'TAS, *D.* (U. S.)—SUBACETATE OF COPPER.

(Ærugo; Diacetas Cupri impura, *L.*—Ærugo; Commercial Diacetate of Copper, *E.*)

History.—Hippocrates employed *Verdigris*, which he terms χαλκου ιος, or *Rust of Copper*, in diseases of the eyes, and as an astringent in hæmorrhoids. (*Opera*, Ed. Fæs. 635, 636; and 894.) Theophrastus, (*De Lapidibus*) Dioscorides, (Lib. v. cap. xci.) and Pliny, (*Hist. Nat.* xxxiv.) describe the method of procuring it. The Romans called it *Ærugo*. It is frequently termed *Diacetate of Copper*: but this name is objectionable, since verdigris frequently occurs as a *Subsesquiacetate* mixed with the *Trisacetate*. I prefer the less precise, though more accurate term, *Subacetate of Copper*.

Preparation.—At Montpelier it is thus made:—The refuse of grapes is allowed to ferment with sour wine, and is then laid in alternate strata with plates of copper: acetous fermentation takes place, and the metal becomes oxidized by the combined influence of the air and acid. In about fifteen days the plates are covered with the acetate of copper: they are then wetted, and exposed for a month to the air: the acetate absorbs the water, and uniting with more oxide of copper, forms a subacetate, which is scraped off, and packed in leathern sacks for exportation. At Grenoble verdigris is obtained by sprinkling plates of copper with ready-made vinegar. (Dumas, *Traité de Chim.* v. 169.)

In this country it is prepared by exposing thin plates of copper to the action of acetic acid: the method now practised consists in alternating plates of copper with pieces of woollen steeped in acetic acid; they gradually become corroded, and superficially covered with verdigris, which is from time to time removed, and the operation repeated, as long as the plate lasts. (Brande's *Manual of Chemistry.*) French verdigris is imported in sacks, weighing from 25 to 30 pounds.

Properties.—It occurs in masses or in powder. One variety is of a pale bluish green colour; another is blue. Its taste is astringent and metallic; its odour is somewhat similar to, though more disagreeable, than acetic acid. It is insoluble in alcohol. Water resolves it into a soluble acetate and an insoluble trisacetate.

*Characteristics.*—When digested with strong sulphuric acid, it evolves acetic acid, which is readily distinguished by its odour. Heated in a glass tube it gives out acetic acid: the residue contains metallic copper. If verdigris be boiled in distilled water a solution is obtained, which is known to contain copper by its colour, and by the before-mentioned tests for its cupreous compounds (*vide* p. 638.)

Composition.—The blue verdigris is a hydrated diacetate of copper. Verdigris with a greenish tint consists of the subsesquiacetate and the trisacetate. (Berzelius, *Traité de Chimie*, iv. 347 and 349.) The composition of these salts is as follows:—

| | Diacetate. | | | Subsesquiacetate. | | | Trisacetate. | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Atoms.* | *Eq. Wt.* | *Per Ct.* | *Atoms.* | *Eq. Wt.* | *Per Ct.* | *Atoms.* | *Eq. Wt.* | *Per Ct.* |
| Oxide of copper | 2 | 80 | 43·24 | 1½ | 60 | 43·48 | 3 | 120 | 63·5 |
| Acetic Acid | 1 | 51 | 27·57 | 1 | 51 | 36·96 | 1 | 51 | 27·0 |
| Water | 6 | 54 | 29·19 | 3 | 27 | 19·56 | 2 | 18 | 9·5 |
| | 1 | 185 | 100·00 | 1 | 138 | 100·00 | 1 | 189 | 100·0 |

Purity.—The following are the characters of its purity given by the London and Edinburgh Colleges:—

May be partly dissolved in water, and is almost entirely soluble either in ammonia, or with the assistance of heat, in diluted sulphuric acid. *Ph. Lond.*

It is dissolved in a great measure by muriatic acid, not above five per cent. of impurity being left. *Ph. Edinb.*

Chalk and sulphate of copper are employed to adulterate verdigris. The first effervesces with the mineral acids. The characteristics of the second have been before pointed out (p. 640.)

Physiological Effects.—The action of verdigris on the system is very similar to that of the other preparations of copper: thus, taken in small and repeated doses, it acts on the nervous system, and is called tonic and antispasmodic; in larger doses it acts as an emetic; and, in excessive doses, is a powerful poison, producing both gastro-enteritis, (indicated by vomiting, purging, and pain,) and an affection of the nervous system (marked by insensibility, convulsions, and even tetanus.)

Uses.—Verdigris, when taken into the stomach, being variable and dangerous in its operation, is never administered internally. It was formerly employed in obstinate syphilis, when mercurials failed.

The *powder* is sometimes employed as an escharotic. It is sprinkled over foul and indolent ulcers, or, when mixed with savin, is applied to destroy venereal warts. When used for the latter purpose it rarely fails.

1. CUPRI SUBACETAS PRÆPARATUM, D.; *Prepared Verdigris.* (Let the Subacetate of Copper be triturated into powder, and let the finest parts be separated by the mode directed for the preparation of chalk.) The object of this process is to obtain a very fine powder. The water, however, effects a chemical change on the verdigris, and converts it into a soluble acetate and an insoluble trisacetate.

2. LINIMENTUM ÆRUGINIS, L. *Oxymel Cupri Subacetatis*, D. *Mel Ægyptiacum; Unguentum Ægyptiacum; Oxymel Æruginis.* (Verdigris, powdered, ʒj.; Vinegar [distilled, *Dubl.*] fʒvij.; Clarified Honey, ʒxiv. Dissolve the verdigris in the vinegar, and strain the solution through linen; afterwards, the honey being added, boil down to a proper consistence.)—Stimulant, detergent, and slightly escharotic. It is applied by means of a camel's-hair pencil to venereal ulcers of the throat, as well as to other indolent ulcers. Diluted with water it is employed as a gargle.

3. UNGUENTUM CUPRI SUBACETATIS, D. (U. S.;) *Unguentum Æruginis*, E. (Prepared Verdigris, ʒss.; Olive Oil, ʒj.; Ointment of White Resin, lbj.; M. Resinous ointment, ʒxv.; Verdigris, in fine powder, ʒj. M. *Ph. Ed.*) [Subacetate of Copper, in fine powder, ʒi.; Simple ointment, ʒxv., U. S.] Stimulant and mildly escharotic. It used as an application to foul ulcers, in ophthalmia tarsi, as a cure for the obstinate forms of ring-worm, and as an application to corns.

Antidotes.—Vide *Cuprum.*

### 5. CU'PRI ACE'TAS, *D.*—ACETATE OF COPPER.

This salt is commonly, though very improperly, termed *Distilled* or *Crystallized Verdigris;* and is met with in the shops crystallized on sticks. It is usually prepared by dissolving common verdigris in acetic acid, and crystallizing. The crystals are oblique rhombic prisms. They consist of one equivalent of oxide of copper, one equivalent of acetic acid, and one equivalent of water. This salt is completely soluble in water, by which it is distinguished from common verdigris. In most other properties it agrees with the latter. It is included in

the list of the materia medica of the Dublin Pharmacopœia, but for what reason I cannot understand, since it is never used in medicine. The bluish white precipitate obtained by adding a solution of the neutral acetate of copper to a solution of albumen, consists of *albumen* 90·81, and *deuto-acetate of copper* 9·19. It is soluble in excess of solution of either acetate of copper or of albumen. (Lassaigne, *Journ. de Chim. Med.* t. vi. 11e Sér. p. 305.)

## Order XXIII.—BISMUTH AND ITS COMPOUNDS.

### 1. BISMU'THUM, *L. E. D.* (U. S.)—BISMUTH.

History.—This metal is first mentioned by Agricola, in 1529. It has been termed *Marcasita*, *Tectum Argenti*, or, by the Germans, *Wismuth*. "The old miners called it Wismuth," says Matthesius, "because it blooms as a beautiful meadow, (*Wiesematte*,) on which variegated flowers of all kinds are glittering." (Schwartze, *Pharm. Tabellen.*)

Natural History.—Bismuth occurs only in the mineral kingdom. It is found in Cornwall, Saxony, Bohemia, &c. It is met with in the metallic state nearly pure, (*Native Bismuth*,) and in combination with sulphur and with oxygen.

Preparation.—It is chiefly obtained from native bismuth by melting the metal out of its gangue.

Properties.—It is a reddish white metal, without taste or smell, composed of brilliant broad plates, and readily crystallizable in cubes or regular octohedrons. Its sp. gr. is 9·83 to 9·88. It is moderately hard, brittle, pulverizable, fusible at 476° F. When strongly heated in the air it takes fire, and burns with a faint blue flame, emitting a yellow smoke (the oxide.) In close vessels it may be volatilized. Its equivalent is 72.

*Characteristics.*—It is distinguished by its brittleness (see p. 648,) its ready fusibility, its solubility in nitric acid, and by the characters of the nitric solution, which throws down a white precipitate on the addition of water, and a black one when hydrosulphuric acid or the hydrosulphates are added to it.

Purity.—Copper may be detected by precipitating the nitric solution with ammonia; the supernatant liquor is blue if copper be present.

It is dissolved by diluted nitric acid; when subnitrate of bismuth is precipated from this solution by ammonia, the liquor is free from colour. Its specific gravity is 9·8. *Ph. Lond.*

Its powder is entirely soluble in nitric acid with the aid of heat; and the solution is colourless or nearly so, and deposites a white powder when much diluted with cold water. *Ph. Ed.*

Physiological Effects and Uses.—In the metallic state, bismuth is inert. Its only use is in the preparation of the trisnitrate.

### 2. BISMU'THI TRISNI'TRAS, *L.*—TRISNITRATE OF BISMUTH.

(Bismuthum album, *E.*—Bismuthi Subnitras, *D.*)—[U. S.]

History.—This compound was first prepared by Lemery. It has had various appellations, such as *Pearl White*, *Magistery of Bismuth* (also a name for submuriate of bismuth,) *Spanish White*, *Sub-nitrate* or *Tetarto-nitrate of bismuth.*

Preparation.—All the British Colleges give directions for the preparation of this salt.

The *London College* orders of Bismuth, ℥j.; Nitric Acid, f℥iss.; Distilled Water, Oiij. Mix a fluid ounce of the water with the Nitric acid, and dissolve the Bismuth in them; then pour off the solution. To this add the rest of the water, and set by that the powder may subside. Afterwards, the supernatant liquor being poured off, wash the Trisnitrate of Bismuth with distilled water, and dry it with a gentle heat. [This is essentially the direction of the U. S. Phar.]

The process of the *Edinburgh College* is essentially similar. The precipitate [the Trisni-