The student's chemical pocket companion / by W. S. Jacobs, M.D.

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Chemistry

ANNEX

John Sparrow

Philadelphia 1807

THE STUDENT'S CHEMICAL POCKET COMPANION.

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BY

W. S. JACOBS, M. D.

Trahit quodcunque potest atque addit acervo.

HOR.

PHILADELPHIA:

PRINTED BY M. CAREY, AND KIMBER, CONRAD & CO.

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1807.

TO THE GENTLEMEN

ATTENDING THE

MEDICAL LECTURES

IN THE

UNIVERSITY OF PENNSYLVANIA,

THE

FOLLOWING SHEETS,

INTENDED TO FACILITATE

THEIR PROGRESS IN

THE SCIENCE OF CHEMISTRY,

ARE INSCRIBED,

BY

THEIR FRIEND,

AND WELL WISHER,

W. S. JACOBS.

PREFACE.

THE utility and necessity of a compendium, to facilitate the study of Chemistry, of the size and compass of the one I now present to the public, has long been acknowledged. To comprise the essential information in a size convenient for the pocket, is attended with more difficulty than many will allow. The following sheets may probably merit the attention of the students in this university, as they contain a detail of many original and useful experiments, as performed by the professor of Chemistry, Dr. Woodhouse.

I have not aimed at any thing elaborate: intending it principally for the Tyro in Chemistry, I have selected, and thrown together in as compendious a manner as possible, what is essentially, indeed indispensibly requisite, to be known by him.

The various and interesting subjects of this science require, in a minute investigation, the aid of volumes ; but the Student, too frequently damped in the commencement of his career, by the prospect of labour before him, turns from the volumes in disgust, and relinquishes the pursuit, before he can become interested in the subject, or capable of appreciating its advantages. A volume of this size is calculated to allure him into the paths of science, by diverting the mind, and exciting in it the spirit of enquiry.

This performance, as being executed in those hours, which could be spared from a laborious employment, will, I hope, meet the indulgence of the candid reader.

CHEMISTRY.

CHEMISTRY has for its object, the investigation of the constituent principles of bodies.

This knowledge is obtained by analysis or decomposition, and synthesis, or composition.

ATTRACTION is that power, by which the particles of bodies are approximated.

There are four kinds of attraction, 1st, the attraction of gravitation; 2d, of cohesion; 3d, of magnetism; 4th, chemical attraction.

The laws of chemical attraction, or affinity, are of two kinds, viz. the affinity of aggregation, and the affinity of composition.

The attraction of aggregation exists between particles of bodies similar in their nature; while the attraction of composition, exists between particles which are dissimilar.

OF CALORIC.

HEAT tends to separate the particles of bodies, and antagonises all kinds of attraction.

When the attraction of cohesion is in an over-proportion, bodies are solid. When caloric predominates in a small proportion, they assume a liquid form; but when in a greater degree, the body is converted into gas.

HEAT always tends to an equilibrium.

Bodies are called good or bad conductors, according to the quick or slow passage of this fluid through them.

When a body passes from a solid to a fluid state, a quantity of heat is absorbed: this heat is then in a state of combination, and is called latent heat. Bodies passing from a fluid to a gaseous state, heat is also absorbed, by which they are kept in that state. When, on the contrary, a body passes from a fluid to a solid state, heat is given out, which becomes sensible heat.

LIGHT.

The solar light is divisible, by the prism, into seven primitive colours, viz. red, orange, yellow, green, blue, indigo and violet.

LIGHT passing from one medium into another of different density, suffers refraction. It is also ponderous.*

* See Newton.

VEGETABLES when deprived of light, exhibit a pale colour, are inodorous, insipid, and deprived of active qualities.

Light has great effects on chemical operations, by disengaging oxygen from various combinations.

SULPHUR

Is a simple substance of an orange yellow colour, burning with a blue flame, and exhaling a strong penetrating odour; by friction, it becomes electric.

It is found native, or combined with earths and metals; it is also obtained from certain vegetables.

FLOWERS OF SULPHUR are obtained from crude sulphur by subliming it in close vessels.

Sulphur burnt with substances, containing oxygen, forms the sulphuric acid.

Sulphur combined with different substances, forms sulphurets; but these combinations will be mentioned in their respective places.

CARBON.

From many experiments, it appears that the diamond is crystalized carbon, or carbon in a state of purity.

PLUMBAGO is the next degree of purity, and is an oxyde of carbon.

CHARCOAL possesses the third degree of purity; and carbonic acid the last, being completely saturated with oxygen.

Plumbago is found in different parts of the world, but the best is found in England.—It is a mixture of carbon and iron.

Charcoal is obtained from animal and vegetable substances by combustion. In close vessels it resists the greatest heat; by this means it is obtained in a state of purity. It readily absorbs moisture from the atmosphere. Fourcroy considers charcoal, as an hydrogenous oxyde of carbon.

PHOSPHORUS

Is a substance of the consistence of wax, of a flesh colour, and when pure, transparent; it is luminous in the dark, and soluble in alkohol and the essential oils.

This substance was first obtained from urine, but is procured with greater facility from bones, as they contain the phosphate

of lime. These must be calcined to whiteness, then pulverized, and diluted sulphuric acid thrown on them; the sulphuric acid unites to the lime, and forms the sulphate of lime, while the phosphoric acid is set at liberty, and remains in the fluid: this is decanted, and evaporated to the consistence of an extract; it then must be put in a crucible, and exposed to heat, till converted into glass. This must be powdered and mixed with pulverized charcoal; it is then to be put in an earthen retort well coated with dung and clay, and exposed to the heat of an air furnace. In this operation, the oxygen of the phosphoric acid unites with the coal, and forms the carbonic acid, while the phosphorus comes over in tears and phosphorated hydrogen gas.

PHOSPHORUS takes fire at about 100° of Farenheit: it then combines with the oxygen of the atmosphere, and forms phosphoric acid.

OF THE GASES.

HYDROGEN GAS is a combination of hydrogen and caloric, so called because it is one of the constituent parts of water. It is obtained from several substances, but

with great facility by the decomposition of water.

If to a piece of zinc, be added a quantity of diluted sulphuric acid, the acid decomposes the water; the oxygen of the water oxydes the zinc, which is dissolved by the acid, forming a sulphate of zinc, and the hydrogen is disengaged. It is also obtained in large quantities, by passing steam through an ignited iron tube.

If 15 parts of hydrogen, and 85 of oxygen, be burnt in a close vessel, water is formed proportionably to the weight of the gases employed.

When this gas is obtained over mercury, it is inodorous; but when obtained over water, it contracts a disagreeable smell from the water it holds in solution.

It is improper for respiration and combustion, unless in contact with atmospheric air. When taken into the lungs, it suffers no decomposition.

It is the lightest of all the gases, a cubic foot weighing only 72 grains.

Hydrogen gas has the property of dissolving certain substances. When combined with sulphur, it is called sulphurated hydrogen, or hepatic gas, which has a disagreeable smell, renders white metals black, and is unfit for animal life. It may be formed by adding water to hepar sulphu-

ris: In this experiment, the water is decomposed, the oxygen unites to part of the sulphur, and forms the sulphuric acid, this combines with the potash of the hepar, and forms vitriolated tartar, while the hydrogen of the water dissolves the other part of the sulphur, forming sulphurated hydrogen gas.

With carbon, it forms carbonated hydrogen gas; this is the most fatal of all the gases.

It may be obtained by extinguishing ignited coals under water, and receiving the gas as it is formed.

It is also procured from cast iron, and the sulphuric acid, or from finery cinder and charcoal by distillation: hydro carbonate generally contains a small quantity of carbonic acid; it is freed from this by washing it in lime-water.

With phosphorus, it forms phosphorated hydrogen gas: this is often seen in the neighbourhood of burial grounds, as the ignes fatui, &c. It is this gas that burns on the surface of certain springs.

OF OXYGEN.

Oxygen, the acidifying and putrifying principle, is found only in combination.

OXYGEN GAS is composed of oxygen and caloric. It forms a constituent part of our atmosphere, in the proportion of 28 to 100. It is the only gas proper for combustion and animal life ; in both cases, the oxygen is decomposed, and sensible heat generated : it is also one of the component parts of water.

It is emitted by exposing vegetables to the light of the sun, under water.

It may be obtained by decomposing acids, of which it is the base.

One pound of nitre yields 1200 cubic inches of this gas, by distillation. In this case, the nitric acid of the nitre is decomposed. It is obtained also in great quantities, from the black oxyde of manganese, by the sulphuric acid and heat, or by exposing the oxyde, in an earthen retort, to a red heat.

MERCURIAL OXYDES yield large quantities of this gas, by heat only, holding a small portion of mercury in solution.

Its specific gravity exceeds that of atmospheric air—a cubic foot weighing 760 grains.

NITROGEN,

Or AZOTE, is the radical of the nitric acid : it is always found in combination.

NITROGEN GAS is a combination of nitrogen with caloric. The best method of obtaining it, is by exposing a quantity of atmospheric air, in a vessel inverted over a liver of sulphur or of lime: the oxygen will be absorbed, and the nitrogen left behind; which must be washed in lime water, to absorb a small quantity of carbonic acid, which generally exists in atmospheric air.

It may also be obtained by treating the muscular parts of animals, with the nitric acid. Also by inverting a vessel over a combustible body, the oxygen will be absorbed during combustion, and the azote left behind.

This gas is improper for respiration and combustion; it is lighter than atmospheric air, of which it forms 72 parts in the hundred.

ATMOSPHERIC AIR

Is a mixture of 72 parts of nitrogen, and 28 of oxygen; a small proportion of carbonic acid exists, but not as a constituent part.

These gases are not in a state of combination, but in a state of mixture.

The gravity of the atmosphere differs at different times, which is evinced by the barometer.

It is invisible, insipid, and inodorous: a cubic foot weighs 720 grains.

This gas is decomposed during respiration, part of its oxygen is absorbed in its passage through the lungs: this unites to the phosphorus of the blood, and produces the phosphoric acid, while heat is set at liberty: this phosphoric acid unites to the iron of the red globules, and produces the red colour—Another part of the oxygen combines with the carbon of the blood, and forms the carbonic acid, which is discharged from the lungs with a portion of atmospheric air, not decomposed in the process.

WATER

Is a transparent fluid, composed of hydrogen and oxygen, in the proportion of 15 parts of the former, and 85 of the latter.

It exists in most bodies, of the animal, vegetable, and mineral kingdoms. At 32° of Farenheit's Thermometer, water freezes; above this temperature it assumes a liquid form, and at 212° it is converted into vapour.

WATER, when raised in the atmosphere, constitutes clouds, fogs, mists, rain, &c. by simple refrigeration.

ICE is the natural state of water; the conversion of water into ice, is attended with a disengagement of heat.

Water, in a solid state, occupies more space than in a liquid form.

Water is generally presented to us by nature in a fluid state; river, or rain water is never found pure, but contains salts, acids, &c. these are rendered pure by distillation. If water be passed through an ignited iron tube, it will be decomposed, the oxygen unites to the iron, and the hydrogen escapes; the metal will be found to have encreased in weight, which if added to the hydrogen will be equal to the weight of the water employed. This experiment is one of the pillars of the new doctrine.

ALKALIES.

ALKALIES have an acrid urinous taste, turn blue vegetable colours, green, (indigo and litmus excepted) effervesce with some

acids, and form neutral salts with all. They likewise render oils miscible with water, forming soap.

ALKALIES are divided into fixed and volatile.

OF FIXED ALKALIES.

POTASH or the vegetable alkali, is composed of nitrogen, and a base, which is supposed to be lime. It is obtained from the ashes of vegetables, and from the lees of wine; this salt attracts the moisture of the atmosphere, and is then called oil of tartar, per deliquium.

Pure potash is also obtained by fusing nitre upon charcoal, the acid and water are dissipated, while the alkali remains alone; this is called extemporaneous alkali.

SALT OF TARTAR is formed by calcining the tartar of wine, dissolving the residue in water, and crystalizing it; or by burning nitre and tartar; the residue after lixiviation, is a beautiful salt of tartar.

MINERAL ALKALI.

Natron or Soda, is found in a native state, in Egypt, but is generally obtained from the ashes of marine plants. It is supposed to consist of nitrogen and magnesia: it effloresces in the air; when pure it is less caustic than potash, and better for the purpose of making glass; contains in 100 parts, 16 acid, 20 alkali, and 64 of water.

Alkalies combine easily with sulphur: If pure liquid alkali be digested upon sulphur, the mixture becomes reddish, and is then called liver of sulphur; a fœtid gas, called hepatic gas, is disengaged. This hepar sulphuris, or liver of sulphur, dissolves metals, even gold itself.

Vegetable and mineral alkalies, have the property of forming glass with silex, and not being volatilized by heat.

AMMONIAC,

Or the volatile alkali, is composed of hydrogen and nitrogen, in the proportion of 193 of the former, and 807 of the latter, in the 1000: volatile alkali is usually obtained by distilling animal substances, as hoofs, horns, bones, &c. this product is contami-

nated with Dipple's animal oil; it is also obtained from certain vegetables. Very pure ammoniac may be obtained by mixing equal parts of sal ammoniac, and quicklime in powder; this is put into a flask, to which a syphon is adapted; being exposed to heat, the volatile alkali comes over, and is received in vessels containing water, until fully saturated; the muriatic acid of the sal ammoniac unites to the lime, and forms muriate of lime, while the ammoniac is disengaged in the form of alkaline gas, which is absorbed by the water, forming the caustic ammoniac.

ALKALINE gas is a combination of ammoniac and caloric; it is improper for respiration and combustion, and is lighter than atmospheric air.

By mixing this gas with the oxygenated muriatic acid, water is produced. This is effected by the union of the oxygen of the acid, with the hydrogen of the alkali, while the azote is set at liberty, and the oxygenated acid is reduced to the state of common muriatic acid.

OF ACIDS.

ACIDS are formed by the combination of oxygen with certain bases.

Acids have a sour, stiptic taste; effervesce with alkalies, and change blue vegetable colours, red—indigo excepted.

The SULPHURIC ACID, is obtained by burning sulphur with a substance containing oxygen; nitre is generally used for this purpose—100 parts of this acid contain about 70 sulphur and 30 oxygen. When this acid is mixed with water, it produces heat sufficient to make water boil. It attracts water from the atmosphere, and congeals by intense cold—If any combustible body is immersed in the acid, this last is changed into the sulphureous by parting with its oxygen. If more oxygen is abstracted, it will be converted into sulphureous gas.

SULPHURIC ETHER is made by distilling together equal parts of strong sulphuric acid, and alkohol. The first product is spirit of wine, the second ether, the third is a substance called sweet oil of wine; and a black matter resembling tar, is left in the retort.

HOFMAN'S ANODYNE DROPS, is a mixture of ether, alkohol, and a small quantity of the sweet oil of wine.

If the sulphuric and muriatic ethers be mixed together, the evaporation is so rapid that mercury has been frozen by the degree of cold thus produced.

SULPHURIC ACID, united to certain bases, forms salts, called sulphates.

SULPHATE OF SODA, or Glauber's salt, is obtained in different ways; but a very economical process of forming Glauber's salt, is by adding the sulphate of ammoniac, in solution, to the muriate of soda; here a double elective attraction takes place, the sulphuric acid unites to the soda, forming sulphate of soda, while the muriatic acid unites to the ammoniac, forming muriate of ammoniac; these salts are then crystalized, and exposed to heat in a close vessel; the muriate of ammoniac sublimes, and the Glauber's salt is left pure: this is to be dissolved and crystalized.

The sulphate of ammoniac, for this experiment, is obtained by decomposing the sulphate of lime, by means of the carbonate of ammoniac, obtained by the distillation of bones.

Glauber's salt contains 27 of acid, 15 of alkali, and 58 of water, in 100 parts; it effloresces in the air, has a bitter urinous taste, and is soluble in its own weight of boiling water.

SULPHATE OF POTASH or vitriolated tartar: 100 parts contain 30.21 of acid, 64.61 of alkali, and 5-18 of water. It has a penetrating taste, becomes red hot before it fuses, and is volatilized without decomposition. These salts supersaturated with the

acid, are called acidulous sulphates of potash or of soda.

SULPHATE OF AMMONIAC has a bitter taste: barytes and lime decompose it: it contains 42 of acid, 40 alkali, and 18 of water, in the 100.

SULPHATES, with earthy bases—

SULPHATE OF LIME, gypsum, or plaster of Paris—100 parts contain 32 of lime, 46 of acid, and 22 of water.

SULPHATE OF MAGNESIA, or Epsom salt: it contains 24 of acid, 19 of magnesia, and 57 of water: it is found in mineral waters; from which magnesia is obtained, by adding fixed alkali to its solution; the earth is precipitated in the state of a carbonate.

SULPHATE OF ALUMINE, or alum: 100 parts contain 38 of acid, 18 of earth, and 44 of water. If alum be exposed to heat, and the water of crystalization be driven off, it becomes caustic, and is then called burnt alum. The alum of commerce contains a small portion of potash.

PYROPHORUS is made by taking three parts of burnt alum and one of sugar, or

honey; this is to be exposed to heat in a crucible, until it becomes black; it is then to be put in a phial, coated with a mixture of horse-dung and clay, then placed in a crucible, surrounded with powdered charcoal, and again exposed to heat, till a blue flame appears.—A pyrophorus may be made by rubbing together 54 grains of sulphur, 36 of willow charcoal, and 3 of phosphorus.

Pyrophorus inflames when in contact with atmospheric air.

SULPHATE OF STRONTITES is insipid, and scarcely soluble in water.

SULPHATE OF BARYTES, or ponderous spar: 100 parts contain 30 of acid, 67 of barytes, and 3 of water; when heated, it becomes luminous, and is called Bolognian phosphorus.

NITRIC ACID is composed of about 80 of oxygen, and 20 of azote or nitrogen; it always exists in a state of combination: it is usually obtained by distilling nitre with a quantity of powdered flints; some of the other earths have also the property of decomposing this salt. It may be obtained by distilling nitre with the sulphuric acid; or a mixture of nitre and sulphate of iron.—The sulphuric acid unites to the potash,

and forms vitriolated tartar; while the nitric acid is disengaged in yellow fumes.—The nitric acid thus obtained, contains a small quantity of sulphuric or muriatic acid; it is cleared from the sulphuric by re-distilling it from fresh nitre; and from the muriatic, by the addition of the nitrate of silver—the muriatic acid unites with the silver, and luna cornea is precipitated.

Nitric acid acts on many of the metals, producing nitrous gas—When mixed with oils, it inflames, or renders them black.—If nitric acid be poured on finely powdered charcoal, or lampblack, the mixture will take fire; carbonic acid, and nitrous gas, being produced. For this experiment the acid should be concentrated.

NITROUS ETHER is made by distilling equal parts of nitric acid, and alkohol.

SPIRITUS NITRI DULCIS is formed by distilling three parts of alkohol, and one of nitrous acid.

NITROUS ACID is supposed to exist in three states: the bright yellow, containing 2.344 of oxygen; the orange coloured 2.292, and the dark green 2.230, to 1 of nitrogen.

NITROUS GAS is composed of 56 parts of oxygen, and 44 of nitrogen, in 100—it is

invisible, and lighter than atmospheric air; improper for respiration and combustion, and is neither acid nor alkaline: but when it combines with the oxygen of the atmosphere, it forms the nitric acid; from this property it has been used to ascertain the purity of the atmosphere, by means of the eudiometer; this process, however, is fallacious.

Nitrous gas may be procured by decomposing the nitric acid, with combustible substances. The best method of obtaining this gas, is by exposing copper in a phial, adding a solution of nitre; and then pouring on the sulphuric acid—In this experiment, the sulphuric acid unites to the potash of the nitre, and forms vitriolated tartar; the nitric acid being disengaged, attacks the copper, and is in part decomposed; a portion of its oxygen oxyding the copper, while another unites to the nitrogen forming nitrous gas, which is given over.

NITROUS OXYDE—The gaseous oxyde of azote, or Dr. Mitchill, or the dephlogisticated nitrous air of Dr. Priestly, is a lower degree of oxydation, than nitrous gas; it consists of 37 of oxygen, and 63 of azote. The oxygen appears to exist in a much weaker state of combination, in this than in the nitrous gas. Inhaled, when mixed with

atmospheric air, it induces hilarity, &c. It differs from nitrous air, in being absorbed by water, and in supporting combustion; a taper burning nearly as vividly in this, as in oxygen gas; and in contact with oxygen, it does not form the nitric acid. It is obtained from tin, and the nitric acid *(see tin)* but the best method is by means of the nitrate of ammoniac; this nitrate is formed by adding the nitrate of potash to a solution of the sulphate of ammoniac; here a double elective attraction takes place, the sulphuric acid of the sulphate of ammoniac, unites to the potash and forms the sulphate of potash, or vitriolated tartar, while the nitric acid of the nitre unites to the ammoniac, and forms the nitrate of ammoniac, which remains in the supernatant liquor, after the vitriolated tartar is crystalized; and by evaporation the nitrate of ammoniac is obtained in crystals; this nitrate is then exposed to heat in a retort, and nitrous oxyde is given out in large quantities.

Dr. Mitchill employs the terms septic acid, for nitric acid; septous acid, for nitrous acid: septic gas, for nitrous gas; septous gas, for nitrogen gas, and septon, for nitrogen.

He supposes that septon, chemically united to oxygen, before it has taken on the form of a gas, constitutes the matter of pestilence.

NITRATES are neutral salts, composed of nitric acid, and certain bases.

NITRATE OF POTASH is formed by a direct combination of the nitric acid and potash. This salt leaves a sense of coldness in the mouth; if thrown on ignited coals, its acid is decomposed, the oxygen unites to the coal, and forms the carbonic acid; its nitrogen and water being dissipated, and pure potash remains behind.—It exists ready formed in the earth, as in burial grounds, &c.—It is also obtained from the plaster of old houses. In some places it effloresces on the surface of the earth, exists in some vegetables, and is produced in the process of putrefaction—the nitrogen of the animal substance, unites to the oxygen of the atmosphere, and forms the nitric acid; this unites with an alkaline base, produced by vegetable decomposition, and forms nitre—100 parts contain 30 acid, 63 alkali, and 7 water.

CRYSTAL MINERAL, or sal prunel, is formed by fusing nitre, and driving off its water of crystalization.

SAL POLYCREST is produced by mixing equal parts of nitre and sulphur, in a red-hot crucible.

GUN POWDER, consists of 75 parts of nitre, 16 of charcoal, and 9 of sulphur.

FULMINATING POWDER is formed by triturating 3 parts of nitre, 2 of salt of tartar, and 1 of sulphur. This put on a shovel and heated, detonates with violence; previous to the explosion, the sulphur unites to the potash, forming hepar sulphuris, which gives out sulphurated hydrogen gas; this unites to the oxygen of the nitre, and is set on fire by the heat applied.

NITRATE OF SODA, or cubic nitre, is a salt formed by the nitric acid and soda; it is never found in a native state; it has a cool and bitter taste: this salt contains the strongest nitric acid, according to Kirwan. It consists of 28.80 of acid, 50.09 of alkali, and 21.11 of water.

NITRATE OF AMMONIAC is formed by adding nitre to a saturated solution of sulphate of ammoniac; this must be twice evaporated, at the temperature of 250°—it deposits the sulphate of potash, leaving nitrate of ammoniac in solution, which at 212° crystalizes in needles. It is also produced by uniting volatile alkali, with nitrous acid vapours.

NITRATES with earthy bases.

NITRATE OF LIME is sometimes found adhering to lime stone, also in spring water or in the lixivium of old plaster: it is a very deliquescent salt—100 parts contain 43 acid, 22 lime, and 35 water—When exposed to heat, it parts with its acid, in the form of nitrogen and oxygen gases: The residue is Baldwin's phosphorus. A solution of this salt in alkohol, burns with a red flame.

NITRATE OF BARYTES is the production of art; alkalies do not decompose it; it is an excellent test for the sulphuric acid; sulphate of barytes being precipitated; by exposing this salt to a violent heat, pure or highly caustic barytes remains: a solution of this salt in alkohol, burns with a pale yellow flame.

NITRATE OF MAGNESIA is found in the walls of old buildings, &c. it is acrid, bitter, and deliquescent. It is decomposed by lime, the alkalies, &c. 100 parts contain 36 of acid, 27 of magnesia, and 37 of water.

NITRATE OF ALUMINE is astringent to the taste, and deliquescent: alkalies, magnesia and lime decompose it.

NITRATE OF STRONTITES forms octahedral crystals, and gives a carmine red flame to alkohol.

NITRITES are neutral salts, formed by nitrous acid, and certain bases : to which very little attention has been paid.

MURIATIC ACID has been supposed by some gentlemen, to be composed of hydrogen and oxygen—and Mr. Lamb thought that sulphurated hydrogen was the base of this acid !!!

It is obtained by distilling common salt, and the sulphuric acid—the sulphuric acid combines with the soda, and forms Glauber's salt, while the muriatic acid is given over. It has a strong saffron-like smell, and is lighter than the sulphuric and nitric acids.—it emits white vapours which are rendered more visible, if in contact with volatile alkali, sal ammoniac being formed.

MURIATES are neutral salts, formed by the muriatic acid, and certain bases.

MURIATE OF POTASH, or febrifuge salt of Sylvius—is found in sea water, and in animal and vegetable fluids. It has a strong

bitter taste ; it contains 29.68 of acid, 63.47 of alkali, and 6.85 of water.

MURIATE OF SODA, or common salt, is found in mines, in several parts of the world, by the drying up of salt lakes, &c. it is also obtained from sea-water, by evaporation, &c. It decripitates in the fire ; is volatilized without decomposition ; and assists the fusion of glass. It contains 43 acid, 46 alkali, and 11 of water, in 100.

SODA is obtained from common salt, by the addition of the acetate of lead, the muriatic acid of the salt unites with the lead, forming a muriate of lead ; while the soda combines with the vegetable acid, from which it must be separated by evaporation and calcination : it is also decomposed by potash and barytes.

It is said that common salt contains a small quantity of mercury, in the state of corrosive sublimate.

MURIATE OF AMMONIAC, or sal ammoniac, is found native in many places, but particularly in the neighbourhood of volcanoes : It is generally brought to us from Egypt, where it is obtained by distillation from the soot of the dung of animals, feeding on saline vegetables. It sometimes exhales from the human body in malignant fevers. It contains 52 parts of acid, 40 of

ammoniac, and 8 of water, in 100; it is ductile under the hammer, and does not change when exposed to the air. It is decomposed by lime and the fixed alkalies; in this process the ammoniac is disengaged, leaving an alkaline muriate, or muriate of lime. If the lime, or alkali, be pure, caustic ammoniac is produced; but if carbonates are employed, the carbonate of ammoniac is the result.

MURIATE OF LIME is found in mineral waters, particularly in sea-water; it is very deliquescent, and of difficult crystalization: 100 parts of lime take up 85 of acid—It may be formed by saturating marine acid with lime: When fused, it is called Homberg's phosphorus. Muriate of lime is also formed, by mixing lime and the muriate of ammoniac in solution; the sal ammoniac is decomposed, the muriatic acid unites to the lime, and forms muriate of lime, while the ammoniac is set at liberty: the liquor is to be evaporated and crystalized. If a strong solution of this muriate be mixed with the concentrated sulphuric acid, the mixture will put on a solid form.

If the crystalized muriate of lime be mixed with snow, the cold it produces is so intense, as to freeze mercury.

MURIATE OF MAGNESIA exists in sea-water, and in the mother waters of salt-works; it is an acrid, bitter, and deliquescent salt: 100 parts contain 34 acid, 41 magnesia, and 25 of water.

MURIATE OF BARYTES has never been found native: pure alkalies and earths have no effect upon this salt (to obtain it, see *barytes*). It is an excellent test for the sulphuric acid.

OXYGENATED MURIATIC ACID is formed by distilling the muriatic acid with the metallic oxydes—For this purpose, the black oxyde of manganese may be used.

If a quantity of common salt and manganese are put in a retort, and sulphuric acid added; a portion of the acid decomposes the salt, and forms Glauber's salt, and the muriatic acid is set at liberty; while the other portion of the sulphuric acid, acting on the manganese, drives over the superabundant oxygen, to which the muriatic acid unites, and passes over in the state of oxygenated muriatic acid—It may also be formed by adding simply the muriatic acid to an oxyde.

It has a strong penetrating smell, and acts positively on the trachea. It has the property of destroying colours in most substances, and when exposed to light, loses its oxygen;

in both of which processes it is converted into the common muriatic acid.

From the property of destroying colours, it is used in bleaching of linen, cotton, silk, wax, &c. for these purposes it is mixed with alkohol : When mixed with minium, or red lead, it is used to destroy the colour of common ink, but does not act on printer's ink.

This acid, in a state of gas, inflames many combustible substances, in a state of division ; as gold, antimony, bismuth, zinc, cinnabar, charcoal, sulphur, phosphorus, &c. The oxygen of the gas unites to the combustible substance, and heat and light are given out.

OXYGENATED MURIATIC GAS may be obtained in large quantities, by adding the muriatic acid to the black oxyde of manganese, and applying heat.

Seeds have been made to vegetate, by putting them in a paste made with the black oxyde of manganese, and the oxygenated muriatic acid.

OXYMURIATES are salts, formed by the combination of the oxygenated muriatic acid and certain bases.

OXYMURIATE OF POTASH is obtained by saturating a solution of caustic alkali with this acid; by evaporation, crystals of an argantine brilliancy are deposited; with this oxymuriate, two other salts are also formed—the hyperoxygenated muriate, and the common muriate of potash, differing in the form of their crystals. The hyperoxygenated muriate of potash contains the greatest quantity of oxygen, of any known substance, and from it the purest oxygen is obtained; 100 grains yielding 75 cubic inches.

If a very small quantity of this salt be triturated with sulphur, it explodes loudly. If, instead of nitre, this salt be used in the formation of gunpowder, its effects will be much augmented.

OXYMURIATE OF SODA is obtained in the same way as the above salt; and has nearly the same properties.

Of the other oxymuriates little has been ascertained.

NITRO MURIATIC ACID, or aqua regia, is formed by distilling two parts of nitric acid, and one of muriatic together: it is also formed by dissolving four ounces of sal ammoniac in a pound of nitric acid. It is said that the nitric acid, in this experiment, attacks the sal ammoniac, and displaces the

muriatic, which combines with a portion of the oxygen and nitrous gas of the nitric acid. It is also formed by mixing the two acids together.

The nitro muriatic acid dissolves metals, and is the true solvent of gold: its specific gravity is less than that of the two acids made use of.

CARBONIC ACID, or fixed air, is found in three different states, viz. in a state of gas, as in wells, tombs, cellars, &c.—in a state of mixture, as in mineral waters—and thirdly, in a state of combination, as in limestone, &c. It is procured in its gaseous form, by adding the sulphuric acid to limestone, or chalk: The sulphuric acid unites with the lime, and forms gypsum, while the carbonic is disengaged.

This gas is also formed in the processes of combustion, respiration, and vinous fermentation. It appears to consist of 28 parts of carbon, and 72 of oxygen, with a portion of caloric. The properties of this gas, are—it is heavier than atmospheric air, consequently occupies the lowest situations, and may be poured from one vessel into another—It turns blue vegetables red, forms neutral salts with the alkalies, is absorbed by water, is unfit for respiration or combustion, and precipitates lime-water, &c.

CARBONATES are neutral salts, formed by the carbonic acid, and certain bases.

CARBONATE OF POTASH, or cretaceous tartar, is formed by saturating a solution of potash, with the carbonic acid, and crystalizing it. This salt effloresces; by heat it is converted into pure alkali, and is then deliquescent. Lime and all the acids decompose it: 100 parts contain 20 acid, 48 alkali, and 32 of water.

If to a solution of carbonate of potash, lime be added, the carbonic acid of the potash unites with the lime, forming a carbonate of lime, and the alkali will be rendered caustic: the clear liquor must then be decanted, and kept in close bottles; if evaporated, fused, and cast into moulds, the lapis causticus is obtained.

CARBONATE OF SODA, or cretaceous soda, effloresces in the air; 100 parts contain 16 acid, 20 alkali, and 64 of water; it is decomposed by heat, lime, phosphorus and the acids—It has greater affinity with silex than the former; in consequence of which it is better calculated for vitrification.

CARBONATE OF AMMONIAC, or concrete volatile alkali—is formed by passing carbonic acid through a saturated solution of ammoniac: or by exposing ammoniac to an

atmosphere of carbonic acid—It is also obtained from animal substances by distillation; but the best method of obtaining it, is by decomposing the muriate of ammoniac; for this purpose, pulverized sal ammoniac and chalk, are to be mixed together, put in a retort, and exposed to a low degree of heat: a double elective attraction takes place, the muriatic acid of the sal ammoniac unites to the lime, forming the muriate of lime; while the carbonic acid of the lime unites to the ammoniac, forming carbonate of ammoniac, which is sublimed and crystalized on the sides of the receiver—In passing over, the ammoniac dissolves a portion of the chalk—100 parts contain, 45 acid, 43 alkali, and the remainder chalk and water.

CARBONATE OF LIME is found crystalized by nature; but has never been obtained in crystals by art.—It effervesces with acids, forming calcareous salts; and the carbonic acid is discharged—100 parts contain 55 lime, 34 acid, and 11 water.

CARBONATE OF BARYTES is an insipid substance, scarcely soluble in water—It is decomposed by heat, and the alkalies: It contains 80 barytes, and 20 acid, in 100 parts.

CARBONATE OF MAGNESIA is obtained from Epsom salt, by adding a carbonate of alkali; cold water dissolves more than hot—when crystalized, 100 parts contain 25 magnesia, 50 acid, and 25 water.

FLUORIC ACID is obtained by distilling fluor spar, and the vitriolic acid, in a leaden retort: The sulphuric acid unites with the lime of the spar, and forms sulphate of lime, while the fluoric acid passes over in the state of gas, and is absorbed by water.

This acid has the property of corroding and dissolving glass (Dr. Priestly says it will corrode a glass retort in the space of ten minutes) and has been used for the purpose of engraving on this substance, in the same manner as the nitric acid is used on copper,

From the great affinity between this acid and lime, it may be used as a test to ascertain the presence of it.

FLUATES are formed by this acid and various bases.

FLUATE OF LIME, or fluor spar; this in a moderate heat becomes phosphorescent; it contains 16 acid, 57 lime, and 27 water.

BORACIC ACID, or acid of borax—If borax be sublimed with half its weight of sulphuric acid, a beautiful white powder is obtained, which constitutes the boracic acid. Or by adding the sulphuric acid to a solution of borax in hot water, the acid will be deposited, in small scaly crystals, on the sides of the vessel.

BORATES are formed of this acid, with certain bases.

BORATE OF SODA, or borax—The purest comes from China; it is white and transparent, is an excellent flux, and used in the fusion of glass and the soldering of metals.

BORATE OF POTASH—This is effected by the direct combination of this acid with potash—It crystalizes in parallelopipedons.

BORATE OF AMMONIAC—This is formed by dissolving boracic acid in ammoniac, and evaporating until it crystalizes.

LITHOLOGY:

OR THE

DOCTRINE

OF

EARTHS AND STONES.

PRIMITIVE EARTHS.

EARTH is an insipid, inodorous, brittle substance; white when pure; soluble in some of the acids, but scarcely soluble in water. Earths are simple substances, and appear to be nine in number; viz. lime, magnesia, alumine, silex, barytes, strontites, jargon of Ceylon, Glucine, and Agustine.

LIME.

LIME-STONE, when exposed to a strong heat, becomes white and brittle; is deprived of its carbonic acid, and is called quick-lime.

To obtain lime in a state of purity, chalk is to be washed in boiling distilled water ; then dissolved in distilled vinegar, and precipitated by the carbonate of ammoniac ; the precipitate must be calcined, and it is then pure lime. It has a penetrating burning taste, seizes water in large quantities, increases in bulk, falls in powder, and emits heat, and light in the dark. It is soluble in some acids.

Strong nitric acid poured upon lime, has no action on it.

It is soluble in 680 times its weight of water : This is called lime-water : It is a good test for detecting the carbonic acid, forming the carbonate of lime. If exposed to the atmosphere, it will, in a short time, exhibit a pellicle on its surface, known by the name of cream of lime : it is regenerated lime-stone.

Pure lime, if exposed to the atmosphere, absorbs the carbonic acid, and re assumes its primitive state of mildness.

BARYTES,

Or ponderous earth, is never found pure, but combined with the sulphuric or carbonic acids, forming the sulphate or carbonate

of barytes. Pure barytes is obtained in the following manner :—The sulphate of barytes, or ponderous spar, is to be pulverized and mixed with a small quantity of charcoal, and exposed to a red heat for about an hour ; the calcined powder must be then thrown in water, to which it communicates a yellow colour ; and hepatic gas is disengaged from it : the liquor is then filtered, and a quantity of muriatic acid added, by which a precipitate is produced : this must again be filtered, and the liquor holds in solution the muriate of barytes. If a solution of the mild vegetable alkali be now added, the carbonate of barytes is thrown down, and the carbonic acid must be driven off by calcination.

Pure barytes is white ; the prussiate of potash precipitates it from its combinations with the nitric and muriatic acids ; this distinguishes it from other earths. It precipitates alkalies from their combinations with acids.

MAGNESIA

Is a light, spongy, white, insipid, and fusible earth : It is soluble in water, when combined with the carbonic acid ; an cold water dissolves more than hot : It has never

been found pure. To obtain it in a state of purity, take a quantity of the sulphate of magnesia, or Epsom salt, and dissolve it in distilled water; to which add the carbonate of potash; the sulphuric acid of the sulphate of magnesia combines with the potash, and the sulphate of potash is held in solution, while the carbonic acid of the potash unites with the magnesia, and the carbonate of magnesia is precipitated, from which precipitate the carbonic acid must be driven off by heat: the remainder is called calcined magnesia.

ALUMINE,

Or pure clay, is found in combination with the sulphuric acid, and known by the name of alum.—To obtain the alumine pure, dissolve a quantity of alum in water, to which add a solution of potash: the sulphuric acid of the alum, unites with the potash, and the pure clay is precipitated in the form of a white powder.—Pure clay seizes water with avidity, forming a paste; it contracts by heat; on this property Wedgwood's thermometer, for ascertaining the higher degrees of heat, is constructed: when baked, this earth strikes fire with the steel, and is infusible by itself.

Alumine is capable of an imperfect fusion, by a current of oxygen gas. Chalk assists this process: it is fusible in a crucible of chalk, but not in a common crucible.

SILEX,

Is found nearly pure in rock crystal; to obtain it perfectly so, fuse one part of rock crystal with four of alkali; this must be dissolved in water, and precipitated by an acid. Silex is soluble in the fluoric acid, but the fixed alkalies are its true solvents, forming thereby glass.

This earth is rough, and insoluble in water; it is likewise infusible when unmixed.

STRONTITES

Has been found in the states of a carbonate, and sulphate. This earth decomposes all the sulphates, owing to its stronger affinity for the sulphuric acid.

JARGON OF CEYLON,

Possesses some properties in common with lime and silex: it unites with the car-

bonic, nitric, and sulphuric acids, but is precipitated from the last by the alkalies.

GLUCINE,

Is a new earth discovered by Vauquelin; exists in the emerald of Peru, and is found in the beryl, or aqua marina.

It is soluble in the sulphuric acid, and its salts have a sweetish taste.

AGUSTINE,

Is an earth which has received a name, from its salts being tasteless. It is insoluble in water; and the alkalies have no effect on it.

ADAMANTINE SPAR has been supposed to contain a new earth; but from the experiments of Mr. Klaproth, it is found to consist of alumine, from 84 to 89 parts, silex from 5.5 to 6.5, oxyde of iron, from 1.2 to 7.5. It has lately been discovered in the United States.

FIRST CLASS.

SALINE STONES, or the combination of earths with acids, comprehending several genera.

GENUS I.

Earthy Salts with a basis of Lime.

Species 1.

Carbonate of lime, including different kinds of lime-stone, of which there are several varieties.

Variety 1.

Calcareous Spar, presents a diversity, in point of figure; the rhomboidal is the most common; some are pyramidal, as in the hog and dog tooth spar. They contain from 34 to 36 of acid, from 53 to 55 of earth, and the remainder water. These stones sometimes contain a small quantity of iron, giving a variety in colour.

Variety 2.

Calcareous Stones not crystalized—Of this we will make two divisions; such as admit of a polish, and such as do not.

Of the former, are the different kinds of marbles and alabasters: white marble is the purest; as the ancient Parian marble—Black marble is coloured by iron, bitumen, schorl, &c. Some are composed of the shells of animals, united by a calcareous cement; that of Carinthia forms one of the most beautiful.

Alabasters are calcareous stones, having some degree of transparency, causing a double refraction.

Such as do not admit of a polish, are found in masses, as stones for building, or in a pulverulent form, as chalk. These are taken up by waters, and deposited on different substances, forming petrifactions, or stalactites.

If the carbonate of lime be exposed to a violent heat, it is converted into quick lime; in this case, the stone is deprived of its water and acid, and a portion of caloric perhaps enters in combination: in this state, the lime is caustic; but if exposed to the air, it again absorbs what it had lost, and becomes mild or regenerated lime-stone, as we observe in mortar, used as a cement for building, &c.

Species 2.

Sulphate of Lime, gypsum, selenite, plaster of Paris, or plaster stone, is found in solid masses, crystalized, stalactites, or in the form of gypseous earth, fossil flower, &c. having a degree of transparency, which is lost by calcination ; by this process it becomes pulverulent, absorbs large quantities of water, and again assumes its hardness, but not its transparency. It is found of different colours : the white is most esteemed : 100 parts contain 30 of acid, 32 of lime, and 38 of water.

Species 3.

Fluate of lime, or fluor spar—It becomes blue, when heated, and, like common salt, decripitates : it is found of different colours, from which it receives the name of false emerald, amethyst, and topaz.

Species 4.

Nitrate of lime exists only in waters, owing to its great solubility and deliquescence.

This salt calcined, emits light in the dark, and constitutes Baldwin's phosphorus.

Species 5.

Muriate of lime exists in sea waters, which is supposed to give the bitter taste to them. It is deliquescent, and when calcined, like the former, becomes phosphorsecent, and is called Homberg's phosphorus.

Species 6.

Phosphate of lime is a whitish stone of some degree of hardness—in the fire it emits a beautiful green light—It constitutes the base of animal bones.

GENUS II.

Earthy Salts with the base of Barytes.

Species 1.

Sulphate of barytes, or ponderous spar, is the heaviest of all stones; it is found in plates, applied upon one another, and easily separated: when heated it exhibits a blueish light in the dark.

Species 2.

Carbonate of barytes; this combination is extremely rare—100 parts contain 7 acid, 65 barytes and 28 water.

Species 3.

Nitrate of barytes is not found native; the nitric having less affinity for this earth than the sulphuric and fluoric acids.

Species 4.

Muriate of barytes appears lancellated, and is an excellent test for the smallest portion of sulphuric acid—It is a production of art.

GENUS III.

Earthy Salts with a base of Magnesia.

Species 1.

Sulphate of magnesia, or Epsom salt, is found in mineral waters: it crystalizes in fine white needles—100 parts contain 24 acid, 19 magnesia, and 57 water.

Species 2.

Nitrate of magnesia: this salt decomposes the muriates, and is decomposed by lime and the alkalies.

Species 3.

Muriate of magnesia exists in the mother waters of salt works; it is very bitter.

Species 4.

Carbonate of magnesia is obtained by precipitating Epsom salt, by an alkaline carbonate.

GENUS IV.

Earthy Salts with the base of Alumine.

Species 1.

Sulphate of alumine, or alum, may be formed by digesting the sulphuric acid upon clay—It is also found native.

Species 2.

Carbonate of alumine is formed by adding a solution of an alkaline carbonate, to a solution of alum : the carbonic acid unites to the alum, while the sulphuric acid unites to the alkali.

The combinations of the other earths are but little known.

SECOND CLASS.

Concerning the mixture of earths.

EARTHS are found mixed with each other, in large masses, having the characters of the

earth which predominates—which we will consider as specific.

GENUS I.

Calcareous Mixtures.

Species 1.

Lime-stone and magnesia : this combination exists in common lime-stone.

Species 2.

Lime-stone and barytes, is found in Derbyshire.

Species 3.

Lime-stone and alumine, as the different kinds of marle.

Species 4.

Lime-stone and silex constitutes the stallated spar, or stern schorl : It contains 66 lime, 30 silex, and 4 of iron.

Species 5.

Lime-stone and bitumen is known by the name of swine-stone ; it emits a fœtid smell by friction.

Species 6.

Lime-stone and iron; sometimes iron exists in such large quantities in lime-stone, as in hematites, &c. as to constitute iron ore.

GENUS II.

Barytes with other substances.

Species 1.

Sulphate of barytes, petroleum, gypsum, alum, and silex, constitute liver-stone, or lapis hepaticus.—100 parts contain 33 barytes, 5 petroleum, 7 gypsum, 17 alum, and 38 silex.

Species 2.

Carbonate of barytes, iron and silex, resemble the sulphate of barytes.

GENUS III.

Magnesian mixtures.

All the stones of this genus are soft, or greasy to the touch, and take a tolerable good polish.

Species 1.

Carbonate of magnesia, with silex and alumine—this mixture forms steatites, talcs, pot-stones, or lapides ollares. It is white and soft; 100 parts contain 80 silex, 17 carbonate of magnesia, 2 alumine, and 1 iron.

Serpentine contains the same ingredients, but differing in the proportions.

It is harder than the former, takes a better polish, is of different colours, and sometimes transparent.

Species 2.

Carbonate of magnesia, silex, lime, alumine, and iron: these constitute asbestos, and mountain cork: asbestos is brittle and rough to the touch, and of a grey colour. Mountain cork is so called from a resemblance to this substance.

Species 3.

Carbonate of magnesia, lime, sulphate of barytes, alumine and iron: this combination forms amianthus; it is composed of flexible threads: this was manufactured into cloth, by the ancients.

GENUS IV.

Mixtures of Alumine.

Species 1.

Alumine, silex, carbonate of lime, and iron, comprehend all the varieties of clay. They adhere to the tongue, and are used for pottery, &c.

Species 2.

Alumine, pure magnesia, silex, and iron: this combination forms mica: it is lamellated, shining, and of various colours.

Species 3.

Alumine, magnesia, silex, lime, and iron, these form horn blende. It has a close grain, and a greyish black colour.

Species 4.

Alumine, silex, carbonate of magnesia, lime and iron—To this species belong most of the varieties of schistus or slate, as the purple, blue, black, &c.

Species 5.

Alumine, silex, barytes, carbonate of lime and magnesia, form another kind of schis-

tus called pyritous schistus; when bitumen is present in the composition, it is called bituminous schistus. When bitumen abounds, it forms the different kinds of pitcoal.

Species 6.

Alumine, silex, lime and water: these form what is called zeolyte: it is white and transparent.

GENUS V.

Siliceous mixtures.

All the stones of this genus give fire with the steel.

Species 1.

Silex, alumine, lime, and iron, intimately combined, form all the varieties of precious stones or gems.

1. Red gems, as ruby, garnet, &c.
2. Yellow do. as topaz, hyacinth, &c.
3. Green do. as emerald, chrysolite, beryl.
4. Blue do. as sapphire.

Species 2.

Silex, with a small quantity of alumine, lime, and iron, form quartz and rock crystal: in this last, silex is in an almost pure

state: It is often tinged with iron, and receives different names, from its colour.

When Red, false ruby.
Yellow, Bohemian topaz.
Brown, smoky topaz.
Green, false emerald,
Blue, water sapphire,
Violet, amethyst.

Species 3.

Silex, lime, alumine, and iron, intimately mixed, form coarse and fine flints; as gun-flints, petro-silex, agate, calcedony, cornelian, &c.

Species 4.

Silex, alumine, and iron, form jaspar; this is one of the hardest stones, and receives a beautiful polish.

Species 5.

Silex, alumine, lime, and a small quantity of magnesia, and iron, form schorls and volcanic productions. Schorl is found differing in colour, as black, green, violet, &c. The tourmaline seems to be a variety of it.

Lava is the principal of volcanic productions; basaltes is crystalized lava. Puzzolano is the same stone attenuated.

Species 6.

Silex, lime, magnesia, iron, copper, and the fluoric acid, form the chrysoprase; it is of a greenish colour, and extremely hard.

Species 7.

Silex, blue fluate of lime, sulphate of lime, and iron, constitute lapis lazuli, or azure stone. This stone, in powder, forms a valuable blue, known by the name of ultramarine.

Species 8.

Silex, magnesia, barytes and alumine, form feld-spar; it is white and lamellated, and is one of the constituent parts of granite.

METALLIC SUBSTANCES.

METALS are simple bodies, distinguished by their gravity, opacity, and brilliancy.—They are found in the bowels of the earth, in a metallic state, called native or virgin metals; in a state of oxydation, or in com-

bination, as pyrites, &c. All the metals are soluble in acids, forming metallic salts. We are acquainted with the following— Gold, platina, silver, mercury, copper, iron, lead, tin, zinc, antimony, bismuth, cobalt, nickel, manganese, uranite, sylvanite, titanite, chrome, arsenic, molybdenite, and tungstinite.

Gold, silver, and platina, are considered as perfect metals, being more difficultly oxyded than the other metals, which are called imperfect.

OF GOLD.

This metal is of a yellow colour, ductile and tenacious, and generally found pure; it melts at 32° of Wedgwood's thermometer; by a continued heat it is volatilized in its metallic state: the sulphuric acid has no action on it, but the nitric, muriatic, and oxygenated muriatic acids dissolve it. If this solution be precipitated by ammoniac, fulminating gold is obtained, in the form of an oxyde; this, when gently heated, detonates violently; the oxygen of the gold, and the hydrogen of the alkali take fire, and the metal is revived.

Tin also precipitates gold from its solution; this powder is used for painting on

porcelain: and is the purple powder of Cassius. Gold is also soluble in the alkaline sulphurets; it unites with most of the metals.

PLATINA

Is of a greyish white colour, the most ponderous of all bodies; it is found in South America, in small grains, resists the heat of a common furnace, and is scarcely altered by a flame of oxygen gas. It is soluble in the nitro and oxygenated muriatic acids, from which it is precipitated by the muriate of ammoniac, potash, and soda. It unites with most of the metals. If platina be once fused, with the burning lens, or oxygen gas, it becomes as malleable as gold.

SILVER

Is a white shining metal, possessing in an eminent degree, malleability and ductility. It is not oxyded by exposure to the atmosphere. By violent heat it is converted into a green glass. It is found frequently pure, being called virgin silver: It is also

found combined with other metals, and frequently mineralized by sulphur, &c. Nitric acid dissolves half its weight of silver; this solution deposits crystals, which when fused and cast into moulds, constitutes the lapis infernalis, or lunar caustic. Copper precipitates silver from all its solutions, in a metallic state, presenting an appearance of vegetation.

If mercury be used for this purpose, the precipitate is called Arbor Dianæ. The nitrates of silver and mercury, are good tests for detecting the presence of the muriatic acid. If to the nitric solution of silver, muriatic acid be added, a precipitate is obtained; the muriatic acid unites to the silver, forming a muriate of silver, or luna cornea. Lime-water and the alkalies also precipitate silver from its solutions. If lime-water be added to the nitrate of silver, the silver is precipitated in the state of an oxyde. If this oxyde be dried in the air, and mixed with the volatile alkali, it assumes a black colour: the fluid must then be decanted and the powder dried; this constitutes fulminating silver, the most dangerous of all fulminating substances; when once made, it cannot be touched without danger of an explosion. Only a very small quantity can be made at a time. In this case, the oxygen of the silver unites to the hydrogen of the ammoniac, and pro-

duces water in a state of vapour: the expansive power of this vapour, with the nitrogen of the ammoniac, are the causes of the explosion; the silver being revived.

MERCURY

Is fluid at the common temperature of the atmosphere; at 39° below 0 of Farenheit's thermometer, it is congealed, and then in common with other metals, possesses malleability, &c. It boils at the temperature of 600°. It is of the colour of bright silver, and has been found in large quantities in South America, in its virgin state, also combined with sulphur, forming cinabar or ethiops; when bright red, it is called vermilion.

If mercury be exposed to the air, it is converted into a black powder, called black oxyde of mercury: this is an imperfect oxyde.

If a quantity of mercury be exposed to the air, in a low degree of heat, for several months, it is converted into a powder, called red oxyde of mercury, or precipitate per se. This gives out its oxygen by heat, and the mercury is revived.

Mercury evaporates like other substances, persons being salivated by breathing the air

of an apartment, in which mercury was exposed.

If water be boiled upon mercury, a minute portion is taken up—It may be detected by exposing a piece of gold in it—This mercurial water has the property of destroying worms.

The sulphuric acid acts on mercury only when assisted by heat; sulphureous gas being disengaged, and a white powder deposited: this powder is heavier than the mercury made use of: if thereon boiling water be poured, it assumes a bright yellow colour, called turbith mineral. The French chemists are of opinion, that this is an oxyde; Dr. Woodhouse, on the contrary, supposes it to be a sulphate: It however gives out its oxygen by heat.

The nitric acid acts on mercury, without the application of heat, nitrous gas being disengaged; one part of the acid oxyding the metal, while the other dissolves it.

RED PRECIPITATE is formed by heating the nitrate of mercury in a crucible, or by distilling it three or four times with fresh nitric acid. Mercurial water is formed by dissolving the nitrate of mercury in water. It detects sulphuric and muriatic salts: some of the acids, alkalies, earths and metals precipitate mercury from its solution, in the state of an oxyde.

MERCURIUS CINEREUS, or ash-coloured calx of mercury, is formed by precipitating the nitric solution by caustic ammoniac.

MERCURIUS FUSCUS, or yellow precipitate, is obtained by adding a solution of mild potash, to the nitric solution of mercury.

MERCURIUS PRECIPITATUS ALBUS, or white precipitate, is formed by precipitating the nitrate of mercury, by the carbonate of ammoniac: it is a carbonate of mercury. The nitric acid, in this experiment, seizes the ammoniac, while the carbonic acid combines with the mercury.

The carbonate of ammoniac employed in this experiment, must be made, says professor Woodhouse, by adding to a solution of the muriate of ammoniac, the carbonate of potash; unless this is attended to, the precipitate, instead of being white, will be of a black colour.

FULMINATING MERCURY: If mercury be boiled with nitric acid, in the proportion of 100 grains to 12 drachms of acid; and if to this nitrate, 2 ounces of alkohol be added to each 100 grains, and applying a low degree of heat, a powder is deposited, which when dried, constitutes the fulminating mercury: This powder inflames and detonates in vacuo; it explodes by friction.

by the blow of a hammer, by electricity, and by the addition of the sulphuric acid: In those experiments, the mercury is revived; and the heat produced is not sufficient to explode gunpowder.

Muriatic acid, digested for some time on mercury, oxydes and dissolves it.

MERCURIUS DULCIS, calomel, or the mild muriate of mercury, may be formed in the dry or humid way. Scheele's method is by adding a solution of common salt, to a solution of nitrate of silver—the muriatic acid of the salt unites to the mercury, and forms the muriate of mercury, while the nitric acid unites to the soda.

It is also made by adding the muriatic acid to a nitric solution of mercury.

If formed in the dry way, four parts of corrosive sublimate, and three of quicksilver, are triturated together, and sublimed in a glass vessel.

Calomel often contains a small proportion of corrosive sublimate; to free it from this, nothing more is required, than the addition of hot water; the sublimate being dissolved, may be poured off with the water, and the calomel, being insoluble, remains.

CORROSIVE SUBLIMATE, or the oxygenated muriate of mercury, is formed by the

oxymuriatic acid and mercury. This salt is also formed in the dry and humid way. If equal parts of dried nitrate of mercury, decripitated muriate of soda, and sulphate of iron, be rubbed together, and sublimed, a fine corrosive sublimate is formed. Equal parts of common salt and sulphure of mercury, being sublimed, also afford it.

Mercury dissolved in the oxygenated muriatic acid, and evaporated, forms a beautiful corrosive sublimate. It is also obtained by mixing common salt, mercury, and the black oxyde of manganese, and then adding sulphuric acid. The only difference between this salt and calomel, is, that it contains a greater proportion of oxygen.

Corrosive muriate of mercury is decomposed by the fixed and volatile alkalies, lime, barytes, and magnesia.

If corrosive sublimate be added to lime-water, a yellow precipitate is produced, which is again dissolved : this liquor is called aqua phagedenica.

The acetic acid dissolves the oxyde of mercury, forming an acetate of mercury: This is the base of Keyser's pills.

The boracic acid unites to mercury—If a solution of borax be added to mercurial water, a yellow precipitate is formed, and part remains in solution, which may be obtained by evaporation.

ETHIOPS MINERAL, or the black oxyde of mercury, is formed by triturating 4 parts of mercury and 12 of sulphur. If ethiops be sublimed, a sulphurated oxyde of mercury or cinnabar is formed, which is called vermilion by the painters.

Mercury combines with most of the metals, forming amalgams: on this is founded the art of gilding, the working of mines, &c.

Mercury is also used in thermometers, barometers, and various chemical experiments.

COPPER

Is a red, elastic, and sonorous metal, nauseous to the taste, often found native, but generally mineralized by sulphur, as in copper pyrites; by the decomposition of these, the sulphate of copper is formed, which is soluble in water, and may be detected in some mineral waters, by immersing a piece of polished iron, on which the copper is deposited in a metallic form.

Sulphuric acid, concentrated, acts on copper, with the assistance of heat; sulphureous gas being disengaged, and the sulphate of copper is formed: to which if ammoniac be added, the copper is precipitated

and immediately redissolved, a beautiful blue colour being produced. This liquor is called aqua cœlestis, which by evaporation leaves cuprum ammoniacum.

Nitric acid acts violently on copper, nitrous gas and dephlogisticated nitrous air being emitted.

Muriatic acid does not act on copper, without the assistance of heat.

Acetous acid corrodes copper, forming acetate of copper, or verdigris.

ENS VENERIS is made by subliming copper and sal ammoniac.

AQUA SAPPHARINA may be made by digesting sal ammoniac and lime-water in a copper vessel, or by adding verdigris and sal ammoniac to lime-water.

Copper combines with several of the metals. With arsenic it forms tombac; with bismuth, a reddish white alloy; with antimony, a violet alloy; with zinc, it forms Manheim gold; with lapis calaminaris, brass; with tin, bronze; it also unites with gold, silver, &c.

IRON

Is of a greyish colour: It is the only metal that strikes fire with quartz, or that

is obedient to the magnet. This metal, when exposed to heat, becomes oxyded, separates in scales, and is called finery cinder, which is still attracted by the magnet: when the oxyde is of a black colour, it is called Ethiops martial, or the black oxyde of iron: If this black oxyde be urged by heat, the crocus martius, or saffron of Mars, is formed.

Iron burns vividly in oxygenous gas. It contains carbon and oxygen.

STEEL is formed by depriving iron of its oxygen, and combining a greater proportion of carbon, by means of heat.

Cast or pig iron contains more carbon than steel.

Iron and steel are fusible, being then called cast iron or steel.

To convert iron into cast steel, nothing more is necessary than to fuse it with a substance containing carbon; as charcoal, pit-coal, plumbago, carbonate of lime, &c. about 1 part of carbon to 90 of iron, is sufficient to make the best cast steel. It was formerly made by fusing steel of cementation, but it is now proved that malleable iron, and even iron ore, answers the same purpose.

Sir Thomas Frankland asserts, that cast steel and common steel, or iron, will unite; the former in a white, the latter in a weld-

ding heat: But the fact is, that if a white heat be given to cast steel, it is converted into iron. From the information of persons of veracity, I am induced to believe, that if the two unite, it must be by giving a cherry red to the cast steel, and a welding heat to the iron, then gently hammering them together; after which they are again to be heated cherry red, and hammered until they become black.

Iron combines with sulphur, forming martial pyrites, or sulphurets of iron: in this manner pyrites are formed in the bowels of the earth. It is by the decomposition of these, that the formation of sulphate of iron must be accounted for.

COLCOTHAR OF VITRIOL is formed by calcining the sulphate of iron, thereby driving off the water and acid.

INK is made by mixing the sulphate of iron and powdered galls in water: the iron is precipitated by the gallic acid.

The common sulphate of iron consists of two salts, the green and red sulphate: the former is soluble in alkohol, but the latter is not.

If diluted sulphuric acid be added to iron, the water is decomposed; its oxygen oxydes the metal, while its hydrogen is disengaged;

and the acid dissolves the oxyde—forming sulphate of iron by crystalization.

The nitric acid acts on iron—If more iron be added to a solution already saturated, the acid throws down the oxyde, and attacks the iron.

The muriatic acid acts on iron, when diluted, with violence, producing hydrogenous gas.

PRUSSIAN BLUE is formed by dissolving iron in the prussic acid.

ZWELFER'S SAFFRON OF MARS is formed by detonating equal parts of steel filings and nitre in a crucible.

ENS MARTIS, flores martiales, or martial flowers, is formed by subliming one pound of muriate of ammoniac, and one ounce of steel filings.

Iron dissolved in the acidulous tartrite of potash, forms the soluble martial tartar, or aperitive extract of Mars.

The carbonic, phosphoric, fluoric, acetic, and prussic acids, all unite to iron, forming different combinations.

Iron is found in plants, and in animal fluids.

LEAD

Is the softest, least sonorous, least tenacious, least elastic, and one of the heaviest and most fusible of the metals. It is of a blueish white colour.

Lead is generally found mineralized with sulphur, and is then called galena: if this metal be kept in fusion for some time, its surface is converted into a grey oxyde: this oxyde, when exposed to a greater heat, becomes yellow, and is called massicot: If the heat be continued, it is changed into a red oxyde or minium. This oxyde is 10 per cent heavier than the metal used.

If a stream of fresh air be directed over lead in fusion, a scaly oxyde is obtained, called litharge.

The oxydes of lead afford oxygenous gas by distillation.

The muriatic acid dissolves lead; this muriate of lead, by calcination, affords a powder of a yellow colour, called patent yellow. This is also made by fusing in a strong heat, an oxyde of lead and common salt.

The acetic acid corrodes lead, and affords a white oxyde, known by the name of white lead. Ceruse is a mixture of white lead and chalk.

SUGAR OF LEAD is formed by dissolving white lead in vinegar: the solution being concentrated, forms efflorescent crystals.

If a piece of zinc be suspended in a solution of sugar of lead, the lead is revived, and adheres to the surface of the zinc, forming the leaden tree.

GOULARD'S EXTRACT is a solution of sugar of lead in vinegar.

The oxydes of lead are used to render oils drying; this is effected by giving out their oxygen to the oils.

If paper be written on with a solution of sugar of lead, it will be invisible; but if exposed to sulphurated hydrogen gas, it becomes black.

TIN

Is the lightest and most fusible of all the metals; it is soft and of a silver white colour; emits a crackling noise when bent, which is called the cry of tin: This has been attributed to arsenic; but some late experiments on Malacca and Banca tin, have proved the contrary.

If tin be kept in fusion, and the surface exposed to the air, it is converted into a

grey oxyde, which by more heat, becomes a white and perfect oxyde, called putty.

If melted tin be triturated in a mortar till it cools, it is called pulvis stanni.

The muriatic acid dissolves tin.

THE FUMING LIQUOR OF LIBAVIUS is made by distilling an amalgam of tin and mercury, and the same quantity of corrosive sublimate; an insipid liquor accompanied with white vapours comes over; it is an oxygenated muriate of tin.

Highly concentrated nitric acid has no action on tin; but if diluted, the water is immediately decomposed, its oxygen converts the metal into an oxyde: part of the acid seizes this oxyde, and forms with it a nitrate of tin; while the hydrogen of the water unites to a part of the azote of the acid, and forms ammoniac; this is seized by another portion of the nitric acid, and is converted into the nitrate of ammoniac; the last portion of the nitrogen and oxygen of the nitric acid, unite, and form the nitrous gas, and the nitrous oxyde, which are given over during the process.

Tin dissolved in the diluted nitric acid, is used for the composition of scarlet dye from cochineal.

AURUM MUSIVUM, or Mosaic gold, is a sulphure of tin, it is formed by amalgamating

8 ounces of tin and mercury; this is put in a matrass with six ounces of sulphur, and 4 of sal ammoniac, which must be exposed to heat: If the heat is such as to inflame the mixture, it is sublimed of a dazzling colour. In this process, the tin is oxyded by the muriatic acid of the sal ammoniac: The hydrogen of the water of the sal ammoniac, unites with the sulphur, forming sulphurated hydrogen gas. The muriated oxyde of tin, and mercury, united with sulphur, forming cinnabar, also rises; the remaining oxyde of tin and sulphur, forming the aurum musivum.

An amalgam of tin and mercury is used in making looking-glasses.

A mixture of 3 parts of tin, 5 of bismuth, and two of lead, form an alloy, fusible at the temperature of boiling water.

An excellent amalgam for exciting the electrical machine, is made by melting together 1 part of zinc, 1 of tin, and 2 of mercury.

PEWTER is a mixture of tin, lead and antimony.

Tin is used for tinning copper vessels. It is used also in enamelling, in the composition of bronze, &c.

ZINC

Is of a whitish blue colour; when heated to redness, it sublimes in the form of a white powder, called flowers of zinc, pompholix, &c. It is an oxyde, and is acted on by all the acids. If diluted sulphuric acid be used, the water is decomposed, its oxygen oxydes the metal, while the acid dissolves it, forming white vitriol; and the hydrogen escapes.

The nitric and muriatic acids act on zinc, forming the nitrate or muriate.

Zinc combines with most of the metals; with copper it forms tombac, prince's, and Pinchbeck's metal, similor, &c.

LAPIS CALIMINARIS is an oxyde of zinc.

ANTIMONY

Is a white semi-metal of a brilliant colour, difficult of fusion; when melted, it sublimes in the form of a white powder, called flowers of antimony,

Antimony is usually found combined with sulphur: The sulphur driven off by heat, leaves the metal after fusion in the state of a regulus. By calcination the re-

gulus is converted into a grey oxyde, which being urged by heat, is changed into a reddish semi-transparent glass, called glass of antimony. This, mixed with wax, constitutes the cerated glass of antimony.

KERMES MINERAL, or the sulphurated oxyde of antimony, is obtained by boiling the ore of antimony in a pure alkaline solution; after which the fluid is filtered, and the kermes is precipitated by cooling. It is also made by digesting pulverized antimony in lime-water. The golden sulphure of antimony only differs from it in colour.

If the sulphuric acid be poured on antimony, sulphureous gas is obtained; and the sulphur sublimes, leaving a metallic oxyde with a sulphate of antimony.

The nitric acid acts on this metal. The oxyde thus prepared, is a true bezoar mineral.

Muriatic acid long digested on antimony, acts partially on it.

If 2 parts of corrosive sublimate, and 1 of antimony, be distilled together, the butter or sublimed ozymuriate of antimony is obtained, which easily crystalizes: it is a violent caustic. If water be added to this oxymuriate, a powder is precipitated, called the powder of algaroth, or mercurius vitæ.

Water acts on this metal, contracting a purgative quality,

ANTIMONIAL WINE is prepared by digesting the glass of antimony, or crocus metallorum, in wine. It is dissolved in proportion to the acidity of the wine.

The PERPETUAL PILL is antimony cast in that shape. The gastric juice acts on it.

TARTAR EMETIC, or the antimoniated tartrite of potash, is formed by the glass of antimony, or the crocus metallorum, and the acidulous tartrite of potash, boiled in equal quantities with water. By filtration and evaporation, over a gentle heat, crystals are obtained.

DIAPHORETIC ANTIMONY is formed by detonating equal parts of nitre and the regulus of antimony.

CROCUS METALLORUM is prepared by deflagrating the sulphure of antimony and nitre in an ignited crucible. This sulphurated oxyde of antimony must be pulverized and washed.

JAMES'S POWDER is a composition of antimony and the phosphate of lime.

Antimony unites with several of the metals. With iron, it is called regulus martialis ; with copper, regulus veneris, &c.

BISMUTH,

Or tin glass, is of a white, yellowish colour, brittle, and the most fusible of all the semi-metals.

When fused, it sublimes in the form of a yellow powder, called flowers of bismuth ; which acquire 12 per cent in weight.

Bismuth is soluble in all the mineral acids, from which, by the addition of water, a white powder falls down, called the magistery of bismuth, pearl white, face white, &c. It is used by the ladies as a pigment for the face ; but, like all metallic pigments, is a bad one, being turned black, by sulphurated hydrogen gas.

The various solutions of bismuth in acids, constitute sympathetic ink.

This semi-metal unites with all the metals, but difficultly with the other semi-metals.

It amalgamates with mercury, forming a fluid alloy.

They are frequently mixed by the druggists. But the fraud may be detected by

dissolving the mixture in the nitric acid: the magistery of bismuth will be produced.

COBALT

Is a semi-metal, of a grey or whitish blue colour. It is generally found combined with arsenic: when cleared from this, it is known by the name of zaffer; this oxyde fused with 3 parts of sand, and 1 of potash, forms a blue glass, which, when pounded and ground in a mill, is called smalt. The finest particles washed off by water, are named azure. It is used in the preparation of clothes, and laundresses use it as they do Prussian blue. It is used in painting on porcelain, pottery, &c. This semi-metal is soluble in the acids. With muriatic, and nitro-muriatic acids, it forms a very singular sympathetic ink.

NICKEL

Is of a greyish colour, difficult of fusion, soluble in the mineral acids, and generally found combined with arsenic and iron. The arsenic is separated by repeated calcination.

The sulphuric acid distilled on nickel affords sulphureous acid. The residue communicates a green colour to water. It does not amalgamate with mercury.

MANGANESE

Is of a blackish colour, and always found in the state of an oxyde, more or less perfect, from which the metal has been obtained by Mr. Ghan. This oxyde affords large quantities of oxygenous gas by heat only. If 1 part of the oxyde of manganese and 3 of nitre, be put in a crucible, and exposed to heat, cameleon mineral will be formed.—Scheele has proved that the ashes of vegetables contain manganese: to this the blue colour of calcined potash has been attributed.

This semi-metal is more fusible than iron.

The oxyde of manganese distilled with charcoal affords the carbonic acid, and unites easily by fusion, with all the metals, except mercury. The sulphuric acid attacks manganese, and produces hydrogen gas.

The nitric acid dissolves manganese with effervescence.

The muriatic acts on the metal: but when digested on the oxyde, it seizes the

oxygen, and is converted into the oxygenated muriatic acid.

The oxyde of manganese is used to deprive glass of its green colour; hence the term glass makers' soap. It gives a violet colour to glass and porcelain.

ARSENIC

Is generally found in the state of an oxyde. It is brittle, white, and soluble in water; exhaling an odour of garlic, when exposed on hot coals.

By fusion it unites with metals, rendering them brittle.

The oxyde of arsenic united with sulphur forms orpiment or realgar: the only difference is in the colour, which solely depends on the degree of heat used. They are found native in different parts of the world.

If equal parts of orpiment and corrosive sublimate be distilled together, a black liquor comes over, called the sublimed muriate, or butter of arsenic.

The arsenical acid is obtained by distilling 6 parts of nitric acid, and 1 of the oxyde of arsenic. This acid is obtained in a concrete state, but attracts the humidity of the atmosphere.

Arsenic is used as a flux in glass-houses, and is also used by dyers. Orpiment and realgar are much used by painters.

MOLYBDENA

Has long been taken for black-lead ore; but is a semi-metal of some degree of brilliancy. It is composed of scaly particles, slightly adhering to each other.

It is oxydated in a strong heat. The concentrated sulphuric acid dissolves a great quantity of it. The molybdic acid is obtained in the same way as the arsenical.

Wolfram, *tungstinite*, *titanite*, *sylvanite*, or *telurite*, and *uranite*, are semi-metals, of which we know but little more than the names.

VEGETABLE KINGDOM.

VEGETABLES are organized living beings, endowed with irritability, and probably with the power of sensation. To these may be added, digestive and secreting organs, with the apparent faculty of loco-motion.

The difference between the vegetable and mineral departments, has been satisfactorily established by philosophers : but the limits between the animal and vegetable creation, will, perhsps, never be determined.

Vegetables may be considered as the lowest order of animated beings : like animals, they digest their food, and propagate their species. They will grow and vegetate in air, in which animals have perished. This fact evinces that pure air is not necessary to their existence. Light is essentially necessary to them ; and they possess a temperature of their own, at times exceeding that of the atmosphere.

The constituent principles of vegetables are more numerous and complicated than those of minerals. It is therefore evident,

that chemists must have made less progress in the former, than in the latter.

Plants are defended with a general covering, analogous to the skin of animals; which is divided into three different parts, viz. the external, or cuticle; the cellular, or true bark; and the cortical, or liber.

The first, or *cuticle*, if detached from the bark, is again reproduced, adhering more closely to the bark; forming a cicatrix, similar to what takes place when the epidermis of animals has been destroyed. It also serves to defend the plant from external injuries.

The second, or *true bark*, is chiefly composed of glands and vessels; and might be considered as the lymphatic system. By this, all the secretions are performed.

And lastly, the *cortical;* which appears to be a perfect tissue of vessels, analogous in its functions to the system of blood vessels in animals; and from which the wood is formed.

The bark is the most essential part of the vegetable. Some plants consist merely of bark, as the gramina, or grasses.

Trees have frequently been decayed internally, and kept alive by the bark alone.

The WOOD is formed of concentric layers; the innermost are the hardest; the external, which are always whiter, are called sap.

The PITH is found in the centre of young branches, and disappears as they grow larger. Vegetables are furnished with glands, for the purposes of secretion.

The LEAVES perform an important office in the economy of vegetables. They have been compared to the lungs in animals.

The food of plants appears to be various; as water, carbonic acid, &c. From these different substances, the sap, or blood of the plant, is produced, from which the secretions, as gums, resins, mucilages, &c. are formed.

MUCILAGE is that viscid substance which exists in seeds, as in linseed, &c. It is in greater quantities in young vegetables; is insipid, inodorous, soluble in water, but not in alkohol, and is one of the nutritious parts of vegetables. Mucilage is absolutely required for the acetous fermentation. If this substance be treated with the nitric acid, the oxalic will be formed; and if with the muriatic, the citric acid will be produced.

GUMS are inspissated mucus; as the cherry gum; also that exuding from other trees, as gum arabic, gum adragant, &c. They appear to consist of oxygen, hydrogen, carbon, nitrogen, lime, and the phosphoric acid.

OIL is a combustible fluid, and insoluble in water. There are two kinds of oil, the fixed and the volatile. The former is combined with mucilage, and the latter with aroma.

FIXED OILS are obtained by expression, from seeds, &c. They combine with alkalies, forming soap. Fine white soap is made from tallow and soda; and the soft soap from whale-oil and potash.

Fixed oils are insoluble in alkohol. They afford, by distillation, phlegm, acid, a light oil, hydrogen gas, and carbonic acid. By the combustion of oils, lampblack, or the charcoal of oils, is produced.

VOLATILE OILS are obtained by distillation and expression; they are slightly soluble in water, and entirely so in alkohol and acids: they have a greater affinity with oxygen, than fixed oils—forming resins.

Some of the essential oils inflame, by the addition of the nitric acid. Dr. Mitchill has taken notice of this in an elegant manner, in the following verses:

You saw, that time, terrific anger boil,
When aqua fortis met with heated oil;
Both vanquish'd falling underneath the shock,
Expir'd in blaze and suffocating smoke!!!

STARKEY'S SOAP is made by triturating 10 parts of caustic alkali, with 8 of the oil of turpentine, together, in a hot mortar.

RESINS are oils rendered concrete, by the absorption of oxygen. They are inflammable, insoluble in water, and soluble in alkohol. The purest are, the balm of Mecca, or Judea, tacamahaca, elimi, sanguis draconis, &c.

VARNISH is made by dissolving resin in different substances. There are three kinds of varnish: the fat oil, essential oil, and spirit varnish. The fat oil varnish is resin dissolved in drying oil; essential oil varnish is a solution of resin in oil of turpentine, &c. spirit varnish is made by dissolving resin in alkohol. Oil of turpentine is generally added to fat oil varnish, to promote its drying; and to spirit varnish, to prevent its cracking.

The beautiful black varnish of the Chinese is obtained from a tree, by incision.

GUM RESINS seem to consist of an extractive matter and resin. They are partly soluble in water, and in alkohol; as the frankincense, scammony, gum gutta, assafœtida, &c.

BALSAMS are resins combined with aroma. They contain a principle, by which

combining with oxygen, forms an acid: under this head are placed, benzoin, balsam of Tolu, storax, &c.

GUM ELASTIC is obtained from a tree of South America, called caoutchouc, by incisions being made in it. It is applied on moulds of clay when soft, and afterwards dried. It is insoluble in water or alkohol; and is only dissolved in the nitric ether.

CAMPHOR is a gum resin, obtained from a species of laurel—the laurus camphora. It grows in China and Japan. Camphor may be obtained, in small quantities, from thyme, sage, rosemary, sassafras, &c. The roots are generally used, from which the camphor is obtained by distillation. This is called crude camphor; which must be purified by sublimation.

The resin possesses the greatest virtue, and is taken up by alkohol.

FECULA of vegetables appears to be mucilage somewhat changed: it is insoluble in cold water: but when dissolved by hot water, it resembles mucilage. Leguminous vegetables contain the most of it. It is obtained by bruising the plant in water: by this process, the fecula will be deposited.

In this manner are prepared starch, cassava, salep, indigo, sago, &c.

VEGETABLE GLUTEN, or the materia vegeto-animalis, having some of the properties of animal substances, is obtained from wheat, barley, &c. by making a paste with the powder, and washing the fecula from it. This substance exists also in opium. It is insoluble in water. In the fire it burns like an animal substance, and seems to consist of carbon, hydrogen, nitrogen, oxygen, and phosphorus.

FARINA, or flour, is composed of three principles: of fecula, or starch; materia vegeto-animalis, or gluten; and sugar—each of which is capable of a peculiar fermentation. The fecula undergoes the acetous; gluten, the putrefactive; and the saccharine, a vinous fermentation. In the rising of bread, these three processes are combined.

SUGAR is a salt extracted from numerous vegetables by a complicated process. The maple (acer saccharinum), beets, parsnips, carrots, &c. afford it; but it is obtained in general, and in the greatest quantity, from the arundo saccharifera, or sugar-cane.—When purified, it is white, and then called loaf-sugar; and sugar-candy, when crystal-

ized. It appears to consist of oxygen, carbon, and hydrogen. An acid is extracted from it. *(See oxalic acid.)*

MANNA is a sugar, secreted by several vegetables; as the maple, juniper, fig, &c. That of Calabria is the most esteemed.

ALBUMEN exists in vegetables, and is obtained from cabbages, &c. It resembles the serum of the blood; coagulating by heat, acids, and alkohol, and being soluble in cold water.

VEGETABLE ACIDS

Are all composed of carbon, hydrogen, and oxygen; they differ from mineral acids, in being more volatile; and after combustion, leave a coaly residue.

CITRIC ACID, or acid of lemons, is obtained by saturating the juice of lemons with chalk, which forms a citrate of lime. This must be washed in warm water, to which sulphuric acid is to be added, sufficient to saturate the chalk; after which, being boiled and filtered, the sulphate of lime remains on the filter. The liquor is then evaporated, and the acid is obtained in crystals.

It may also be obtained highly concentrated, by exposing lemons to the frost: the aqueous parts congeal, while the acid remains fluid.

It is one of the strongest of the vegetable acids, and acts on many of the metals.

MALIC ACID is obtained from the juice of unripe apples, by saturating it with chalk, and adding a solution of acetite of lead; the acetic acid combines with the lime, and the lead with the malic acid, which is precipitated. This is to be washed in water, and sulphuric acid added; sulphate of lead is formed, and the malic acid left pure. It unites with the earths and metals, forming malates.

BENZOIC ACID is formed by boiling together 1 part of lime, 4 of benzoin, and 4 of water, over a gentle fire. The acid unites with the lime, forming a benzoat of lime.—This is to be filtered, and muriatic acid added as long as a precipitate continues to be formed. This precipitate is the benzoic acid. If distilled with the sulphuric acid, and the oxyde of manganese, it is converted into the acetic acid. Like the former, it unites with earths, alkalies, and metals.

TARTAROUS ACID, or acid of tartar, is obtained from tartar, by dissolving it in water, and saturating it with chalk; a tartrite of lime is precipitated: to this the sulphuric acid must be added, and the tartarous is set at liberty, and is obtained by evaporation and crystalization. If this acid be boiled with the sulphuric, it is converted into the acetic acid. The taste of this acid is very sharp. By the addition of soda, sal rochelle or seignette is formed.

OXALIC ACID, or acid of sugar, is generally obtained from the salt of sorrel, which is the juice of the oxalis acetosella.

It may be obtained by treating 1 ounce of loaf-sugar, with 4 ounces of nitric acid. A low degree of heat is then to be applied, until nitrous gas ceases to come over. The heat is then to be increased, and the liquor evaporated and crystalized. It is an excellent test for detecting the presence of lime.

CAMPHORIC ACID is obtained in the same manner as the oxalic. It acts on copper, iron, zinc, arsenic, &c.

GALLIC ACID is obtained from bark, roots, &c. or by infusing nut galls in water, and filtering it. After standing, a precipi-

tate is deposited, which, being dissolved in boiling water, and evaporated by a gentle heat, deposits fine sandy crystals, which constitute the gallic acid. It is acid and astringent to the taste. It effervesces with alkalies, and reddens litmus. It precipitates several of the metals: iron, of a black; lead, of a white; copper of a brown; silver of a grey; and mercury of an orange yellow colour.

TANNIN is that principle which combines with the gelatinous parts of animals, in the process of tanning. It is found in the bark and ligneous part of vegetables, generally accompanying the gallic acid.

SUBIREC ACIC, or acid of cork, is bitter and pungent, and if exposed to the air, assumes a brownish colour. It unites with lime, potash, magnesia, alumine, &c.

EMPYREUMATIC ACIDS.

These acids are three in number.

PYRO-TARTAROUS ACID is obtained by distilling dry tartar. Its combinations are called pyro-tartrites.

PYRO-MUSCUS ACID is obtained by distilling saccharine, gummy, or farinaceous

mucilages. It communicates a reddish colour to the skin ; dissolves iron, tin, and copper ; corrodes lead, &c.

PYRO-LIGNOUS ACID is obtained by distilling wood. Hard wood, as beech, &c. affords the largest quantities. It reddens the blue vegetable colours ; does not precipitate iron ; unites with alkalies and earths. Its action on metals is similar to the acetous acid.

VEGETABLE FERMENTATION

Never takes place without the presence of oxygen. It is afforded by the atmosphere, or the decomposition of water. In this process heat is generated.

Fermentation is of three kinds, the acetous, the vinous, and the putrefactive. If mucilage be abundant, the acetous takes place ; if sugar abound, it is termed vinous ; and if gluten predominate, the putrefactive fermentation results.

ACETOUS FERMENTATION : for this process, it is necessary, that oxygen, a certain degree of heat, and mucilage be present.—When fermentation commences, the mass of liquid becomes warm ; turbid atmos-

pheric air is absorbed; and a sediment falls to the bottom. The liquor then becomes clear, emits a lively smell, and is acid to the taste.

If wine, beer, or cider, be suffered to ferment too long, or too much heat be applied, it passes from the vinous, to the acetous fermentation, forming vinegar. Spirit of wine, mucilage, and air, are required in the formation of vinegar.

Vinegar thus obtained, is concentrated by distillation, and is then called acetous acid.

The combination of this acid with potash, forms the acetite of potash, or terra foliata tartari; with soda, an acetite of soda; with ammoniac, spiritus mindereri.

The oxygenated acetous acid, radical vinegar, or acetic acid, is formed by combining a large dose of oxygen with the acetous. For this purpose, it is distilled with the metallic oxydes, or by the sulphuric acid, and the acetite of soda.

This acid forms salts denominated acetates; differing from those made by the acetous acid.

The acetic acid is acrid and volatile, forming ether with alkohol.

It may be procured as strong as the sulphuric acid.

Combined with the sulphate of potash, it forms the salt of vinegar.

VINOUS FERMENTATION is that by which wine, beer, cider, &c. are obtained. No substances but those containing a saccharine matter, are capable of this fermentation.

By mixing water and sugar, a rum, or taffia is obtained.

In making wine, the ripe grapes are pressed, and the juice received in proper vessels, in which the fermentation is suffered to advance. After a few hours, a motion is perceived in the liquor, which gradually increases. Heat is developed, and the volume of the fluid is augmented, becoming oily and turbid, attended with the disengagement of carbonic acid. After some days, the motion subsides; the bulk decreases, the liquor becomes clearer, has an agreeable odour, is less saccharine, and has acquired a reddish colour, if made of the red grape. This is owing to the spirit dissolving the colouring matter of the pellicle. The liquor is now decanted and put into casks, where it undergoes a second fermentation. If this be prevented, the wine will be brisk, as the brisk champaigne, &c.—During the process, a substance is deposited on the sides of the vessel, called crude tartar. It is purified by washing, and boiling it with clay; which, when evaporated, and crystalized, is called cream of tartar, or the acidulous tartrite of potash. Some wines afford more than others; and the tartar of

red wines possesses the colour of them. Its taste is acid and vinous.

CIDER, by a similar process, is obtained from the juice of apples. This liquor affords by distillation, the same product as wine, namely, brandy. Brandy, when obtained in this way, has a disagreeable taste and smell, owing to the cider containing a great quantity of mucilage, which is altered by heat in this process.

PERRY is obtained from pears.

Cherries afford a tolerable good wine.

BEER is made from certain grains, as wheat, barley, oats, &c. These are moistened, and suffered to germinate to a certain degree, which is stopped by torrefying them. The germination and drying of the grains, destroy the gluten. It is then ground into a coarse meal, and is called malt; on this, warm water is poured, which dissolves the sugar and mucilage. In this state, it is called wort. It is then boiled with a quantity of hops, for the purpose of obtaining the bitter principle of that vegetable. It is now suffered to cool, and a quantity of recent yeast added. This soon excites the vinous fermentation, which is prevented from going too far, by putting it in casks, where it throws off a frothy scum. The

colour of the beer is owing to the degree of heat applied in drying the malt: when gently heated, pale beer is obtained.

BRANDY is usually procured from wine, by distillation.

RUM, from sugar, or the juice of the sugar-cane.

WHISKEY, or malt spirit, from the different grains.

KOUMISS of the Tartars, is obtained from milk, which has first gone through the acetous, and afterwards the vinous fermentation.

In the vinous fermentation, at the commencement of the intestine motion, atmospheric air is absorbed. This air, as well as the water of the mass, is decomposed; a portion of the oxygen unites with the carbon of the saccharine principle, and flies off in the form of carbonic acid: while the hydrogen of the water unites with the remainder of the carbon, and forms alkohol.

ALKOHOL is an inflammable and volatile fluid, composed of hydrogen and carbon. It is purified by the addition of caustic potash; which combines with the water of the alkohol. A small quantity of the potash is

dissolved: this is proved by distilling it. Ammoniac will be produced in consequence of the hydrogen of the alkohol uniting with the nitrogen of the alkali. By burning a pound of alkohol, Mr. Lavoisier obtained 18 ounces of water.

Alkohol is the true solvent of resins, essential oils, soap, &c.

OFFA ALBA HELMONTII is formed by mixing equal parts of alkohol and carbonate of ammoniac. The two instantaneously unite, in a solid form. To succeed in this experiment, the vessel should be colder than the surrounding air. By rubbing the vessel with the hand, it becomes again fluid. This is called *the liquefaction of the blood of St. Januarius!* This pretended miracle is annually exhibited in Naples; cochineal is there added to give it a red colour.

ETHER is oxygenated alkohol. If the oxygenated muriatic acid be passed through alkohol, it will be converted into ether, and the acid changed into the common muriatic.

It is commonly obtained by distilling equal parts of alkohol and sulphuric or nitric acids. The carbon of the alkohol unites with the oxygen of the acid, and comes over in the form of ether. If sulphuric acid be digested upon ether, it is, after

some time, converted into an ethereal oil, or sweet oil of wine Muriatic ether is made by distilling a mixture of alkohol, muriatic acid, and the black oxyde of manganese together.

Ether is the lightest and most volatile of all fluids; is insoluble in water; burns with a white flame; has a strong, agreeable, and penetrating odour.

VEGETABLE PUTREFACTION takes place whenever vegetables, impregnated with their juices, are heaped together, and exposed to the air. The mass soon swells; becomes heated; and hydrogen, azote, carbonic acid, with ammoniacal, sulphurated, and phosphorated hydrogen gasses are given out. After this, the mass diminishes, and is reduced or resolved into a brown mold, forming an excellent manure.

It appears that a gas may be formed by vegetable putrefaction, deleterious to animals, by producing malignant fevers.

ART OF DYING

Consists in fixing the colouring principle of one body upon another. No process requires more chemical knowledge than

this. We must in the first place consider the manner in which colours are formed; the combination of colours, and the best means of extracting and obtaining them; and lastly, the method of applying and rendering them permanent. All bodies in nature possess the property of absorbing or reflecting the rays of light, thereby forming the various shades.

The art of dying, therefore, consists in changing the surface of one body by means of another; so that they will both reflect the rays of light alike.

The colouring principle in vegetables exists in four different states: with gum, extract, resin, or with fecula—from which it is extracted by chemical processes. When combined with gum and extract, water is sufficient to extract it. Spirit of wine dissolves it, when combined with resin. When it exists with fecula, an alkaline solution, or solution of lime, dissolves it: from which combinations they are precipitated by the addition of an acid, on those substances which are to be dyed. When the colour is of the nature of a gum, and soluble in water, it is necessary, in order to fix it upon stuffs, that they be immersed in a liquor, called a mordant. These are various; as, the acidulous tartrite of potash, sulphate of alumine, of iron, of copper, of zinc, &c. the nitro and oxygenated muriatic acids,

tin, &c. These are calculated to prevent the colours from being washed out. It is requisite that the mordant have a certain relation with the stuff and the colour. Tin is the mordant for scarlet; but will not give that colour to silk; and gives no colour at all to cotton.

Indigo, turnsole, rocou, &c. are soluble in alkalies and lime.

Indigo is sometimes dissolved in the vitriolic acid.

Stuffs to be coloured, are previously impregnated with a solution of alum, and then dipped in the colouring matter, which renders the blue colour permanent.

Before the application of the colouring principle, it is requisite to prepare the stuffs, by washing and boiling them in an alkaline solution. The oxygenated muriatic acid is also used for this purpose.

TURNSOLE is made from a kind of moss, by putrefaction.

INDIGO is obtained from a plant, by bruising it in water. By fermentation the colouring principle, or fecula, is deposited on the bottom.

WOAD is obtained in a similar way.

Sap colours are extracts of plants.

ALKALIES exist in vegetables. They are obtained, by lixiviation, from the ashes.

Plants near the sea-shore, afford soda; others potash; and some ammoniac; as the horse-radish, mustard, &c.

POLLEN, or prolific powder of vegetables, is of the nature of a resin. It is inflammable, soluble in alkohol, and has a peculiar smell.

WAX is a solid oil. It appears that wax and the fecundating powder are nearly alike.

HONEY, or nectar, is obtained from certain flowers, by bees. It often retains a noxious property, if obtained from poisonous vegetables. It appears to be a solution of sugar in mucilage.

AROMA, or the fragrant principle of vegetables, exists only in those containing an essential or volatile oil.

CHARCOAL, or the oxyde of carbon, is obtained from vegetables, by the process of charring or burning wood, without the free access of air. It is a black, sonorous, and brittle substance, insoluble in water, &c.

Sulphur, iron, gold, manganese, lime, alumine, and silex, are all contained in vegetables.

Opium is obtained from a species of poppy, the papaver somniferum. It grows in Persia and Asia minor. It is extracted from the heads of the plants, by incisions made into them. The first fluid is collected, and affords the purest opium; but this is never exported from the country. That which we receive, is procured by expression. It is then inspissated, and wrapped up in its own leaves. From some late experiments it appears to consist of a gum, a resin, a fecula, and a materia vegeto-animalis, or gluten farinæ.

ANIMAL KINGDOM.

The constituent radical principles of animals, are but few; as carbon, hydrogen, nitrogen, oxygen, lime, and phosphorus.

BLOOD, when first drawn, is an homogenous fluid; but soon separates into two distinct parts: serum, and crassamentum.—The serum swims on the top; and the crassamentum is composed of coagulable lymph and red globules.

SERUM is slightly saline. It coagulates at a moderate degree of heat; also by alkohol and the acids. It yields, by distillation, phlegm, carbonate of ammoniac, and a fœtid blackish oil. The ashes of the residue afford muriate and carbonate of soda, with the phosphate of lime.

The COAGULABLE LYMPH of the blood may be obtained by putting a rough piece of wood in blood, when warm, and stirring it round; on which the coagulable lymph is collected. It is then to be washed in water,

and it presents a fibrous texture, has no smell, is insipid, and easily putrefies.

RED GLOBULES contain a large quantity of iron. If dried blood be burned, an oxyde of iron is obtained, obedient to the magnet.

GASTRIC JUICE is secreted from the stomach: by this the food is dissolved.—It yields in distillation, phosphates, water, and gelatin.

PANCREATIC JUICE, and SALIVA, appear to be nearly the same.

MILK is secreted by that order of animals called mamalia. It is a white, sweet, and oily fluid. When exposed to the air, cream is observed on its surface. In a short time it becomes sour, and separates into two distinct parts—coagulum and whey.

SERUM LACTIS, or whey, may, by several processes, be made to pass into the vinous fermentation, and affords alkohol, vinegar, &c.

COAGULUM contains two substances—cheese and butter. Cheese is obtained by suffering it to undergo the putrefactive fermentation. It is then dried, and acquires a proper consistence.

Butter is produced from the cream, by agitating it. The remainder is called butter-milk. Butter, by distillation, yields water, the sebacic acid, and a coloured oil.

Lactic acid, or acid of milk: by evaporating sour milk, then adding lime water to the residue, a precipitate is obtained; and the lime combines with the acid. The oxalic acid is then added, which combines with the lime, forming an oxalate of lime, which is insoluble; and the acid remains in the fluid. This is evaporated to the consistence of an extract, to which alkohol must be added; this combines with the acid. It is then filtered, and the lactic acid is obtained by distillation.—This acid unites with earths, alkalies, and metals.

Sugar of milk is obtained by evaporating whey to the consistence of honey. It is then dried in the sun, afterwards washed and dissolved in water, and suffered to crystalize. It has all the appearance of sugar. By the nitric acid, it is converted into the oxalic.

Saccholactic acid is obtained in the process of making oxalic acid, from sugar of milk. It is soluble in spirit, but not in water; is combustible, but leaves no residue; is sour to the taste, and reddens litmus.

FAT is a condensed oil, consisting of carbon, hydrogen, and the sebacic acid. It is generally white, or yellowish; and is obtained pure, by boiling it in water. It has more consistence in some animals than others. It has all the characters of oil, being inflammable, forming soap, &c.

SEBACIC ACID, or acid of fat, is obtained by distilling fat, on the water bath, or with a low degree of heat. It is also obtained by distillation from spermaceti.

It appears to exist ready formed in fat; and unites with metals, earths, &c.

BILE is a fluid secreted by the liver. It is of the consistence of an oil, of a greenish colour, intensely bitter, and forms a froth by agitation, like a solution of soap. It has been supposed to be saponaceous: but this is denied by my ingenious friend Dr. Roebuck, in his inaugural dissertation printed at Philadelphia in 1801. By distillation it affords a water or phlegm, impregnated with a spiritous rector or aroma, and a quantity of fixed oil. The residue contains the phosphates and muriates of lime and soda. Iron has been supposed to exist in the bile: but some late experiments render this doubtful.

GELATIN, or jelly, is obtained by boiling animal substances, such as bones, cartilages, tendons, skin, &c. It is insipid, inodorous, soluble in water, but not in alkohol. It soon putrefies, giving out hydrogen, azote, and carbonic acid. It is also soluble in acids and alkalies: with nitric acid, it affords nitrogen gas. This substance made into cakes and dried, forms the portable soup. In a similar manner glue is obtained. The strongest glue is obtained from the skins of old animals.

Gelatin by distillation, affords a phlegm. With additional heat it becomes black, swells up, and emits a strong smell. An alkaline phlegm, empyreumatic oil, and carbonate of ammoniac, then come over. The residue affords muriate of soda, and phosphate of lime.

The MUSCULAR PARTS of animals yield by distillation an alkaline phlegm, which soon putrefies, empyreumatic oil, and carbonate of ammoniac. From the residue, fixed alkali, and muriate of potash are obtained. By the addition of the nitric acid, much nitrogen comes over. It also affords oxalic and malic acids, when treated with the nitric.

The muscular parts of animals, when buried for a certain time under ground, afford a substance, similar to spermaceti.

URINE is a fluid secreted from the blood by the kidneys. It is saline to the taste, of a pale yellow colour, and has a peculiar smell when fresh; which however is soon lost, and the smell of ammoniac is then perceptible. This ammoniacal odour is succeeded by one of a very fœtid and offensive nature.

Urine, when recent, contains phosphoric acid in excess, holding a quantity of lime in solution. The urine of animals feeding on vegetables, does not contain this acid, Fresh urine contains no less that 11 ingredients, viz. uree, the radical or specific matter of urine; sulphate of lime, of magnesia, of soda, and of ammoniac; muriate of soda, and of ammoniac; albumen, gelatin; lithic and benzoic acids.

If urine be suffered to undergo the putrefactive fermentation, some of these principles are changed, and new ones formed: the crystals of the muriate of ammoniac, and soda are altered, and the following substances are generated: phosphate, urate, and carbonate of ammoniac; ammoniaco-magnesian, phosphate and ammoniac, united with the acetous and benzoic acids.

CALCULUS OF URINE is a concrete salt, soluble in boiling water; which deposits crystals, by cooling. These crystals consti-

tute the lithic acid. This acid is also obtained by dry distillation, being called the sublimate of Scheele. It may also be procured by adding the nitric and muriatic acids to fresh-made urine; reddish small crystals are precipitated. This acid is insipid and inodorous, changes blue vegetable colours, and is soluble in caustic alkali.

The sulphuric and nitric acids act on calculus: but the muriatic acid does not.

It is always dissolved by the caustic alkalies, and precipitated by the acids.

A small quantity of lime, ammoniac, and animal matter is found in its composition.

PRUSSIC ACID is that substance which gives the colour to prussian blue.

To obtain prussian blue, animal substances, as horns, hoofs, dried blood, &c. are exposed to a red heat, with a quantity of alkali. In this process, the alkali unites with the prussic acid of the animal substance, forming prussian alkali. This alkali has the property of precipitating all the metals from their solutions—the alkali unites with the acid, which hold the metal in solution, while the prussic acid unites to the oxyde, giving it a peculiar colour: Iron, blue; constituting prussian blue, or prussiate of iron: Gold, yellow: Lead, white: Copper, brown, &c.

Prussiate of lime or of potash is made by digesting prussian blue with lime, or potash. These are good tests for detecting the presence of iron.

Mucus of the nose is a peculiar mucilage, containing muriate of soda, phosphate of lime, and soda, in a pure state.

Saliva is fluid secreted by glands, situated in or about the mouth. It is more fluid than mucus, and contains the same saline principles.

The phosphate of lime from the saliva, is frequently deposited upon the teeth, and is then called tartar. Similar concretions have been noticed, in the ducts of the salivary glands.

Tears are secreted by the lachrymal glands. The constituent principles are the same as saliva.

Synovia is a glutinous substance, found in moveable articulations. It consists of water, carbonate, and muriate of soda, with the phosphate of lime.

Semen consists of the following principles, water, mucilage, phosphate, and muriate of soda and of lime, and caustic soda.

SWEAT is generally of an acid nature, and probably contains the phosphoric.

LIQUOR AMNII, is composed of albumen, muriate of soda, pure soda, phosphate of lime, and water.

PUS is a substance secreted by the arteries. When fresh it does not appear to differ much from mucus; but undergoes the acid fermentation, while mucus becomes putrid. Some persons have pretended that they have discovered a peculiar acid in pus.

BONES are composed of jelly, oil, lime, and phosphorus. By distillation, volatile alkali, Dipple's empyreumatic oil, hydrogen, and carbonic acid are obtained. The residue is called ivory black, by the painters.

ENAMEL OF THE TEETH is the hardest part of the animal. It is soluble in the nitric acid. This liquor, saturated with the carbonate of ammoniac, affords a precipitate, which is the phosphate of lime. The phosphoric acid, after being disengaged by the nitric, existed in the liquor and seized the lime, while the carbonic acid was dissipated. It is also soluble in the muriatic acid, without the application of heat.

ZOONIC ACID is lately found to exist in and is to be obtained from animal substances by distillation.

FORMIC ACID, or acid of ants, is procured in large quantity, by distilling the animals. It is soluble in alkohol, and unites with most of the metals.

ANIMAL PUTREFACTION: for this process air, heat, and water, are required. The animal substance first acquires a faint and disagreeable smell; its texture becomes relaxed. Its colour changes to a blue, then green, and becomes softer, more fœtid, and assumes a brown colour: next a putrid odour manifests itself, mixed with that of ammoniac. It loses its consistence; the carbonated phosphorated hydrogen, together with carbonic acid are separated. It is now changed into a black fœtid mass, which forms a good manure, when mixed with mould.

In the process of animal decomposition, the nitric acid is generated by the union of the oxygen of the atmosphere, with a part of the nitrogen of the animal substance; while the hydrogen of the animal fluid, combining with another portion of the nitrogen, forms ammoniac; a portion of the oxygen, unites with the carbon of the flesh, and forms the carbonic acid, which, with a part of the hydrogen, holding phosphorus in solution, are disengaged.

MINERAL WATERS.

They are so termed from their containing mineral substances in solution. They may be divided into four classes—*acidulous, saline, sulphureous, and metallic.*

ACIDULOUS WATERS have a sharp penetrating taste; boil with facility; emit bubbles by agitation; precipitate lime-water; and change blue vegetable colours red. Carbonic acid is generally contained in these waters. The sulphuric acid sometimes exists in them.

SALINE WATERS are characterized by a saline taste. They hold in solution sulphate and muriate of soda, muriate, carbonate, and nitrate of potash; but most commonly sulphate, muriate and carbonate of lime; sulphate, and muriate of magnesia, and of alumine.

SULPHUREOUS WATERS have in general a disagreeable smell, resembling that of rotten eggs; owing to a quantity of hepatic gas held in solution, and which is easily disengaged: but the hepar sulphuris is contained in water, as well as the sulphurated hydrogen, or hepatic gas.

METALLIC WATERS are the most general. They commonly contain iron, and are then astringent to the taste. The sulphates of copper, iron and zinc are occasionally detected, and sometimes arsenic.

For detecting the ingredients of these waters, three processes have been instituted, viz. evaporation, distillation, and the action of chemical re-agents. By evaporation alone, the proportions of the ingredients are ascertained. The elastic fluids, by distillation; and by re-agents, acids, earths &c.

IN ACIDULOUS WATERS,

The carbonic acid is detected by lime-water: a white precipitate is formed which is the carbonate of lime. The caustic volatile alkali is deposited in the state of a carbonate of ammoniac.

Sulphuric acid is detected by the muriate of barytes.

IN SALINE WATERS,

Muriate of soda, is detected by the nitrate of mercury.

When the nitrate of silver is used, the muriate of silver, or luna cornea, is precipitated. By the oxalic acid, calcareous salts are detected; an insoluble oxalate being formed.

Corrosive sublimate precipitates pure lime in the form of a yellow powder: caustic potash detects magnesia, with which it forms a white fleaky precipitate. The salts with a base of alumine are detected by the alkalies.

SULPHUREOUS WATERS.

Waters which contain sulphurated hydrogen, have their courses marked, by the deposition of sulphur. This is owing to the

hydrogen, which holds the sulphur in solution, forming water on coming in contact with the oxygenous portion of the atmosphere; and the sulphur is precipitated.

The sulphur of hepatic gas may be precipitated by very strong nitric acid. Arsenic also detects the sulphur: and the acetite of lead forms a brownish precipitate.

IN METALLIC WATERS,

The gallic acid strikes a back colour with the iron in the water; the prussiate of potash and lime produces a blue one. When the carbonic acid holds iron in solution in mineral waters, it may be driven off, by boiling, and the iron falls to the bottom, in the state of an oxyde.

Sulphate of copper is detected by the volatile alkali, forming the cuprum ammoniacum. By immersing a piece of polished iron in it, the acid unites to the iron and the copper is precipitated on it.

Arsenic is detected by adding the cuprum ammoniacum, forming a greenish yellow precipitate, or by evaporating the water, and exposing the residue on burning coals, the smell of garlic will be evident.

The residuum of evaporation may also be placed between two pieces of copper, and exposed to heat: the surface of the copper will become white.

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