

tin in an iron vessel; pour it into an earthenware mortar heated a little above the melting point of the metal; triturate briskly as the metal cools, ceasing as soon as a considerable portion is pulverized; sift the product, and repeat the process with what remains in the sieve.—The *Dublin College* orders of the purest Tin, any required quantity. Liquefied by heat, let it be strongly agitated until it passes into a powder, which when cold is to be shaken through a sieve.)—Tin may be reduced to powder by shaking it when melted in a wooden box, the inside of which has been rubbed with chalk. The doses and uses have been above described.

Tin Filings (*Stanni Limatura* seu *Rasura Stanni*) have also been used in medicine.

ORDER XXV.—LEAD AND ITS COMPOUNDS.

1. PLUMBUM.—LEAD.

HISTORY.—This metal was known in the most remote ages of antiquity. It is mentioned by Moses. (Job, xix. 23, 24.) The Greeks called it *μολυβδος*; the alchemists, *Saturn*.

NATURAL HISTORY.—It is found both in the metallic state (*Native Lead*) and mineralized. It is met with combined with sulphur (*Galena*), with selenium, with chlorine (*Horn Lead*), with oxygen (*Native Minium*), and with oxygen and an acid, forming an oxy-salt (*Carbonate, Phosphate, Sulphate, Tungstate, Molybdate, Chromate, Arseniate, and Aluminate*.)

PREPARATION.—It is usually extracted from galena, which is roasted in reverberatory furnaces, by which it is converted into a mixture of sulphate and oxide of lead, and afterwards smelted with coal and lime; the first to abstract oxygen, the second to remove the sulphur.

PROPERTIES.—It has a bluish-gray colour and considerable brilliancy. It may be crystallized by cooling in four-sided pyramids. It is malleable, but not ductile. Its sp. gr. 11.35. It has a peculiar odour when handled. It fuses at 612° F. and at a red heat boils and evaporates. Its equivalent is 104. By exposure to the air it attracts, first oxygen, and then carbonic acid, so as to form carbonate of lead.

Pure distilled water has no action on lead,¹ if the gases (as air and carbonic acid) be excluded; but if these be admitted, a thin crust of carbonate is soon formed. It is remarkable that the presence of most neutral salts—sulphate of soda and chloride of sodium, for example—impairs the corrosive action of air and water. (Christison, *Treatise on Poisons*.) Hence, therefore, we can easily comprehend the reason why leaden cisterns and pipes do not more frequently give a metallic impregnation to water; and why rain-water is more apt than spring-water to become impregnated with lead. The latter, however, by long keeping in leaden vessels, may also become contaminated with lead.

Characteristics.—If the lead be dissolved in nitric acid, we may easily recognise its presence in the solution by the following tests:—Alkalis, their carbonates, sulphuric acid and the sulphates, and ferrocyanide of potassium, produce white precipitates (which are respectively *hydrated oxide, carbonate, sulphate, and ferrocyanide of lead*;) chromate of potash and iodide of potassium occasion yellow precipitates (*chromate and iodide of lead*;) hydrosulphuric acid and the hydrosulphates form black precipitates (*sulphuret of lead*;) lastly, a piece of zinc throws down metallic lead in an arborescent form.

¹ For some observations on this subject see Mr. Taylor's memoir in the *Guy's Hospital Reports*, vol. iii.

The delicacy of these tests is according to Devergie (*Méd. Lég.* ii. 779.) as follows:—

	<i>Degree of Dilution.</i>
Sulphate of Soda.....	stops at 5,000
Iodide of Potassium.....	10,000
Ferrocyanide of Potassium.....	18,000
Potash.....	20,000
Carbonate of Soda or of Potash.....	60,000
Chromate of Potash.....	100,000
Hydrosulphuric Acid.....	500,000

PHYSIOLOGICAL EFFECTS. 1. Of Metallic Lead.—I believe that so long as lead retains its metallic form it is inert. In a French journal (*Journ. de Méd. de Leroux*, xxiii. 318.) it is stated that three ounces and six drachms of this metal have been given to a dog without any obvious effects. As, however, it is a metal which is readily oxidated, it occasionally proves active when swallowed. An instance of this kind is mentioned by Paulini, (*Miscell. Nat. Cur.* Dec. ii. Ann. vi. App. p. 7, quoted by Voigtels, *Arzneimittellehre.*) in which colic was produced by swallowing a leaden bullet. Proust (*Ann. de Chim.* lviii. 84.) says that the alloy of lead and tin may be swallowed with impunity, in consequence of its being much less easily oxidated than the pure metal.

2. Of the Preparations of Lead. α. On Vegetables.—Marceet found the solution of acetate of lead injurious to plants, but Wiegmann declares it to be inert, and ascribes its inertness to the formation of an insoluble salt (carbonate) of lead by the carbonic acid of the roots of the plants.

β. On Animals.—The preparations of lead are, for the most part, energetic poisons. The *Sulphuret*, however, appears to be inactive, or nearly so; for Orfila (*Toxicol. Gén.*) gave an ounce of it to dogs without observing any ill effects; four ounces have even been given to horses without any unpleasant results. The *Sulphate*, also, according to Orfila, is inactive. Our knowledge of the effects of the salts of lead on animals is derived from experiments made with the acetate, nitrate, and carbonate. The first two act as corrosives: all affect the nervous system, and occasion convulsions, palsy, and colica pictonum. (Christison, *Treat. on Poisons*, 506 et seq. 3d ed.)

γ. On Man.—Mr. Braid (Christison, *op. cit.* 518.) states that workmen who dig and pulverize the ore (*sulphuret of lead*.) at the Lead Hills in Lanarkshire, never have the lead colic until they work at the smelting furnaces.

Most, if not all, the other preparations are more or less active; the effects and symptoms, however, vary with the dose.

In *small doses* these preparations act on the alimentary canal as astringents; checking secretion and causing constipation. These may be regarded as the local effects. When absorbed, the constitutional effects of lead are observed: the arteries become reduced in size and activity, for the pulse becomes slower and smaller; the temperature of the body is diminished; and sanguineous discharges, whether natural or artificial, are frequently checked, or even completely stopped. This constringing and sedative effect seems extended to the secreting and exhaling vessels; the discharges from the mucous membranes, the exhalation from the skin, and the urine, being diminished in quantity. Thus we observe dryness of the mouth and throat, thirst, greater solidity of the alvine evacuations, diminution of the bronchial secretion, and of cutaneous exhalation. From these circumstances it appears that the preparations of lead give rise to a contracted state of the coats of the blood-vessels (at least of the arteries.) It is not at all improbable that the absorbent vessels are similarly affected. The wasting of the body produced by lead (*Tabes saturnina*, or *Tabes sicca*) may perhaps be referred to this constringing influence on the vessels.

A remarkable effect on the human gums, produced by the absorption of lead, has been pointed out by Dr. Burton. (*Medico-Chirurgical Transactions*, 2d Series, vol. v. p. 63. Lond. 1840.) It consists in the formation of a narrow

lead-blue line, about the one-twentieth of an inch thick, which borders the edges of the gums attached to the necks of two or more teeth of either jaw. In every case of lead colic that has fallen under my care I have observed this line. Moreover, in several cases where sugar of lead, in full doses, has been given for many days continuously, I have noticed it; and in most of the cases it was accompanied by abdominal pain. On two patients not known to have been subjected to the influence of lead I have observed some faint indication of a similar line, without, however, any constitutional symptoms of lead poisoning. I have not observed this line in patients under the influence of mercury. In one instance mentioned by Dr. Burton, fifteen grains of acetate of lead, taken in four days, caused the blue line: in another this effect was not produced until the patient had taken one hundred and sixty grains in twenty-one days.

Salivation, (Dr. Warren, *Medical Transactions*, vol. ii. p. 87.) turgidity of the gums,¹ and a bluish colour of the saliva, (Dr. Christison, *Treatise on Poisons*, p. 514. 3d. ed.) are other effects ascribed to the influence of lead. "I do not wish to assert," observes Dr. Burton, "that salivation and turgidity of the gums are never produced by the internal operation of lead; but I venture to affirm they are rare occurrences, and not characteristic of its influence."

The bluish colour of the saliva, and the blue line on the gums, probably depend on the presence of sulphuret of lead, formed by the action of sulphuretted hydrogen, evolved by the lungs, on the lead contained in the salivary and buccal secretion; for I have observed that an alloy of mercury and silver, introduced into the hollow of a tooth, becomes coated in a few days with a black film of metallic sulphuret.

The long-continued use of the preparations of lead rarely fails to give evidence of its effect on the muscular and nervous systems: and which is manifested by a curious train of symptoms, commencing with colic, and terminating in palsy or apoplexy. *Lead or painter's colic*, (*colica pictorum*) is variable in its mode of attack; at one time commencing suddenly, and without any very marked premonitory symptoms, at another being preceded by dyspeptic symptoms—such as diminished appetite, with a painful and constipated state of the bowels, the faeces being very hard. During an attack, there is usually obstinate constipation, with acute pain, much increased at intervals; but sometimes a relaxed condition of the bowels has been met with. Merat (*Traité de la Colique Metallique.*) refers the continued pain to the small intestines, while the more violent and intermitting kind resides principally in the transverse portion of the colon. Pressure rarely increases, and very commonly relieves, the pain. Cases, however, do occur (and I have seen several) in which there is great tenderness of the bowels. The abdomen is strongly retracted, sinks in about the navel, and feels very hard. To these symptoms may be added vomiting, cramps of the lower extremities, hard and generally slow pulse, though sometimes it has been found frequent.

De Haen and Merat, on examining the bodies of patients who have died affected with lead colic, found a contracted condition of the colon, and this was considered by the last-mentioned writer to indicate the seat of the disease. But Sir G. Baker, Andral, (*Path. Anat.* by Townsend and West, ii. 140.) Louis, and Copland, (*Dict. Pract. Med.* i. 366.) have not, in some cases, found any alteration. Moreover, it would appear probable from Dr. Abercrombie's observations on ileus (*On Diseases of the Abdom. Viscera.*) that the empty and collapsed portion of the intestine was not the seat of the colic, but another part found in a state of distention,—for the collapsed or contracted state is the natural condition of healthy intestine when empty; while the distended portion is, in ordinary cases of ileus, the primary seat of the disease, the distention arising from a paralytic condition of the muscular fibres, whereby it is unable to contract

¹ Dr. A. Thomson, *Elements of Materia Medica*, vol. ij. p. 66; and Laidlaw, in the *Lond. Med. Rep.* N. S. vi. 292.

and propel its contents onward. Now this view of the case is the more probable, since the action of lead on the muscular fibres of the intestine is doubtless of the same kind as that on the fibres of the voluntary muscles. Some have found intus-susception, others have noticed marks of inflammation.

Lead colic is accompanied by the blue line on the gums above referred to; which, therefore, is an important aid in distinguishing this variety of colic from that which arises from other causes.

Another effect of poisoning by lead is an affection of the cerebro-spinal system, generally manifested by *paralysis*, but occasionally by giddiness, convulsions, and coma, and now and then by apoplexy. The palsy may occur without colic, or it may come on while the patient is suffering with it, but in general it succeeds colic. It is accompanied with the blue line on the gums above described. It may happen in both upper and lower extremities, though more frequently in the former; and it affects the extensor more than the flexor muscles, so that the hands are generally bent on the arms, which hang dangling by the side. Frequently pain is experienced in the paralyzed part, and sometimes in the region of the spine also. On examining the bodies of persons who have died with this disease, no lesion has hitherto been discovered in the spinal marrow. The muscles of the affected limb are observed to be wasted and very pale, and have sometimes the appearance of a white fibrous tissue.

In *very large doses*, some of the plumbeous preparations (the acetate, for example) act as irritant and caustic poisons; giving rise to the usual symptoms indicative of gastro-enteritis. However, none of them equal, in the intensity of the local action, the mercurial or even the cupreous compounds.

MODUS OPERANDI.—Tiedemann and Gmelin (*Vers. über d. Wege, auf welchen Subst. aus d. Mag. ins Blut. gelang.*) found lead in the blood of the splenic, mesenteric, and hepatic veins of dogs killed by the acetate; they also found it in the contents of the stomach and intestines, but neither in the chyle nor the urine. Wibmer (Christison's *Treatise on Poisons*, 3d edit. p. 509.) detected it in the liver, muscles, and spinal cord.

The local or corrosive action of the soluble salts of lead depends on the affinity of these bodies for the organic constituents of the tissues (vide *Plumbi Acetas.*)

The nervous system is specifically affected by lead. The paralysis of the voluntary muscles, the pain in the course of the spine, the occasional giddiness, coma, or apoplexy, seem to establish this. The colic as well as the astringent influence of lead over the coats of vessels are probably secondary effects of the action of lead over the nervous system.

The constitutional effects of lead may be produced in various ways: as, when taken with articles of food and drink into the stomach; when inhaled in the form of dust or vapour with the air; when applied to mucous membranes, ulcers, &c. Hence the persons most liable to these effects are those whose occupations bring them in contact with this metal; for example, painters, plumbers, roasters and smelters of lead, the manufacturers of the plumbeous preparations, glass-blowers, potters, lapidaries, &c.

Dr. Anthony Todd Thomson (*Lond. Med. Gaz.* v. 538, and x. 689.) is of opinion, that carbonate of lead is the only preparation of this metal that can produce colic; and though he has, I think clearly, shown that lead colic more frequently arises from the carbonate than from any other salt of lead, he has, in my opinion, failed in proving that no other preparation of lead *can* produce it. Indeed, if his opinion were true, it would constitute an exception to the general effects of the metallic preparations; for we do not find that the specific effects of arsenic, or of mercury, or of copper, or of antimony, are produced by one preparation only: so that, *à priori*, analogy is against the opinion. Furthermore, it is well known that the vapour of the oxide of lead taken into the lungs may produce colic, and that the ingestion of the acetate, citrate, or tartrate of lead, is capable of exciting the same effect. Now Dr. Thomson explains these facts by

assuming that the oxide of lead unites with carbonic acid in the lungs, and is thus converted into carbonate: and that the acetate, citrate, and tartrate, are decomposed in the alimentary canal, and converted into carbonates. But it appears to me to be much more simple and consistent with analogy, to admit that these preparations are of themselves capable of producing colic, than to assume that they undergo the changes here supposed. Moreover, in some instances in which colic was produced, it is unlikely that these changes would have occurred, owing to the excess of acid taken with the salt of lead.

USES.—The uses of the preparations of lead may be in part inferred from the foregoing account of their effects. These agents are employed when we wish to constrict the capillary vessels and to diminish their vital activity. Thus we administer them internally to check excessive secretion and exhalation, as in catarrhal affections of the mucous membranes of a chronic nature; in profuse secretion of pus; in sanguineous exhalations from the mucous membranes; and colliquative sweating. They have also been applied, in some instances with success, in certain chronic affections of the nervous system, as epilepsy; but the practice is altogether empirical, as we have no rational principles, to guide us in using them. As topical remedies,¹ we employ the preparations of lead to diminish vascular excitement, to allay preternatural heat, and to check excessive secretion. Thus we apply them to inflamed parts to promote resolution, and to ulcers and other secreting surfaces as astringents or desiccants. During the internal employment of lead, attention must be paid to the condition of the gums, stomach and bowels, as we find traces of their injurious effects in these organs. The blue line on the gums has been noticed. Constipation is a very frequent result of the medicinal employment of lead. Loss of appetite, indigestion, and griping pains, are also often noticed. The tendency to colic is diminished, according to Dr. A. T. Thomson, by conjoining acetic acid.

ANTIDOTES.—Poisoning by lead usually puts on one of three forms—*irritant poisoning, lead colic, and paralysis*; and the treatment varies with each.

In irritant poisoning administer diluents holding in solution some sulphate (as sulphate of soda, of magnesia, or of potash or alum,) so that a sulphate of lead may be formed. If vomiting have not already come on, tickle the throat, and administer emetics of the sulphate of zinc or of copper, or the stomach-pump may be employed.

In lead colic the best remedy is alum (*vide* pp. 518 and 519.) But in this country lead colic is frequently treated by the combined use of purgatives and anodynes, the purgatives being either castor oil or salts and senna, and the anodyne being opium. When the vomiting is very troublesome, and liquid medicines do not remain on the stomach, we may give the compound extract of colocynth, with opium in the form of pill. In several cases in which the pulse was full and strong, the face flushed, and the tongue furred and dry, I have used blood-letting with evident advantage. The sulphates have been recommended, as also mercury.

In lead paralysis, nux vomica, and its active principles—strychnia and brucia are perhaps of all internal remedies most deserving of trial, because of their specific effect on the spinal marrow; and the chance of their success is, of course, much increased by the circumstance of there being no discoverable lesion of this portion of the nervous system. Mercury has been recommended by Dr. Clutterbuck. Various local measures have been tried, but without much benefit; for example, electricity and irritants (such as ammonia and cantharides.)

2. PLUM'BI OX'YDUM.—OXIDE OF LEAD.

(Lithargyrum, E.—Plumbi Oxydum semivitreum, D.)—(U. S. 2)

HISTORY.—The ancients were acquainted with oxide (*Protoxide*) of lead. Hippo-

¹ See Dr. Aikin's *Observations on the External Use of Preparations of Lead*. Lond. 177.

² In all cases the U. S. P. uses the *i* instead of *y* in spelling the latin word for oxide, thus *Oxidum*.

crates (*De Morb. Mul.* ii.) employed the semi-vitrified oxide (*Litharge*) λιθαργυρον. Dioscorides (*Lib. v. cap. cii.*) and Pliny (*Hist. Nat.* xxxiv. 53.) both mention litharge: the latter calls it *Molybdæna*.

PREPARATION.—If melted lead be exposed to a current of air, it is rapidly oxidated and converted into the protoxide of this metal. The oxidated skimmings are denominated *Massicot*. This, when fused at a bright red heat, is separated from some metallic lead with which it was intermixed; the fused oxide forms, on solidifying, a brick-red mass, which readily separates into crystalline scales: these constitute *Litharge*.

Litharge is obtained as a secondary product in the cupellation of argentiferous lead. The alloy is melted on a porous vessel, called a *test* or *cupel*, and exposed to the blast of a bellows, by which the lead is oxidized, half vitrified, and driven off into hard masses of a scaly texture, and in that state is called *Litharge* or *Silver Stone*. (Watson's *Chem. Essays*, iii. 325, 6th ed.)

PROPERTIES.—Oxide of lead presents itself in several forms. One of these is yellow, and is termed *Massicot* (*Cerussa citrina*.) When semivitrified (*Plumbi Oxydum semivitreum*.) it is called *Litharge* (*Lithargyreum*.) which occurs in the form of small yellow or reddish scales or flakes, and according to its colour, is called *Gold* or *Silver Litharge* (*Lithargyrum aureum* [*Chrysiis*] seu *Argenteum* [*Argyritis*].) Gold Litharge owes its red tint to the presence of a portion of minium.

Oxide of lead is fusible, and at a very high temperature volatile. It is almost insoluble in water.

Characteristics.—Heated on charcoal by the blow-pipe, it is readily reduced to the metallic state. It is blackened by hydrosulphuric acid and completely dissolves in nitric acid. The characteristics of this solution have been already described (vide p. 651.) The varieties of the oxide are distinguished by their physical peculiarities.

COMPOSITION.—Oxide of lead is thus composed:—

	Atoms.	Eq. Wt.	Per Cent.	Berzelius.	Berthier.
Lead.....	1	104	92.85	92.85	93.3
Oxygen.....	1	8	7.14	7.15	6.7
Oxide of Lead.....	1	112	99.99	100.00	100.0

PURITY.—It is not subject to adulteration.

Almost entirely soluble in dilute nitric acid. Its other properties are the same as those of carbonate of lead. *Ph. Lond.*

Fifty grains dissolve entirely, without effervescence, in a fluid ounce and a-half of pyroligneous acid; and the solution, precipitated by 53 grains of phosphate of soda, remains precipitable by more of the test. *Ph. Ed.*

The presence of a carbonate would be indicated by effervescence on the addition of acetic acid.

PHYSIOLOGICAL EFFECTS.—Inhaled in the form of vapour, or fine dust, it produces the before-mentioned constitutional effects of lead (vide p. 653.)

The effects of this substance, when swallowed, are but little known. It possesses very slightly irritant properties. "The experimentalists of Lyons found litharge to be irritant in large doses of half an ounce." (Christison, *op. cit.* p. 509.)

From its external use ill consequences have sometimes resulted.

USES.—Oxide of lead is never employed internally. Litharge is sometimes sprinkled over ulcers, as an astringent and desiccating substance. In pharmacy, it is used in the preparation of *Emplastrum Plumbi* (see p. 669,) *Ceratum Saponis* (see p. 481,) *Acetas Plumbi* (see p. 663,) and *Liquor Plumbi Diacetatis* (see p. 667.)

1. **PLUMBI OXYDUM HYDRATUM, L.** *Hydrated Oxide of Lead.* (Solution of Diacetate of Lead, Ovj.; Distilled Water, Cong. iij.; Solution of Potash, Ovj., or

as much as may be sufficient to precipitate the oxide. Mix. Wash with water what is precipitated, until nothing alkaline remains.) In this process the potash combines with acetic acid, and forms acetate of potash, which remains in solution, while the white hydrated oxide of lead is precipitated. According to Mitscherlich this compound consists of two equivalents or 224 parts of *oxide of lead*, and one equivalent or 9 parts of *water*: it is, therefore, a dihydrated oxide. It is soluble in a considerable excess of a solution of caustic potash.

What is used in preparing disulphate of quinia should be totally dissolved by dilute nitric acid. Its remaining properties resemble those of the preceding. *Ph. Lond.*

It is directed, by the London College, to be employed in the preparation of *Quinæ Disulphas*.

2. *CALCIS PLUMBIS*; *Plumbite of Lime*.—This compound is employed as a *Hair Dye* (see p. 211.)

3. PLUM'BI OX'YDUM RU'BRUM:—RED OXIDE OF LEAD.

(Plumbi Oxidum rubrum, E.)—[U. S.]

HISTORY.—It is doubtful whether the ancients were acquainted with this compound, as the substance which Pliny (*Hist. Naturalis*, lib. xxxiii. cap. 40, ed. Valp.) called Minium was Cinnabar (see p. 629.) He describes, however, an inferior kind, which he terms *Minium secundarium*, (*Idem.*) and which may be perhaps the red oxide of lead. Dioscorides (Lib. v. cap. 109.) distinguished Minium from Cinnabar.

Besides *Minium* there are several other names for red oxide of lead. In commerce it is usually known as *Red Lead*. It is sometimes termed *Deutoxide of Lead*.

NATURAL HISTORY.—*Native Minium* is found in Yorkshire, Suabia, Siberia, and some other places.

PREPARATION.—Red lead is prepared by subjecting protoxide of lead (massicot or litharge) to the combined influence of heat and air. It absorbs oxygen and is converted into red lead. A heat of about 600° is necessary. The finest minium is procured by calcining the oxide of lead obtained from the carbonate. (Graham, *Elements of Chemistry*, p. 589.)

PROPERTIES.—Red oxide of lead has a brilliant red colour. By heat it gives out oxygen gas, and is converted into the protoxide of lead.

Characteristics.—Before the blowpipe on charcoal it is converted into the yellow protoxide, and then into metallic lead. When digested in nitric acid, the nitrate of the protoxide is obtained in solution, while the insoluble brown or peroxide of lead remains. By the action of sulphurous acid on red lead, the white sulphate of the protoxide is obtained.

"Entirely soluble in highly-fuming nitrous acid; partially soluble in diluted nitric acid, a brown powder being left." *Ph. Ed.*

COMPOSITION.—The composition of real or pure red lead is as follows:—

	Atoms.	Eq. Wt.	Per Cent.	Or,	Atoms.	Eq. Wt.	Per Cent.	Dumas.
Lead.....	3	312	90.7	Protoxide....	2	224	65.11	64.9
Oxygen....	4	32	9.3	Peroxide....	1	120	34.89	35.1
Red Lead ...	1	344	100.0		1	344	100.00	100.0

Dumas (*Ann. de Chim. et de Phys.* xlix. 398.) has shown that red lead of commerce is not uniform in composition; but consists of variable mixtures of real red lead with protoxide. His results have been confirmed by those of Mr. Phillips. (*Phil. Mag.* N. S. iii. 125.) That real red lead is not a mere mixture of protoxide and peroxide is apparently shown by its colour as well as by the fact that

it is not altered by heating it in a solution of acetate of lead, which is capable of dissolving free protoxide.

PHYSIOLOGICAL EFFECTS AND USES.—Its effects are similar to the protoxide of lead. It is but little employed in pharmacy. The Edinburgh College directs it to be employed in the preparation of *Aqua Chlorinii* (see p. 221.)

4. PLUM'BI CHLO'RIDUM, L.—CHLORIDE OF LEAD.

NATURAL HISTORY.—Chloride of lead is found native at Churchill, in the Mendip Hills of Somersetshire.

PREPARATION.—In the London Pharmacopœia this compound is directed to be prepared as follows:—

Take of Acetate of Lead, ℥xix.; Distilled Water, Boiling, Oijj.; Chloride of Sodium, ℥vj. Dissolve the Acetate of Lead and Chloride of Sodium separately, the former in three pints of Distilled Water, and the latter in one pint of Distilled Water. Then the liquors being mixed together, wash what is precipitated with distilled water when it is cold, and dry it.

In this process one equivalent or 163 parts of dry acetate of lead are decomposed by one equivalent or 60 parts of chloride of sodium; by which one equivalent or 140 parts of chloride of lead are precipitated, and one equivalent or 83 parts of acetate of soda remain in solution.

MATERIALS.	COMPOSITION.	PRODUCTS.
1 eq. Acetate of Lead.....163	1 eq. Acetic Acid..... 51	1 eq. Acetate Soda.... 83
	1 eq. Ox. Lead 112	
	1 eq. Oxyg. 8	
	1 eq. Lead 104	1 eq. Soda....32
1 eq. Chloride of Sodium.... 60	1 eq. Sodium..... 24	1 eq. Chloride Lead....140
	1 eq. Chlorine..... 36	
223	223	223

Hydrochloric acid occasions the precipitation of more chloride of lead after the action of chloride of sodium is over; so that there must be some compound of lead in solution. (Phillips, *Transl. of Pharm.* 4th ed.)

PROPERTIES.—It is a white crystalline powder (*Magisterium Saturni Crollii*), soluble in thirty parts of cold or twenty-two parts of boiling water. When heated it fuses; and by cooling forms a semi-transparent horny-like mass, called *Horn Lead* (*Plumbum corneum*.)

Characteristics.—Its aqueous solution causes a white precipitate with nitrate of silver, soluble in ammonia but insoluble in nitric acid; hence it is shown to be a chloride. The solution is known to contain lead by the before-mentioned tests for this metal (vide p. 651.)

Totally dissolved by boiling water, the chloride concreting almost entirely into crystals as it cools. On the addition of hydrosulphuric acid it becomes black, and by heat yellow. *Ph. Lond.*

COMPOSITION.—The following is its composition:—

	Atoms.	Eq. Wt.	Per Cent.	J. Davy.
Lead.....	1	104	74.3	74.22
Chlorine.....	1	36	25.7	25.78
Chloride of Lead.....	1	140	100.0	100.00

USE.—It is employed in the preparation of hydrochlorate of morphia.

5. PLUM'BI IO'DIDUM, L. E.—IODIDE OF LEAD.

HISTORY.—This compound was introduced into medicine by Cottereau and Verdé-Delisle.

PREPARATION.—The London and Edinburgh Colleges give directions for the preparation of it.

The London College orders of Acetate of Lead, ℥ix.; Iodide of Potassium, ℥vij.; Distilled Water, cong. j. Dissolve the Acetate of Lead in six pints of the Water, and strain; and to these add the Iodide of Potassium first dissolved in two pints of the water. Wash what is precipitated, and dry it.

The reacting proportions of iodide of potassium and crystallized acetate of lead are 166 parts of the former and 190 parts of the latter. Hence the London College uses a larger proportion of iodide than is requisite, supposing the acetate to be neutral.

This excess is disadvantageous, since it retains a portion of the iodide of lead in solution. To prevent the formation of the pale yellow oxyiodide of lead, a little acetic acid should be added to the acetate of lead, before adding the iodide of potassium. The precipitate should be washed and dried.

By the mutual action of one equivalent or 163 parts of dry acetate of lead, and one equivalent or 166 parts of iodide of potassium, we obtain one equivalent or 230 parts of iodide of lead, and one equivalent or 99 parts of dry acetate of potash.

MATERIALS.		COMPOSITION.		PRODUCTS.	
1 eq. Acetate of Lead.. 163	{ 1 eq. Acetic Acid..... 51 { 1 eq. Ox. Lead { 1 eq. Oxyg. 8 { 112 { 1 eq. Lead 104	1 eq. Potsh. 48	1 eq. Acet. Potash. 99	1 eq. Iodide of Potash. 166	1 eq. Iodide Lead. 230
1 eq. Iodide of Potash. 166					
	329				

The Edinburgh College orders of Iodide of Potassium, and Nitrate of Lead, of each, ℥j.; Water, Oiss.; dissolve the salts separately, each in one-half of the water; add the solutions; collect the precipitate on a filter of linen or calico, and wash it with water. Boil the powder in three gallons of water acidulated with three fluid ounces of pyroligneous acid. Let any undissolved matter subside, maintaining the temperature near the boiling point; and pour off the clear liquor, from which the iodide of lead will crystallize on cooling.

The reacting proportions are one atom or 166 parts of nitrate of lead, and one atom or 166 parts of iodide of potassium; or equal weights of the materials. The products are one equivalent or 230 parts of iodide of lead, and one equivalent or 102 parts of nitrate of potash.

For Pharmaceutical purposes, especially for the preparation of ointments, the pulverulent iodide is preferable to the crystalline or scaly kind.

PROPERTIES.—It is a fine yellow powder, very sparingly soluble in cold water, but readily soluble in boiling water; from which it for the most part separates, as the solution cools, in the form of golden yellow, brilliant, small scales. It is fusible. It combines with the alkaline iodides, forming a class of double salts, called the *plumbo-iodides (iodo-plumbates, Thomson.)* Caustic potash dissolves it, and forms a plumbo-iodide of potassium and plumbate of potash. (Dumas, *Traité de Chim.* iii. 379.) It is soluble in acetic acid and in alcohol.

Characteristics.—When heated, it first forms a yellow vapour (*iodide of lead,*) and afterwards a violet vapour (*iodine,*) leaving a residue (*lead,*) which, when dissolved in nitric acid, gives all the characters of solution of lead (vide 651.) Boiled with carbonate of potash, it forms carbonate of lead and iodide of potassium.

COMPOSITION.—Its composition is as follows:—

	Atoms.	Eq. Wt.	Per Cent.	Henry.
Lead.....	1	104	45.21	45.1
Iodine.....	1	126	54.78	54.9
Iodide of Lead.....	1	230	99.99	100.0

PURITY.—It should be completely soluble in boiling water.

Totally dissolved by boiling water, and as it cools separates in shining yellow scales. It melts by heat, and the greater part is dissipated first in yellow, and afterwards in violet vapours. *Ph. Lond.*

Bright yellow: five grains are entirely soluble, with the aid of ebullition, in one fluid drachm of pyroligneous acid, diluted with a fluid ounce and a-half of distilled water; and golden crystals are abundantly deposited on cooling. *Ph. Ed.*

PHYSIOLOGICAL EFFECTS. *α. On Animals.*—Twenty-four grains of iodide of lead were given to a cat at two doses, with an interval of four hours: the animal suffered violent colic, and died in three days; but no signs of irritation were observed after death. (Paton, *Journ. de Chim.* iii. 41, 2^{de} Sér.) Iodide of lead was given in doses of from gr. v. to ʒss. to a bull-dog: no effect was observed until the fifteenth day, when the animal refused food, and kept in the recumbent posture. He died on the eighteenth day, having swallowed altogether ten drachms and fifty grains of iodide. During the whole period, he had only three or four intestinal evacuations. (Cogswell, *Essay on Iodine*, 143.)

β. On Man.—Its effects on man have been imperfectly determined. It does not appear to act as an irritant when applied to the skin or ulcerated surfaces. Under the continued external and internal use of it, enlargements of the lymphatic glands have disappeared, from which we infer a specific influence over the glandular and lymphatic system. In some cases it appeared to occasion irritation of the stomach. I have seen constipation induced by it. After its medicinal use for several weeks I have not observed any blue line on the gums.

USES.—It has been principally employed to reduce the volume of indolent tumors, especially enlargements of the cervical, axillary, and mesenteric glands. In these cases it should be simultaneously administered internally and externally. I have also employed it in suspected incipient phthisis. I have used it in two cases of enlarged cervical glands, but without benefit. Velpeau (*Lugol's Essays*, by Dr. O'Shaughnessy, p. 206.) and others, however, have been more successful.

ADMINISTRATION.—The dose is three or four or more grains. Dr. O'Shaughnessy (*Lugol's Essays*, p. 207.) says, ten-grain doses are easily borne, without the slightest annoyance. It is given in the form of pill.

UNGUENTUM PLUMBI IODIDI, L. (Iodide of Lead, ʒj.; Lard, ʒviiij. M.)—This is applied, by way of friction, to scrofulous and other indolent swellings.

6. PLUMBI CARBONAS, L. E. D. (U. S.)—CARBONATE OF LEAD.

HISTORY.—This substance was employed by Hippocrates, (*De Morbis*, lib. ii.) under the name of *ψιμμιθιον*. Theophrastus (*De Lapidibus*.) described the method of making it. Dioscorides (Lib. v. cap. ciii.) and Pliny (*Hist. Nat.* lib. xxxiv.) also mention it.

It has been known by several names, as *Psimmythium*, *Ceruse* (*Cerussa*.) *Magistry of Lead* (*Magisterium Plumbi*.) *White Lead*, *Flake White*, and *Sub-carbonate of Lead*.

NATURAL HISTORY.—This salt is found native, crystallized, or massive, in Scotland, England, &c. It is called *White Lead Ore*.

PREPARATION.—Neutral carbonate of lead is obtained by adding an alkaline carbonate to a solution of acetate or nitrate of lead. Procured in this way it is deficient in *body*, owing to the transparency of the crystalline grains; and it is not, therefore, fitted for the use of the painter, who requires a carbonate having a dense and opaque body.

Within the last few years several patents have been taken out for new modes of preparation.¹ Some of the processes so patented have been subsequently

¹ See *Repertory of Patent Inventions*; also Brande's *Manual of Chemistry*, 5th ed.; *Journal de Pharmacie*, t. xxvi. p. 772; and Ure's *Dict. of Arts*, art. *White Lead*.

abandoned, either because a profitable remuneration could not be obtained by them; or because the quality of the product was inferior. I am informed that the white lead obtained by the old or Dutch process is superior, as an oil pigment, to that procured by most other methods.

"In the *Dutch process*, introduced into England about 1780, lead is cast into plates or bars, or into the form of stars, or circular gratings of six or eight inches in diameter, and from a quarter to half an inch in thickness; five or six of these are placed one above another in the upper part of a conical earthen vessel something like a garden-pot, in the bottom of which there is a little strong acetic acid. These pots are then arranged side by side, on the floor of an oblong brick chamber, and are imbedded in a mixture of new and spent tan (ground oak bark as used in the tan-yard.) The first layer of pots is then covered with loose planks, and a second range of pots imbedded in tan is placed upon the former; and thus a stack is built up so as entirely to fill the chamber with alternate ranges of the pots containing the lead and acetic acid, surrounded by and imbedded in the tan. Several ranges of these stacks occupy each side of a covered building, each stack containing about 12,000 of the pots, and from 50 to 60 tons of lead. Soon after the stack is built up the tan gradually heats or ferments, and begins to exhale vapour, the temperature of the inner parts of the stack rising to 140° or 150°, or even higher. The acetic acid is slowly volatilized, and its vapour passing readily through the gratings or folds of lead, gradually corrodes the surface of the metal, upon which a crust of subacetate is successively formed and converted into carbonate, there being an abundant supply of carbonic acid furnished by the slow fermentative decomposition of the tanners' bark. In the course of from 4 to 6 weeks the process is completed, and now, on unpacking the stacks, the lead is found to have undergone a remarkable change: the form of the castings is retained, but they are converted, with considerable increase of bulk, into dense masses of carbonate of lead; this conversion is sometimes entire, at others it penetrates only to a certain depth, leaving a central skeleton as it were of metallic lead, the conversion being unequal in different parts of the stack, and varying in its perfection at different seasons, temperatures, and states of the atmosphere. The stacks are so managed that they are successively being built up and unpacked. The corroded and converted gratings, or cakes, are then passed through rollers, by which the carbonate of lead (white lead) is crushed and broken up, and the central core of metallic lead (blue lead,) if any remain, is easily separated: the white lead is then transferred to the mills, where it is ground up into a thin paste with water, and is ultimately reduced, by the process of elutriation or successive washings and subsidences, to the state of an impalpable powder; it is then dried in wooden bowls, placed upon shelves in a highly-heated stove, and thus brought to the state of masses easily rubbed between the fingers into a fine powder, in which the microscope does not enable us to discern the slightest traces of crystalline character. If intended for the use of the painter, it is next submitted to grinding with linseed oil; and it is found that a hundred-weight of this white lead is formed into a proper consistence with 8 pounds of oil, whereas precipitated white lead requires 16 pounds of oil for the same purpose; the one covering the surface so much more perfectly, and having so much more body than the other. It is sometimes supposed in this process that the oxygen and carbonic acid required to form the carbonate of oxide of lead are derived from the decomposition of the acetic acid; but this is evidently not the case, for not more than 100 pounds of real acetic acid exist in the whole quantity of the diluted acid contained in the several pots of each stack; and in 100 pounds of acetic acid there are not more than 47 to 48 pounds of carbon, whereas 6740 pounds would be required to furnish the carbonic acid which should convert 50 tons of lead (the average weight of that metal in each stack) into carbonate of lead. There can be no doubt then that the carbon or carbonic acid must come from the tan, and that the oxygen is partly derived from the same source, and partly from the atmosphere: the principal action of the acetic acid therefore is to form successive portions of subacetate of lead, which are successively decomposed by the carbonic acid: the action is, however, of a very remarkable description, for even masses of lead, such as blocks of an inch or more in thickness, are thus gradually converted through and through into carbonate, so that if due time is allowed there is no central remnant of metallic lead. The original texture of the lead is much concerned in the extent and rapidity of the conversion. Rolled or sheet lead will not answer, and the gratings, coils, and stars which are employed, are all of cast-lead. The purest metal is also required; for if it contain iron, the resulting white lead acquires a tawny hue, and if a trace of silver, it acquires a perceptible dinginess when it is subjected to the action of light." (Brande.)

PROPERTIES.—The form of the crystals of the native carbonate of lead is a right rhombic prism. Artificial carbonate is a heavy, snow-white, tasteless powder, or it occurs in white chalk-like masses. It is insoluble in water, but dissolves in caustic potash. When heated it gives out carbonic acid, and forms the yellow oxide.

Characteristics.—Heated before the blow-pipe, on charcoal, it yields metallic lead. It is blackened by hydrosulphuric acid. It dissolves in nitric acid with effervescence. The solution possesses the general characters of the plumbeous solutions as already described (*vide* p. 651.)

COMPOSITION.—Its composition is as follows:—

	Atoms.	Eq. Wt.	Per Cent.	Berzelius.
Oxide of Lead.....	1	112	83.58	83.5
Carbonic Acid.....	1	22	16.42	16.5
Carbonate of Lead....	1	134	100.00	100.0

Commercial white lead is not a neutral salt, but a mixture or combination of carbonate and hydrated oxide of lead in varying proportions.¹

PURRY.—Carbonate of lead of commerce is rarely pure. It is usually adulterated with earthy or metallic sulphates (as of lime, baryta, or lead.) These are detected by their insolubility in diluted nitric acid. Chalk (which is by some used to adulterate it) may be detected as follows:—Dissolve the suspected substance in nitric acid, and precipitate the lead by hydrosulphuric acid. Boil and filter the solution, in which will be contained nitrate of lime (if chalk had been present,) recognisable by oxalic acid or oxalate of ammonia (*vide* p. 488.)

Dissolved with effervescence in dilute nitric acid. What is precipitated from the solution by potash is white, and is re-dissolved by excess of it: it becomes black on the addition of hydrosulphuric acid. It becomes yellow by heat, and, with the addition of charcoal, it is reduced to metallic lead. *Ph. Lond.*

It does not lose weight at a temperature of 212°: 68 grs. are entirely dissolved in 150 minims of acetic acid diluted with a fluid-ounce of distilled water; and the solution is not entirely precipitated by a solution of 60 grs. of phosphate of soda. *Ph. Ed.*

PHYSIOLOGICAL EFFECTS.—Its *local* effects are not very powerful: applied to ulcerated surfaces it acts as a desiccating and astringent substance: swallowed in large quantities it does not act as a local irritant, like the acetate. Its *constitutional* effects are similar to those of the other preparations of lead already described. It appears (see p. 654) that carbonate of lead more frequently produces colic than the acetate of lead—a circumstance which Dr. Christison thinks may be owing to the great obstinacy with which its impalpable powder adheres to moist membranous surfaces, and the consequent greater certainty of its ultimate absorption.

USES.—It is never administered internally.

Externally it is employed as a dusting powder in excoriations of children and rusty persons; but the practice is objectionable, on account of the danger of absorption. In one case, related by Kopp, (*Richter, Ausf. Arzneim.* iv. 613.) a child was destroyed by it. An ointment or plaster of carbonate of lead has been known to give relief in some cases of neuralgia. (*Journ. de Pharm.* xx. 603).

UNGUENTUM PLUMBI CARBONATIS, E. D. (U. S.) *Ointment of Carbonate of Lead.* (Simple Ointment, ℥v.; Carbonate of Lead, ℥j. *E.*—Carbonate of Lead, reduced to very fine powder, ℥ij.; Ointment of White Wax, lbj. *D. (U. S.)* Mix.)—This ointment is valuable as a cooling and desiccating application to excoriated surfaces or burns.

7. PLUMBI NITRAS, E.—NITRATE OF LEAD.

PREPARATION.—The Edinburgh College gives the following directions for its preparation:—

Take of Litharge, ℥ivss.; Diluted Nitric Acid, Oj. Dissolve the litharge to saturation with the aid of a gentle heat. Filter, and set the liquor aside to crystallize. Concentrate the residual liquid to obtain more crystals.

The nitric acid combines with the protoxide of lead to form the nitrate of this metal.

PROPERTIES.—This salt crystallizes in regular octohedrons or modifications of

¹ Mulder, *Pharmaceutisches Central-Blatt für 1840*, S. 100; and Richardson, in *Graham's Elements of Chemistry*, p. 391.

these. It is soluble in water and alcohol. Its solution is sweet and austere. The crystals loudly decrepitate by heat.

Characteristics.—When subjected to heat in a glass tube this salt evolves the reddish-brown vapour of nitrous acid. It possesses also the other characters of a nitrate which have been before stated (p. 274.) It is known to be one of the plumbeous salts by the before-mentioned tests for these substances (p. 651.)

COMPOSITION.—This salt is anhydrous. Its composition is as follows:—

	Atoms.	Eq. Wt.	Per Cent.	Döbereiner.	Berzelius.
Oxide of Lead.....	1	112	67.47	67.6	67.2225
Nitric Acid.....	1	51	32.53	32.4	32.7775
Crystallized Nitrate of Lead. 1		166	100.00	100.0	100.0000

PHYSIOLOGICAL EFFECTS.—Its general effects are similar to those of the other soluble salts of lead. Its local action on the animal tissues depends on its affinity for albumen and fibrin. In a solution of albumen it forms a white precipitate, composed, according to Lassaigne, (*Journ. de Chim. Méd. t. vi. 2^{de} Série.*) of albumen, 89.45, and nitrate of lead, 10.55. This precipitate is soluble in a great excess of albumen, as well as in solutions of ammonia and some neutral salts, as acetate of potash.

USES.—The Edinburgh College employs it in the preparation of *Iodide of Lead.*

8. PLUM'BI ACET'AS, L. E. D. (U. S.)—ACETATE OF LEAD.

HISTORY.—Raymond Lully and Isaac Hollandus were acquainted with this salt in the 13th century. It has been known by several appellations, as *Sugar of Lead*, (*Saccharum Saturni*), *Acetated Ceruse*, (*Cerussa acetata*), and *Superacetate of Lead* (*Plumbi Superacetat.*)

PREPARATION.—Though directions are given in British Pharmacopœias for its preparation, it is never made by the apothecary, but is procured from persons who manufacture it on a large scale.

The *London College* orders of Oxide of Lead, rubbed to powder, lbiv. and ℥ij.; Acetic Acid; Distilled Water, each Oiv. Mix the acid with the water, and add the oxide of lead to them, and, a gentle heat being applied, dissolve it; then strain. Lastly, evaporate the liquor, that crystals may be formed.

The *Edinburgh College* uses of Pyroligneous Acid (D. 1034) Oij.; Distilled Water, Oj.; Litharge, ℥xiv.

The *Dublin College* employs of Carbonate of Lead, named Ceruse, any required quantity; Distilled Vinegar, ten times the weight of the Carbonate of Lead.

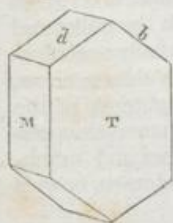
In the above processes the protoxide of lead combines with acetic acid, and forms a definite compound. In the Dublin process carbonic acid is set free.

Acetate of lead is sometimes procured by partially immersing lead in crude acetic acid. The metal attracts oxygen from the air, and the oxide thus formed unites with the acid.

PROPERTIES.—The crystals of this salt belong to the oblique prismatic system.

Their taste is sweetish and astringent. In a dry and warm atmosphere they slightly effloresce, and are apt to be decomposed by the carbonic acid of the air, and thus to become partially insoluble. When heated they fuse, give out their water of crystallization, and, at a higher temperature, are decomposed; yielding acetic acid, *Pyroacetic Spirit*, (*Acetone*, C³H⁶O.) carbonic acid, inflammable gas, and water: the residuum is a pyrophoric mixture of lead and charcoal. Acetate of lead is soluble in both water and alcohol. The aqueous solution feebly reddens litmus, though it communicates a green colour to the juice of violets. "A solution of the neutral acetate is partially decomposed by carbonic acid: a small quantity of carbonate of lead is precipitated, and a portion of acetic acid is set free, which protects the remaining solution from farther change." (*Dumas, Traité de Chim. t. v. p. 173.*)

FIG. 96.



Crystal of Acetate of Lead.

Characteristics.—When heated with sulphuric acid, the vapour of acetic acid is disengaged. Its solution is known to contain lead by the tests for this metal already mentioned (vide p. 651.) If a small quantity of acetic acid be added to the solution, a current of carbonic acid occasions no precipitate. The ordinary acetate of the shops throws down a scanty white precipitate (*carbonate of lead*) with carbonic acid. When charred, it readily yields globules of metallic lead on the application of the blowpipe flame.

COMPOSITION.—The neutral acetate has the following composition:—

	Atoms.	Eg. Wt.	Per Cent.	Berzelius.
Oxide of Lead.....	1	112	58.9	58.71
Acetic Acid.....	1	51	26.8	26.97
Water.....	3	27	14.3	14.32
Crystallized Acetate of Lead	1	190	100.0	100.00

PURITY.—It should be readily and completely soluble in water. Sulphuric acid, or sulphuretted hydrogen in excess, being added to the solution, to throw down the lead, the supernatant liquor should be completely volatilized by heat; any fixed residue is impurity.

Dissolved by distilled water. By carbonate of soda a white precipitate is thrown down from the solution, and by iodide of potassium a yellow one; by hydrosulphuric acid it is blackened. Sulphuric acid evolves acetic vapours. By heat it first fuses, and is afterwards reduced to metallic lead. *Ph. Lond.*

Entirely soluble in distilled water acidulated with acetic acid: forty-eight grains thus dissolved are not entirely precipitated by a solution of thirty grains of phosphate of soda. *Ph. Ed.*

PHYSIOLOGICAL EFFECTS. *α. On Vegetables.*—(Vide p. 652.)

β. On Animals.—Orfila (*Toxicol. Gén.*) found that in large doses the acetate of lead acted on dogs as an irritant, and caused vomiting, pain, and death. When the action was slower an absorption took place, an affection of the nervous system was observed, marked by difficult progression, and in some cases convulsive movements. The mucous membrane lining the alimentary canal was found whitened (owing to the chemical influence of poison,) and, where the action was more prolonged, reddened. Injected into the veins, or applied to wounds, it affects the nervous system. Schloepfer (quoted by Dr. Christison, p. 507.) produced colica pictonum, paralysis, and convulsions, in dogs, by the repeated use of small doses. Dr. A. T. Thomson (*Lond. Med. Gaz.* x. 691.) gave successively, one, two, three, and six drachms to a dog without any ill effect.

γ. On Man.—Applied to ulcers, mucous membranes, or other secreting surfaces, it acts as a desiccative and astringent. It reacts chemically on the albumen of the secretions and of the living tissues, and forms therewith compounds which are for the most part insoluble in water and acids.¹ Hence the difficulty with which this salt becomes absorbed. Some of its compounds with organic substances are, however, rendered soluble in water by acids (as the acetic, hydrochloric, and lactic.) In large quantities, acetate of lead taken into the stomach acts as an irritant, and causes symptoms of inflammation of the stomach, viz. vomiting, burning in the gullet and stomach, and tenderness at the pit of the stomach; but these are usually accompanied with colica pictonum, and are not unfrequently followed by convulsions, coma, or local palsy.² Ten grains taken daily for seven days caused tightness of the breast, metallic taste, constriction of the throat, debility, sallow countenance, slow respirations and circulation, turgid and tender gums, ptyalism, tightness and numbness in the fingers and toes, no nausea, pains of the stomach and abdomen, bowels

¹ Dr. C. G. Mitscherlich *Brit. Ann. of Med.* i. 204.

² Christison, *Treat. on Poisons*, 3d edit. p. 512.—In a recent case an ounce of acetate of lead in solution, caused, in a young girl, collapse and syncope followed by vomiting and convulsions. Orfila detected lead in the urine (*Pharm. Trans.* No. vi. p. 119.)

confined.¹ The observations of Dr. A. T. Thomson and others (Van Swieten,² Reynolds, Latham, Laidlaw, Daniell, Christison, &c.) have, however, shown that injurious effects from the use of large doses are very rare. I have repeatedly given five grains three times a day for ten days, without inconvenience. This dose was taken for a fortnight.³ The blue line on the gums (see p. 653) was then very distinct, and the patient complained of griping pains in the bowels. Dr. Christison has given eighteen grains daily for eight or ten days without any unpleasant symptoms whatever, except once or twice slight colic. During its employment the gums should be frequently examined, in order that the earliest appearance of the blue line, before referred to, may be detected. Whenever this salt gives rise to any obvious effects, they are those of the plumbeous preparations in general, and which have been already described (p. 652.) Its medicinal action, therefore, is sedative and astringent.

Uses.—Acetate of lead is administered *internally* to diminish the diameter of the capillary vessels, and lessen circulation, secretion, and exhalation. Thus, we employ it in profuse discharges from the mucous membranes; as from the lungs, alimentary canal, and even the urino-genital membrane. In the mild cholera, so common in this country towards the end of summer, I have found acetate of lead in combination with opium most efficacious where the chalk mixture failed. I have used this combination in a few cases of malignant cholera, and in one or two with apparent benefit. In colliquative diarrhœa and chronic dysentery it occasionally proves serviceable.⁴ In phthisis it has been found beneficial, but only as a palliative; namely, to lessen the expectoration, check the night-sweats, or stop the harassing diarrhœa. Dr. Latham⁵ speaks most favourably of the use of sugar of lead and opium in checking purulent or semi-purulent expectoration. I have repeatedly seen it diminish expectoration, but I have generally found it fail in relieving the night-sweats, though Fouquier supposed it to possess a specific power of checking them: they are more frequently benefited by diluted sulphuric acid. In sanguineous exhalations from the mucous membranes, as epistaxis, hæmoptysis, and hæmatemesis, and in uterine hemorrhage, it is employed with the view of diminishing the caliber of the bleeding vessels, and thereby of stopping the discharge: and experience has fully established its utility.⁶ It may be employed in both the active and passive states of hemorrhage. It is usually given in combination with opium. In bronchitis, with profuse secretion, it proves exceedingly valuable. (Henderson, *Lond. Med. Gaz.* May 8, 1840.) It has been employed also as a remedy for mercurial salivation. (Daniell, *Lond. Med. Repos.* N. S. vi. 308.) It had been applied for this affection in the form of gargle by Sommé. (*Archiv. Gén. de Méd.* i. 483.) Unless care be taken to wash the mouth carefully after its use, it is apt to blacken the teeth. On the same principles that we administer it to check excessive mucous discharges, it has been employed to lessen the secretion of pus in extensive abscesses attended with hectic fever.

There are some other cases in which experience has shown acetate of lead is occasionally serviceable, but in which we see no necessary connexion between its obvious effects on the body and its remedial powers; as in epilepsy, chorea, intermittents, &c.

As a *topical* remedy, we use acetate of lead as a sedative, astringent, and de-

¹ Laidlaw, *Lond. Med. Repos.* N. S. vi. 292.

² *Commentaries*, vol. x. p. 236, Eng. ed. Van Swieten says colic was induced by the use of a drachm of lead in an emulsion every day for ten days.

³ In the *Journ. de Chim. Méd.* (t. vi. 21^e Serie, p. 97) a case is related of death from this salt. The patient, a boy of 15 years of age, affected with a phthisical malady, took from a ½ gr. to grs. ii. four times a day, until he had taken 130 grs. without any ill effect. A month after he was seized with colic, which was followed by paralysis and death.

⁴ See Dr. Burke, *On the good Effects of a mixture of Acetate of Lead and Tincture of Opium in the Dysentery which occurred in Dublin in 1825*, in the *Edinb. Med. and Surg. Journ.* vol. xxvi. p. 56.

⁵ *Med. Trans. Coll. Phys.* v. 341.

⁶ Reynolds, *Trans. of Coll. Phys. London.* iii. 217; Davies, *Med. and Phys. Journ.* Jan. 1808, p. 8; also, Mitchell, *ibid.* p. 69; and Latham, *op. cit.*

siccant. An aqueous solution of it is applied to inflamed parts, or to secreting surfaces, to diminish profuse discharges. Thus, we use it in phlegmonous inflammation, in ophthalmia, in ulcers with profuse discharges, in gonorrhœa, and gleet. In the sloughing and ulceration of the cornea which attend purulent and pustular ophthalmia, its use should be prohibited, as it forms a white compound which is deposited on the ulcer; to which it adheres tenaciously, and in the healing becomes permanently and indelibly imbedded in the structure of the cornea. The appearance produced by this cause cannot be mistaken: its chalky impervious opacity distinguishes it from the pearly semi-transparent structure of even the densest opacity produced by common ulceration. (Dr. Jacob, *Dublin Hosp. Rep.* v. 369; also, Velpeau., *Lond. Med. Gaz.* Oct. 5, 1839.) The white compound consists of oxide [acetate?] of lead, animal matter, much carbonate of lead, traces of phosphate and chloride of the same metal. (Dr. Apjohn, *op. cit.* p. 402.)

ADMINISTRATION.—Acetate of lead may be administered internally in doses of one or two grains to eight or ten grains, repeated twice or thrice daily. Dr. A. T. Thomson advises its exhibition in diluted distilled vinegar, to prevent its change into carbonate, which renders it more apt to occasion colic. It is usually exhibited in the form of pill, frequently in combination with opium. Acetate of lead and opium re-act chemically on each other, and produce acetate of morphia and meconate, with a little sulphate of lead. Experience, however, has fully established the therapeutic value of the combination. Sulphuric acid (as in infusion of roses,) sulphates (as of magnesia, and soda, and alum,) phosphates, and carbonates, should be prohibited. Sulphuric acid, the sulphates, and phosphates, render it inert: the carbonates facilitate the production of colica pictonum. Common (especially spring) water, which contains sulphates, carbonates, and chlorides, is incompatible with this salt. The liquor ammoniæ acetatis is incompatible with it, on account of the carbonic acid usually diffused through this solution.

1. CERATUM PLUMBI ACETATIS, *L.*: *Unguentum Plumbi Acetatis*, *E. D.*; *Unguentum Saturninum*; *Cerate of Sugar of Lead*. (Acetate of Lead, powdered, ℥ij.; White Wax, ℥ij.; Olive Oil, ℥3vij. *L.*—Simple Ointment, ℥xx.; Acetate of Lead, in fine powder, ℥j. *E.*—Ointment of White Wax, ℥iiss.; Acetate of Lead, ℥j. *D.* Mix.)—An excellent soothing application to irritable ulcers, painful excoriations, and blistered surfaces.

2. PILULÆ PLUMBI OPIATÆ, *E.* *Acetate of Lead and Opium Pills*. (Acetate of Lead, *six parts*; Opium, *one part*; Conserve of Red Roses, *about one part*. Beat them into a proper mass, which is to be divided into four-grain pills.—This pill may be made also with twice the quantity of opium.)—Each pill contains three grains of acetate of lead, and half a grain of opium. I have before stated that, notwithstanding a mutual decomposition is effected between acetate of lead and opium, the resulting compound is a most efficacious one. The Edinburgh College, therefore, has done wisely in countenancing the combination, but the permission to vary the strength of the pill is highly objectionable. In hæmoptysis, profuse secretion of bronchial mucus, obstinate diarrhœa, and dysentery, its effects are most valuable. Dose, one to three grains.

9. LIQUOR PLUMBI DIACETATIS, *L.*—SOLUTION OF DIACETATE OF LEAD.

(Plumbi Diacetatis Solutio, *E.*—Plumbi Subacetatis Liquor, *D.*)—[Liquor Plumbi Subacetatis, *U. S.*]

HISTORY.—This compound was known to Basil Valentine in the fifteenth century. It owes its reputation, as a medicine, principally to the praises bestowed

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on it by M. Goulard,¹ in the latter end of the last century. He called it *Extract of Saturn* (*Extractum Saturni*.) It is frequently termed *Goulard's Extract*.

PREPARATION.—The following are the directions of the British Colleges for its preparation:—

The *London College* orders, of Acetate of Lead, lbij. and ℥iij.; Oxide of Lead, rubbed to powder, lbj. and ℥iv.; Water, Ovj. Boil them for half an hour, frequently stirring, and when the liquor is cold, add of distilled water as much as may be sufficient to measure with it six pints; lastly, strain [the solution.]

The *Edinburgh College* employs, of Acetate of Lead, ℥vj. and ℥vj.; Litharge, in fine powder, ℥iv.; Water, Oiss.

[The U. S. P. directs Acetate of Lead, sixteen ounces; Semi-vitrified Oxide of Lead, in fine powder, nine ounces and a-half; Distilled Water, four pints. The mode of proceeding is essentially the same as that of the London College.]

The acetate of lead combines with an additional equivalent of oxide of lead to form the diacetate. This process yields a uniform product.

The *Dublin College* employs, of Litharge, one part; Distilled Vinegar, twelve parts. Boil together in a glass vessel until eleven parts of the fluid remain; then let the liquor rest, and when the impurities have subsided, let it be filtered.

In this process the acetic acid unites with the oxide of lead to form a subsalt. This method of preparation is objectionable, since the strength of the solution depends on the strength of the vinegar, which is subject to variation.

PROPERTIES.—It is a transparent and colourless liquid. Prepared according to the *London Pharmacopœia*, its specific gravity is 1.260: according to the *Dublin Pharmacopœia*, it is 1.118. Its taste is sweet and astringent. By evaporation it yields crystals of the diacetate of lead, which according to Dr. Barker, are flat rhomboidal prisms, with dihedral summits.

Characteristics.—The presence of lead and acetic acid in this solution may be known by the tests before mentioned (p. 651) for acetate of lead.

From the neutral acetate it is distinguished by the copious precipitate which it produces with carbonic acid, as well as with mucilage. Solution of the diacetate of lead forms a precipitate with most vegetable colouring matters.

COMPOSITION.—This liquid is an aqueous solution of the diacetate of lead. The solid hydrated diacetate has, according to Dr. Thomson, the following composition:—

	Atoms.	Eq. Wt.	Per Cent.
Oxide of Lead.....	2	224	61.37
Acetic Acid.....	1	51	13.97
Water.....	10	90	24.66
Solid Hydrated Diacetate of Lead 1		365	100.00

PURITY.—When this compound has been prepared with common vinegar, it has a brown colour.

Its sp. gr. is 1.260. Its other properties are similar to those of the last preparation. *Ph. Lond.*

A copious precipitate is gradually formed when the breath is propelled through it by means of a tube. *Ph. Ed.*

PHYSIOLOGICAL EFFECTS.—Its effects are analogous to the acetate. Its chemical action on the living tissues depends on its affinity for albumen and fibrine. In a solution of albumen it occasions a white precipitate, composed of albumen and diacetate of lead. According to Lassaigne, (*Journ. de Chim. Méd. t. vi. 2^e Série*, p. 299.) the precipitate caused in an albuminous liquor by the trisacetate of lead consists of albumen 71.67, and trisacetate of lead 28.33. This precipitate is soluble in an excess of the solution of the trisacetate, as well as in concentrated solutions of several salts (as acetate and nitrate of potash,) and of caustic ammonia.

¹ *A Treatise on the Effects and various Preparations of Lead, particularly of the Extract of Saturn, for different Chirurgical Disorders*, 2nd ed. Lond. 1770.

Dr. A. T. Thomson (*Lond. Med. Gaz.* vol. v. p. 538; vol. x. p. 693.) asserts, from his experiments on animals, that the diacetate has more tendency to cause colic than the neutral acetate, because it is more readily converted into carbonate of lead. It is employed in medicine as a local astringent and sedative. Paralysis is said to have resulted from its external use.

USES.—It is employed, when diluted, to promote the resolution of external inflammation, to check profuse discharges from suppurating, ulcerated, and mucous surfaces, and to alleviate local pains. Thus it is applied to parts affected with either phlegmonous or erysipelatous inflammation, to whitloes, to inflamed tendons, aponeuroses, or absorbent glands; in ophthalmia, to contusions, sprains, burns, wounds (whether incised or lacerated,) to blistered surfaces, ulcers, abscesses, &c.

It is said to have proved successful, when administered internally, in hydrophobia.

ADMINISTRATION.—It is employed diluted with water, added to poultices, or mixed with fatty matters, and applied as an ointment.

1. LIQUOR PLUMBI DIACETATIS DILUTUS, *L.* *Plumbi Subacetatis Liquor compositus*, *D.* (Solution of Diacetate of Lead, ℥ʒiiss; Distilled Water, Oj.; Proof Spirit, ʒij.—*M.*) [*Liquor Plumbi Subacetatis Dilutus*, *U. S.* *Diluted Solution of Subacetate of Lead.* Take of Solution of Subacetate of Lead, ʒij.; Distilled Water, a pint. Mix them.]—This preparation is an imitation of the *Water of Saturn*, or *Vegeto-Mineral Water* of Goulard. It is commonly termed, in the shops *Goulard Water*. It should be transparent and colourless; but when prepared with common water it is more or less milky, owing to the formation of carbonate, sulphate, and chloride of lead. The small quantity of spirit employed can be of no service. The quantity of the solution of diacetate of lead employed in making Goulard water is much too small; it should be, at least, three times, and in some cases, I have used six times as much. I have never seen any ill effects from its use, though it is said to have become absorbed in some cases. The same objection applies to the use of this compound as to that of the neutral acetate, in ulceration of the cornea (*vide* p. 666.)

Goulard water is used as a cooling, sedative, and astringent wash in the cases already enumerated for the Goulard's extract. A poultice, composed of crumb of bread, boiled in Goulard water, is sometimes a very useful application to phlegmons, painful wounds, irritable ulcers, &c. &c.

2. CERATUM PLUMBI COMPOSITUM, *L.* [*Ceratum Plumbi Subacetates*, *U. S.*, *Cerate of Subacetate of Lead.*] (Solution of Diacetate of Lead, ℥ʒiij., [℥ʒiiss., *U. S.*;] Wax, ʒiv.; Olive Oil, Oss., [℥ʒix., *U. S.*;] Camphor, ʒss. Mix the melted Wax with eight fluid-ounces of the Oil; then remove them from the fire, and, when first they begin to thicken, gradually add the solution of Diacetate of Lead, and stir them constantly with a spatula until they cool; lastly, with these mix the Camphor dissolved in the rest of the oil.) This is the *Cerate of Saturn* of M. Goulard, and is commonly called *Goulard's Cerate*. It is employed as a dressing to wounds and ulcers, for the purpose of allaying irritation and appeasing pain. With the same views it is also applied to excoriated surfaces, burns, scalds, blistered surfaces, and irritable cutaneous affections. Opium is sometimes advantageously combined with it.

3. CERATUM SAPONIS, *L.*—This contains a subacetate of lead. It has been before described (p. 414.)

10. EMPLAS'TRUM PLUM'BI, *L.* (*U. S.*)—PLASTER OF LEAD.

(*Emplastrum Lithargyri*, *E. D.*)

HISTORY.—This compound was known to the ancients: both Pliny (*Hist. Nat.* xxxiv. 53.) and Celsus (*De Medicina*, lib. v. cap. xix.) gave a formula for a plas-

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ter used by the Roman surgeons, which is almost identical with that for the official plaster of lead. It is commonly sold in the shops as *Diachylon* or *Diachylum*.

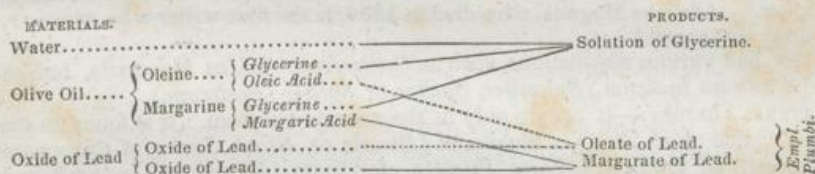
PREPARATION.—The following are the directions of the British Colleges for its preparation:—

The *London College* orders of Oxide of Lead, rubbed to very fine powder, lbvj.; [lbv. U. S.] Olive Oil, Cong. j.; Water, Oij. Boil them together with a slow fire, constantly stirring, until the Oil and Oxide of Lead unite into the consistence of a plaster; but it will be proper to add a little boiling water, if nearly the whole of that which was used in the beginning should be evaporated before the end of the boiling.

The *Edinburgh College* orders of Litharge, in fine powder, ℥v.; Olive Oil, f℥xij.; Water, f℥iij. Mix them; boil and stir constantly till the oil and litharge unite, replacing the water if it evaporate too far.

The process of the *Dublin College* is similar to that of the *London College*.

Olive Oil is a compound of Oleine (*Oleate of Glycerine*) and Margarine (*Margarate of Glycerine*.) When subjected to heat with litharge and some water, the oxide of lead combines with the oleic and margaric acids, and sets free the glycerine, which remains dissolved in the water. The mixture of oleate and margarate of lead constitutes *emplastrum plumbi*. (See p. 478 for an account of Saponification.) The water employed in this process serves two purposes: it moderates the heat and facilitates the union of the acids with the oxide of lead.



PROPERTIES.—It is met with in the shops in cylindrical rolls, of a grayish or yellowish-white colour, brittle when cold, but softening and ultimately fusing by heat. It is insoluble in water, and nearly so in alcohol. It has no taste, but a slight though peculiar odour.

Characteristics.—When heated it fuses, then decomposes, gives out inflammable gas, and leaves a carbonaceous residue, which, when heated in a close vessel, yields globules of lead. Ether dissolves oleate but not margarate of lead.

COMPOSITION.—Lead plaster consists of *Oxide of Lead, Oleic Acid, and Margaric Acid*. The proportions have not been precisely ascertained. The two compounds which oleic and margaric acids form with oxide of lead are probably basic salts.

EFFECTS AND USES.—This plaster is employed in surgery, on account of its adhesiveness and the mildness of its local action; for it rarely excites irritation. It is used to keep the edges of wounds together in persons with delicate skins. Spread on calico it forms a good *strapping* for giving support and causing pressure in ulcers of the leg,—a most successful mode of treating them, and for which we are indebted to Mr. Baynton.

In pharmacy it serves as a basis for various other plasters.

1. **EMPLASTRUM RESINÆ, L.** (U. S.): *Emplastrum Resinosum, E.*; *Emplastrum Lithargyri cum Resinâ, D.*; *Resin Plaster.* (Resin, lbss. [℥j. E.]; Lead Plaster, lbij. [℥v. E.; lbijss. D.]) To the plaster of lead, melted with a slow fire, add the Resin, powdered, and mix.)—This is the common *Adhesive Plaster* (*Emplastrum Adhæsivum*), and is kept in the shops ready spread. It is employed to retain the lips of wounds in contact, as in cuts, surgical operations, &c. It is more adhesive than lead plaster, but at the same time somewhat more irri-

tating, and occasionally causes excoriation. It is employed as a *strapping* for dressing ulcers on Baynton's principles.

2. EMPLASTRUM SAPONIS, L. E. D. This contains lead plaster, (see p. 415.)

3. UNGUENTUM PLUMBI COMPOSITUM, L. (Prepared Chalk, ℥viii.; Distilled Vinegar, f℥vj.; Plaster of Lead, lbij.; Olive Oil, Oj. Mix the chalk with the vinegar; and, when the effervescence has ceased, add gradually the solution to the plaster and oil melted with a slow fire, and stir constantly until they are cooled.)—By the action of the acetic acid on the chalk, an acetate of lime is procured, and carbonic acid evolved, and the acetate of lime is then mixed with lead plaster and oil. This compound is an imitation of *Kirkland's Neutral Cerate*, used as a dressing to indolent ulcers. It is employed by Mr. Higginbottom, (*Essay on the Use of Nitrate of Silver*, 2nd ed. p. 119.) under the name of *Neutral Ointment*, as a defence for ulcers after the application of nitrate of silver.

ORDER XXVI.—ZINC AND ITS COMPOUNDS.

I. ZINCUM, L. E. D. [U. S.]—ZINC.

HISTORY.—Although the ancients were acquainted with the method of converting copper into brass by means of an ore of zinc, yet we have no positive evidence that they were acquainted with metallic zinc, one of the constituents of this alloy.¹ Albertus Magnus, who died in 1280, is the first writer who expressly mentions this metal.²

It has had various appellations, such as *Contrefeyn*, *Golden Marcasite*, *Indian Tin* (*Stannum Indicum*), *Spiaulter*, *Speltre* or *Spelter* (*Speltrum*.)

NATURAL HISTORY.—It occurs only in the mineral kingdom. It is found in the form of Oxide (*Red Zinc*), of Sulphuret (*Blende* or *Black Jack*), of Carbonate (*Calamine*), of Sulphate (*White Vitriol*), of Silicate (*Electric Calamine*), and Aluminate (*Automalite* or *Gahnite*.)

PREPARATION.—Zinc is usually procured from the native sulphuret or carbonate of that metal. It may also be obtained from the silicate.

Both the sulphuret and carbonate are roasted: by this process the sulphur of the sulphuret is transformed into sulphurous acid, which escapes, and the zinc is oxidized; while the carbonate loses carbonic acid and water. The oxide is then mixed with some carbonaceous substance and submitted to heat, by which the metal is reduced and vaporized. Sometimes the reduction is effected in a covered earthen crucible, the bottom of which is perforated by an iron tube, which terminates over a vessel of water situated in an apartment below the furnace. The gaseous products and zinc escape by this tube; and the latter is condensed in the water. This is called *distillatio per decensum*. In Silesia, however, *distillato per ascensum* is employed. (Dumas, *Traité de Chimie*, t. iv. p. 82.)

The zinc used in this country is principally imported in ingots and plates from Silesia, by way of Hamburgh, Antwerp, Dantzic, &c.

PROPERTIES.—It is a bluish-white metal, of considerable lustre. It crystallizes in four-sided prisms and needles; its texture is lamellated and crystalline. Its sp. gr. is from 6.8 to 7.2. At a common temperature it is tough; from 202° 300° it is ductile and malleable, and may be readily rolled into thin leaves (*Sheet Zinc*;) at 400° it is so brittle that it may be reduced to powder. It readily fuses, and, at a white heat, may be volatilized.

Characteristics.—It is soluble in dilute sulphuric acid, with the evolution of hydrogen gas. Ferrocyanide of potassium forms, in this solution, a gelatinous white

¹ Beckmann, in his *History of Inventions and Discoveries*, vol. iii. p. 71, has given a good account of the history of zinc.

² An anonymous reviewer (*British and Foreign Medical Review*, vol. viii. p. 361,) in commenting on the above paragraph, observes, that a passage in Strabo authorizes the belief that the ancients did know this metal in its separate state, and that it is the *false silver* (ψευδαργυρος) of that ancient geographer.