+ Show wire gauze over flame of Turpentine & other flames.

The Safety Lamp in Sec of Gas describes the apparatus of Lamp

means of lighting by coil of Platina wire over wick

‡ This Lamp is now constantly used in all the English Coal Mines — The Mine owners of Northumberland subscribed for a magnificent Table Service of Silver Plate with they presented to Davy, thus showing how highly they estimated the importance of this Invention.

this effect; and that a plate of brass, pierced with a great number of small holes, so as to present in fact an assemblage of fine tubes, effectually prevented the passage of flame. The gas itself passed, but was so much cooled by its contact with the metallic surface, as to be no longer luminous.

529. *The Safety Lamp.*—A piece of fine wire gauze was substituted for the plate, and was found to be equally impermeable to flame, and this led to the construction of the *safety lamp.* This simple contrivance is a common oil lamp, completely surrounded by a cage of wire gauze. It not merely prevents explosion, but indicates the precise moment of danger; for when it is carried into an atmosphere charged with the fire-damp, the flame begins to enlarge, and when the mixture becomes highly explosive, it takes fire as soon as it has passed the gauze, and burns on its inner surface, while the light in the centre of the lamp is extinguished. The wire gauze becomes heated to a red and even to a white heat, but does not allow the flame to pass. As soon as this appearance is observed, the miner must withdraw; for the gauze, which is generally made of iron or brass wire, would become oxidated in a few minutes, and fall to pieces.

This beautifully simple and effectual contrivance has been the means of preserving the lives of thousands. The only case in which it has been found to fail has been that of a rapid current of air carrying the flame through the gauze before it was cooled below the luminous point. This is effectually prevented by surrounding the common safety lamp with a glass cylinder, and allowing the air to enter through a fine wire gauze at the bottom of the cylinder, and to escape through another at the top.

530. *Mineral Coal.*—Bituminous coal is the result of the decomposition of wood under circumstances which do not allow of the escape of the carburetted

hydrogens which are formed, and which are therefore retained by, or compressed among, the particles of the carbon. When bituminous coal is exposed to the destructive distillation, these are evolved in the shape of tar and bitumen, and, when the heat is sufficiently great, of gaseous products consisting of various proportions of olefiant gas, light carburetted hydrogen, and carbonic oxide gases. The gas which is prepared by the decomposition of coal in close vessels, for the purpose of illumination, is a varying mixture of these gases. The composition of bituminous coal is $C_{32}H_{12}$. When the heat to which the coal has been exposed in the interior of the earth has been sufficiently great, all the hydrogen is expelled, and it is converted into *anthracite*, which is a nearly pure carbon.

531. *Creasote.*—The destructive distillation of wood tar, gives rise to a great variety of products, the only one of which it seems necessary to notice, is an oily, colourless, inflammable liquid called creasote. It has a penetrating odour of smoke, a sharp burning taste, and is chiefly remarkable for its power of depriving animal substances of their tendency to putrefaction.

SECTION II.

THE CAMPHENE SERIES.

532. *The Essential Oils.*—The essential oils which are secreted in the living plant, form, together with camphor and the resins, a very natural and closely allied group of organic products. They agree in being highly aromatic, soluble in alcohol and ether, and very sparingly, or not at all soluble in water, to which they communicate their taste and odour. They are highly inflammable, and burn with much

Show Gas lighting with olefiant Gas issuing from Gasometer or reservoir

Explain Gas lighting – the alternates by Diagram

The Coal, coal Tar purification &c.
First used by Murdoch at Soho in 1798 & by Winsor in London in 1803. an argand Burner consumes 1½ cubic foot of Gas per hour so that 100 cub feet wo. last 1 burner 75 hrs wo. be equivalent in light to 7 candles burning that time. Now 100 cubic feet of Gas made on large scale wo. not cost 2 cents – but when it to cost 10 times as much, or 20 cents & Gas then the saving as compared with candles wo. be enormous.

from ἀνθρακ charcoal

for 7 candles at 2 cents ea wo. be 14 cts & these candles wo. need to be renewed at least 6 times in the 75 hours
∴ 14×6 = 84 cts at 20 cts.
Potable Gas.

Κρεας flesh σωζ3ω I save
creosote is C_7H_4O – It is always present in wood smoke, in Tar & in unverified pyroligneous acid to which it communicates its odour taste & antiseptic properties – It coagulates albumen – hence tooth ache.

– of Camphogen series – generators of Camphor

The several Gas works of London consume daily during winter months on an average 890 tons of coal for making Gas. and this produces every day 7 million cubic feet of Gas which is consumed in each night in London & its suburbs – report of Mr. Fletcher to Statistical Society see Westm review Vol 23 for Sept. 1846 note p. 16.

† They are called essential oils or essences because they combine with the essence or aroma of the matter producing them, which is in most cases vegetable; and to distinguish them from the fixed oils - so called because they do not evaporate in the air at ordinary temperatures, while the essential oils are very volatile. - They both form grease spots, the one permanent while the other is fugitive. - Fixed oils as Castor oil, olive oil Linseed oil, Poppy oil &c. are obtained by compression - While the essential are got by heat or distillation, as turpentine from Pine wood leaving Resin - They are generally the bases of perfumes as rose Lavender Bergamot Peppermint Cloves Cinnamon &c. -

‡ Camphor is the natural gum of the Laurus Camphora a large Tree of China & Japan - It is obtained from the wood Bark & roots by sublimation

Mercaptane

smoke. They do not form soaps with alkalies, and are converted into resins by the absorption of oxygen.

The essential oils may be divided into three classes; those which contain only carbon and hydrogen; those containing oxygen and destitute of acid properties; and those forming acids.

533. The oils of the first class form a very remarkable group, most of them being isomeric, and represented by the formula $C_{10}H_8$, or its multiple. These isomeric oils yield vapours having the same specific gravity 4.766. Oil of turpentine, lemon, copaiva, juniper, cubebs, pepper, and bergamotte, are the most important of this class. The constitution of oil of turpentine is $C_{20}H_{16}$; being identical with camphene; that of oil of cubebs $C_{15}H_{12}$; and that of the remainder C_5H_4.

534. The second class contains the oils of cajeput, lavender, pennyroyal, the mints, anise, asarum, the camphor tree, &c., They consist of, or are resolved into, a solid oil called *stereoptene*, analogous to camphor, and a liquid oil; the former of which separates by long standing.

535. *Camphor*—Common camphor is a white, semi-transparent, tough, crystalline, volatile solid, of a bitter taste and peculiar odour, highly inflammable, soluble in ether and alcohol, and sparingly so in water.

Its formula is $C_{20}H_{16}O_2$, being the deutoxide of camphene. By boiling with strong nitric acid, it is converted into camphoric acid, which crystallizes in small rhomboidal tables, has a sour and bitter taste, and forms soluble salts.

536. Camphor is the stereoptene of the oil of the camphor tree. Various other oils yield camphor, the composition of which varies with its origin. Those of peppermint, anise, and fennel, are isomeric with their oils, those of turpentine, and asarum, are their hydrates, and those of camphor, and most others, their oxides.

When chlorohydric acid gas is passed into oil of turpentine, they combine and form a white crystalline solid, smelling strongly of camphor, which is called artificial camphor, from its resemblance to that body.

537. *The Resins.*—The resins appoach closely to the camphors in constitution and properties, but differ in being decomposed before they are volatilized, and in possessing acid properties which enable them to combine with alkalies and form a species of soap. They are produced by the oxidation in the living plant itself, of essential oils isomeric with oil of turpentine. They mostly exude naturally from the living plant, in which case several distinct products are usually blended together.

538. The most important are common rosin, copal, mastich, sandarac, guaiacum, copaiva, amber, olibanum, caoutchouc, and dragon's blood. The principal use of the resins is in the preparation of varnishes.

539. *Caoutchouc.*—This is the most singular, and promises to be the most useful, of all these resins. It is a soft, tenacious, inflammable solid, remarkable for its great elasticity. It is insoluble in alcohol and water, but soluble in essential oils and in the volatile liquid obtained from its decomposition by heat in close vessels. It thus yields a varnish capable of being applied to the softest fabrics, and surpassing all other known bodies in the degree in which it combines insolubility, flexibility, elasticity, and resistance to the ordinary causes of change and decay.

540. *Benzule.*—The third class of essential oils contains the oils of bitter almonds, of cloves, of cinnamon, and of the spiræa ulmaria. The careful examination to which these oils have been subjected, has thrown much light on the laws of organic combination. The oil of bitter almonds is a feeble acid, the base of which is hydrogen, and the electro-nega-

artificial camphor.

† The Resins are all soluble in Alcohol & but very sparingly soluble in Water, or not at all so. Pitch is a Resin used for Boats & Flutes

‡ explain the nature and use of Varnishes & Lacquers for Wood & Metals —

Japanning on metals &c — Resins are immensely durable as witnessed in Egyptian Mummies 2000 years old

⊕ Caoutchouc — is milky Juice of Siphonia Cahucca.

Mackintoshes Patent for water Proof — Showing aprons as example — original State & how made in Hurly Hurly

Benzoyl — the hypothetical base of Benzoin which exists in many plants

Meadow Sweet

tive element is a complex radical called benzule, of which the formula is $C_{14}H_5O_2$, and the symbol, Bz. This radical combines with the simple elements chlorine, iodine, bromine, and sulphur, forming compounds which are neither acid nor basic.

541. *Benzoic Acid.*—Its protoxide is the benzoic acid, BzO, which exists in combination with resin in what are called the Balsams, viz. gum benzoin and storax, and the balsams of Peru and Tolu.

Benzoic acid is a volatile, inflammable acid, having a fragrant odour when heated, and a sweet, aromatic taste. It is soluble in alcohol and water, and crystallizes in needles of a silky lustre. It is a monobasic acid, from which the atom of base cannot be separated, and the formula of its salts is M, BzO_2.

542. *Oil of Bitter Almonds.*—This oil does not exist ready formed in the plant, but is evolved in the decomposition of *amygdaline*, an albuminous solid, which forms a principal portion of the kernels of the bitter almonds. When these are macerated in water and distilled, the amygdaline disappears, and oil of bitter almonds, cyanohydric and formic acids, and sugar, are formed. The oil of bitter almonds is a colourless, transparent, inflammable fluid, of a strong, peculiar odour, and burning taste, which absorbs oxygen from the air, and is converted into benzoic acid. It unites with various bases, and undergoes a series of highly interesting changes by the action of different reagents. It seems probable that the true radical in all these products is $C_{14}H_5$; of which benzule is itself the deutoxide.

553. The oil of cinnamon is the compound of a peculiar radical, cinnamule, $C_{18}H_7O_2$, with hydrogen, and, like the oil of bitter almonds, it may be regarded as a feeble acid. Cinnamule unites with an atom of oxygen to form an acid very similar to benzoic acid, and combines also with chlorine.

544. The oil of the spiræa ulmaria is similar in

constitution, being the hydruret of *salicule*, a complex radical, represented by C_{12} H, O_4, which may be regarded as the deutoxide of benzule.

SECTION III.

THE OILY ACIDS.

545. The fixed oils, whether of vegetable or animal origin, closely resemble each other in composition. The animal oils are chiefly deposited in the cavities of the cellular tissue, and the vegetable oils in and around the seed. They cannot be volatilized without decomposition, and they all form soaps with the alkalies. By exposure to the air, one class of these oils, called the drying oils, absorb oxygen, and become converted into an elastic, tough solid, which renders them useful in painting.

The fixed oils are nearly inodorous and tasteless; their density varies from .9 to .96. Some of them, as the animal fats, palm oil, and cocoa-nut oil, are solid at common temperatures, but become fluid at a gentle heat. At 600° they begin to boil, suffering a partial decomposition, and disengaging an inflammable vapour at the same time. When heated to a red heat, in a close vessel, they are decomposed and evolve large quantities of olefiant gas. In the open air they burn with a clear and bright flame, and are converted into water and carbonic acid.

The fixed oils are insoluble in water, but may be permanently suspended in that liquid by means of mucilage or sugar. This mixture is termed an emulsion. They are in general sparingly soluble in alcohol and ether, although castor oil is soluble in all proportions in the former.

546. The fixed oils absorb oxygen gas when ex-

– olive or sweet or salad oil the Type – Sunflower seeds

x and they solidify by cold to such extent as not to flow

The common Gas of Flame

Linseed from Linseed

x Soft & hard soap with Potash & Soda

Steap fat, suet

posed to the air, and become thick and rancid. The oil of flax-seed, hemp-seed, nut oil, and some others of the fixed oils, are called drying oils, because they are at length converted by this process into an elastic, gummy mass. It is this property which renders these oils valuable in painting, in the preparation of varnishes, and the manufacture of printer's ink. This absorption of oxygen by the drying oils is under some circumstances so abundant and rapid, and accompanied by the extrication of so much heat, as spontaneously to kindle easily inflammable substances, with which they may be mixed. Many extensive fires have been caused by carelessly spilling drying oils on lamp-black, cotton, flax, wool, or even shavings of wood.

The fixed oils combine with the alkalies and metallic oxides; their combination with the alkalies forms soap, and that with the metallic oxides, more particularly with the oxide of lead, forms the *plasters* of the pharmacopœias.

547. The experiments of Chevreul have shown that fixed oils consist of three proximate elements; two of them solid and crystalline, and the other remaining fluid at low temperatures. These principles, which closely resemble each other, are named stearine, margarine, and oleine. They consist of organic acids combined with an organic base called glycerine.

548. *Stearine.*—Stearine is obtained from mutton suet by the crystallization of the hot ethereal solution. It is crystalline like spermaceti, not greasy to the touch, soluble in ether and alcohol, and fusing at 143°. Stearine is found to be a bi-stearate of glycerine, and its formula is $C_{142}H_{141}, O_{17}$, or $C_6H_7O_5 + 2C_{68}H_{66}O_4 + 2Aq$. Pure stearic acid is tasteless, and inodorous. It is soluble in alcohol but not in water, and crystallizes from its alcoholic solution in brilliant white plates, of a pearly lustre. Stearic

acid has a feeble reaction, its solution turns vegetable blues red, and it decomposes the alkaline carbonates. It melts at 158°, and congeals into a crystalline mass, which burns with a clear white flame, and is extensively manufactured as a substitute for wax and spermaceti for candles. Stearic acid is a bibasic acid, and the formula of its salts is $M_2+C_{68}H_{65}O_7$. The alkaline stearates are the only ones soluble in water.

549. *Margarine.*—Margarine is found with stearine, though in smaller proportions in most animal and vegetable oils. It is the principal ingredient of human fat. It closely resembles stearine, but fuses at 118°, and is more soluble in ether and alcohol. *Margaric acid* crystallizes in white needles, and fuses at 140°. It is a monobasic acid, and its formula is $C_{34}H_{33}, O_3+Aq$.

550. *Oleine.*—Oleine exists in conjunction with stearine and margarine in almost all oils and fats. It is soluble in cold alcohol, and may thus be obtained separately. It remains fluid at 0°, and exists nearly pure in almond oil. It is a binoleate of glycerine, and its formula is $C_{94}H_{87}O_{15}=C_6H_7O_5+2C_{44}H_{39}O_4+2Aq$. The oleic acid is an oily liquid having a slight smell and a pungent taste. It is acid to test paper, soluble in ether and alcohol, and crystallizes in needles when cooled below 32°. The formula of oleic acid is $C_{44}H_{39}O_4+HO$.

551. *Glycerine.*—These acids exist in nature in combination with an oxide of hydrocarbon, which has received the name of glycerine. This is separated during the process of saponification, and may be obtained in combination with an atom of water. The hydrate of glycerine is an inodorous syrupy liquid, of the sp. gr. of 1.27, and very sweet to the taste. It is insoluble in ether, but miscible in all proportions with water and alcohol. Its solution is inca-

Shearing Candles – made from Hogs Lard in obtaining Lard oil

Margarite a pearl or pearly lustre

Μαργαριτη

or Elain (ελαιον oil)

‡ It is the winter strained oil of commerce

Glycus sweet

hence its name.

† premising at the same time that by native Acids are meant such as exist ready formed in organic bodies, chiefly vegetables, without any operation or interference of man such as the acids of the lemon the apple, of sorrell & Tartar &c.

pable of being fermented. Its formula is $C_6H_7O_5 +$ Aq. Glycerine, therefore, differs from mannite in containing one atom ~~more~~ of oxygen. less

552. The various soaps of commerce are the stearates, margarates, and oleates of potassa and soda.

The salts of soda are the hard white soaps, and those of potassa are a semi-transparent gelatinous mass. Yellow soap contains about one-third of resin to two of fat.

Almost every variety of oil and fat, contains, along with stearine, margarine, and oleine, a larger or smaller portion of a peculiar acid, which belongs to the same group as those above described, has similar reactions with the bases, and is combined in a state of nature with glycerine.

SECTION IV.

NATIVE ORGANIC ACIDS.

553. It would swell an elementary ~~treatise~~ course of Lecture beyond its proper ~~size,~~ limits to attempt to treat of the great variety of native acids which have been discovered, and their bare enumeration would be useless. All that can be done, is to point out the properties of the most important.†

554. The views which have been unfolded respecting the nature of active acids, and of salts, are placed in still clearer light by the constitution of the organic acids. All these acids are what is called *hydrated*, that is, exist in combination with one or more atoms of water, which are essential elements of their constitution. The number of basic atoms in the salts which they form, is always determined by the atoms of this basic water, and the hydrated acid may be regarded as a salt of hydrogen. These views

are further strengthened by the changes which take place in tartaric acid, which is the only organic acid from which we are able to expel all the water. In its anhydrous state, it is destitute of acid properties, and is insoluble in water.

555. ~~Pyrogenous Acids.~~—When these acids are submitted to the action of strong heat in a close vessel, they give rise in most cases to new acids, which are called, from the circumstances in which they are formed, the pyrogenous acids. Thus, citric acid, $C_{12}H_5O_{11}+3Aq$, when heated, is converted into pyrocitric acid, C_4HO_3+HO, which is identical with the aconitic acid, that exists in the aconitum napellus, or wolf's bane.

556. *Tartaric Acid.* $\overline{T}$.—This acid exists naturally in combination with lime or potassa, in the juices of several fruits. It is found in the grape in the form of bitartrate of potassa, and as this salt is less soluble in alcohol than in water, it is deposited during the fermentation of the juice of the grape, and has long been known in commerce by the name of crude tartar, or when purified and pulverized, by the name of cream of tartar. Tartaric acid has strong acid properties; it is very soluble in water, crystallizes in rhomboidal prisms, which are permanent in the air, and may be distinguished from all other acids by forming white granular crystals, when added to a solution of potassa or any of its salts. The formula of tartaric acid is $C_8H_4O_{10}+2HO$. It is a bibasic acid, and the constitution of its salts is $C_8H_4O_{12}+M$, H, or 2M. ‡

The bitartrate of potassa, KO, HO+$\overline{T}$, the common cream of tartar of the shops, is a natural secretion of the grape, and being insoluble in alcohol, it is precipitated during the fermentation of the juice. It is sparingly soluble in water. The basic tartrate, 2KO+T, is the soluble tartar of the shops. Rochelle

† premising
are meant
organic b
operation
acids of
Tartar &

+ produced by fire

Ταρταρος infernal - dregs of wine

Cream of Tartar or bi. Tartrate of Potasa

Show crude Tartar

‡ Tartaric acid has a stronger affinity for lime than for Potasa, and is therefore obtained by mixing 30 pts quick lime with 100 of cream of Tartar in water to obtain Tartrate of lime; which is afterwards decomposed by a quantity of Sulph. acid equal in weight to the lime made use of. The M occurring in the formulae each Metal or any metals.

Being a purgative salt, new wine is not wholesome or at any rate is apt to gripe before it has deposited its coat or sediment of Bi Tartrate of Potasa

Hence get Tartaric acid

Lat Racemus a bunch of grapes

salt is the double tartrate of potassa and soda, $KO, NaO+\overline{T}$.

557. Tartar emetic is the tartrate of potassa and antimony, $KO, St_2O_3+\overline{T}+2Aq$; this water is driven off at 212°, and when the salt is heated to 480°, two additional atoms of water are formed, which must arise from the disintegration of the salt, as they are restored when it is again dissolved. The real constitution of tartar emetic is not understood; and is difficult to reconcile with the binary theory of salts, which supposes the active acid to be a salt of hydrogen, and that the ordinary salts are formed by the union of the oxygen of the base with this hydrogen. To explain the constitution of tartar emetic on this theory we must suppose tartaric acid to be quadribasic and not bibasic, as is the fact. The *boracic acid* unites as a base with the bitartrate of potassa to form a double salt, which presents the same theoretical difficulties as tartar emetic.

558. Tartaric acid is changed by fusion into an isomeric acid called the *tartralic*, of which the atomic number is one and a half times that of tartaric acid. By longer fusion it loses all its water and is converted into a porous white mass, insoluble in water and alcohol, and destitute of acid properties. When distilled at still higher temperatures, it is converted into a monobasic acid—the pyrotartaric, of which the constitution is $C_5H_3O_3$.

559. *Racemic Acid.*—The wines of the Vosges mountains in France, deposit during certain seasons, a peculiar salt of potassa, the acid of which is not the tartaric, but an isomeric acid, the *racemic*. It is less soluble than the tartaric acid, and its salts differ in crystalline form from the tartrates. It forms a parallel series of salts with the tartaric acid, and has the same combining number, although it is said by Fresenius to be a monobasic, and not a bibasic acid.

560. *Citric Acid.* $\overline{Ci}$. This acid exists in the juices of the lemon, the gooseberry, and other fruits. It has an agreeable sour taste, is soluble in less than its weight of cold water, and usually crystallizes in large rhombic prisms, containing two atoms of water of crystallization. It is a *tribasic* acid; its formula being $C_{12}H_5O_{11}+3HO$; and that of its salts, $C_{12}H_5O_{14}+M_3$, M_2H, or MH_2. Citrate of soda consists of $C_{12}H_5O_{14}$, $Na_3+4Aq+7Aq$. At 212° the seven atoms of water are driven off, and the remaining four are not parted with, till the heat is raised to 400°.

The pyrocitric acid has already been noticed.

561. *Malic Acid.*—This acid exists along with citric acid, in the berries of the mountain ash and other fruits. It is strongly acid and deliquescent. It is a bibasic acid, its constitution being $C_8H_4O_8+2HO$, and that of its salts, $C_8H_4O_{10}+M_2$, or MH. When heated it gives out two atoms of water, and is converted into two acids, one of which, the *Maleic*, is a bibasic acid, isomeric with the aconitic, and having double its atomic number, viz. $C_8H_3O_6+2HO$. The other is a monobasic acid, of which the formula is C_4HO_3+HO. It is identical with the fumaric acid which exists naturally in the fumitory, and in Iceland moss.

562. *Tannic Acid*—This acid principle is the chief cause of the astringency of vegetable substances. It exists abundantly in the inner bark of the oak, in gall nuts, in the inspissated juices, kino and catechu, and in the seeds of the grape. Pure tannic acid is prepared by submitting finely powdered gall nuts to the action of cold ether. The water contained in ether combines with the tannic acid, while the remaining proximate principles of the gall nuts are dissolved by the ether. The aqueous solution, which forms a dense stratum at the bottom of the vessel, is separated and carefully evaporated to dryness. Pure tannic acid is colourless and

Lemon juice is not naturally crystallizable on
ac/c of the Vegetable pulp and other matter wanting
in the fruit going into a state of decomposition
or rotting before they evaporate enough to permit
crystallⁿ. – Therefore lemons or Lemon slices will
not keep. – But to fresh lemon juice add quick
lime, and afterwds take it up by sulphᵗᵉ and
I then the acid of lemon is left in crystal tⁿ. that
in later Warmer fluid

Eat Malum Apples

So called from its property of Tanning Leather
or rather hides to make them Leather
especially in unripe fruit of Pasemon Tree

also in Tea hence use of Iron
L. Jelly improper and
Indigestible

+ Mr Hatchett discov.d that 100 grns charcoal - digested and dissolved in 1 oz Nit.c acid diluted with 2 oz of Water & wash.d to dryness also produces artific Tannic acid

White Leather is Tanned - Skins sank & heavily buttered - then fermented with Bran & water when called a Pelt, & then Tanned by solut.n of Alum & Salt in warm Water - Lastly trodden in water with Yolks of Egg & dried & smoothed by a warm Iron.

+ explain process of Tanning Leather by Solution of Gelatine - work at first 2 to 4 mos for calves & thin Skins & 12 to 18 for thick Sole Leather

Dr Granville of London thinks that Egyptn Mummies were Tanned ~~for 2 to 4 mos for calves & thin skins & 12 to 18 for thick Sole Leather~~

⊕ Making of Ink - Black Dyes

Blacking of Shoe Leather by Solution of Sulphate of Iron.

The salt is necessary to yield chlorine, which when united to Gelatine converts it into a volatile fluorescent substance insoluble in water - See Dr Ure's Chem p667

inodorous, has a purely astringent taste without bitterness, and may be preserved dry without change. It is very soluble in water, and the solution reddens litmus paper, and decomposes the alkaline carbonates. Tannic acid forms a salt of a deep blue colour with the peroxide of iron, and combines with many other of the metallic oxides.

Tannic acid is distinguished from all other substances by forming with gelatine a compound which is insoluble in water. This compound, which is called leather, is formed whenever the skins of animals, which consist chiefly of gelatine, are exposed to the continued action of a solution of tannic acid. Leather, when dried, becomes tough and hard, and resists putrefaction.

The salts of tannic acid are remarkable for their peculiarities of colour; and it is on this account highly useful as a test. It is a tribasic acid, its formula being $C_{18}H_2O_9+3HO$.

563. *Gallic Acid.*—This acid is obtained by boiling for a few minutes an infusion of gall nuts with a strong solution of potassa, and adding an excess of sulphuric acid, which causes a copious precipitate of gallic acid. This acid is bibasic, and its formula is C_7HO_3+2HO. It is also formed by the decomposition of a solution of tannic acid, which absorbs from the air 8 atoms of oxygen, and forms 4 $\overline{CO_2}$, $\overline{2C, HO_3}$, $\overline{2HO}$, and HO. Three atoms of tannic acid contain the elements of six atoms of gallic acid, and one atom of grape sugar.

564. Pure gallic acid has a weak acid and astringent taste, and reddens litmus paper. It is freely soluble in boiling water, but requires 100 parts of cold water to dissolve it. The pergallate of iron is a salt of a deep blue colour; common writing ink is a mixed solution of the pertannate and pergallate of iron. Gallic acid does not precipitate solutions of

gelatine, as does the tannic acid. When anhydrous gallic acid is exposed to a heat of 419°, it is decomposed into one atom of carbonic acid, and one of *pyrogallic* acid, consisting of $C_6H_3O_3$. This acid sublimes and condenses into brilliant, white, scaly crystals. It is more soluble than gallic acid, and strikes a blackish blue colour with the persalts of iron. When pyrogallic acid is heated to 480°, it is decomposed; two atoms yielding three atoms of water, and one atom of *metagallic* acid, $C_{12}H_3O_3$. Metagallic acid is a black, shining, insoluble mass, that is dissolved by the alkalies, and forms neutral salts, most of which are black and insoluble. During the process for the preparation of gallic acid, another modification of that acid subsides in the form of an insoluble gray powder. It has been called *ellagic* acid, and consists of C_7HO_3+HO, containing one atom less of water than the gallic acid.

565. *Pectic Acid.*—When the filtered juice of certain plants, such as the carrot or the beet, is mixed with alcohol, a gelatinous mass subsides, which may be collected on a filter, washed, and dried. It then forms a transparent, insipid mass, one part of which forms a firm jelly with one hundred parts of water. This vegetable jelly is called *pectine.* By long boiling it changes into *pectic acid;* which exists in plants as a pectate of lime, and may be obtained from their juice by the action of chlorohydric acid. Pectic acid is obtained in white transparent scales, acid to the taste, and reddening litmus paper. Its solution does not gelatinize, but is converted into a firm jelly by acids, lime water, and sugar. It is a bibasic acid, isomeric with pectine, and its formula is $C_{22}H_{17}O_{22}+2HO$.

+ from ΠΕΚΤΙΣ coagulum or Jelly

† Nitrogen exists in so few vegetables and is so common and constant a constituent in most animal substances, that this branch of chemistry is usually denominated Animal chemistry – But our author does not make this distinction, altho' it has very lately been made in all chemical works. Modern discoveries have however shewn that there is such an intimate relation between what were formerly called Vegetable & Animal substances that they may almost be said to exist in common or at any rate it is difficult, or perhaps impossible to draw a line of demarkation between them and to say definitively what belongs to the one, and what to the other class of beings.

The same overlapping or interference, appears to run thro' all the works of the animated creation so as until lately to have presented considerable difficulties in the study and classification of the objects of Natural history – We formerly had animal plants described, because altho' apparently plants, they appeared to perform some of the functions of animals & these are now considered as animals in the lowest grade of animal existence – now called Radiata. Then the Mollusca or shell fish The annulata no limbs – Crustacea – & Insecta, having no skeleton internally & lastly the vertebrata – then changes by the classes The Ornithorynchus paradoxus. Birds – Beast & fish, no feet amphibia with feet

CHAPTER IV.

NITROGENOUS COMPOUNDS OF CARBON AND HYDROGEN.

SECTION I.

IMMEDIATE ORGANIC PRODUCTS.

566. The principal distinction between animal and vegetable products, is the presence in the one case, and the absence in the other, of nitrogen. Many animal secretions, however, such as the fatty oils, are destitute of nitrogen, and many vegetable products, such as gluten, and the organic alkalies, contain it. The presence of nitrogen renders the substances more liable to putrefaction, and greatly complicates the results of decomposition.

567. Fibrine, albumen and caseine, are to animals, what lignine, gum, starch, and sugar, are to vegetables; their most copious and important secretions, products essential to the life and health of the individual.

568. *Fibrine.*—Fibrine constitutes the basis of the flesh of animals, and is deposited in the muscular tissue from the blood, of which it forms a principal constituent, and in which it remains during life in a liquid state. It may be obtained by stirring freshly drawn blood with a bundle of twigs, to which the fibrine adheres in soft tenacious masses; and it is purified by washing in water, and digesting in alcohol and ether. When dried at a gentle heat, it is a yellowish, opaque, tasteless, insoluble mass, which undergoes no change when kept in dry air. In the damp it absorbs so much water as to treble its weight, and become soft, elastic, and flexible. When long boiled in water it is decomposed and dissolved.

569. Fibrine absorbs cold oil of vitriol, and forms

with it a neutral compound soluble in water. It is dissolved in acetic acid, and by caustic potassa; and when exposed to the damp speedily undergoes putrefaction.

570. *Gluten.*—When the newly expressed juices of vegetables are allowed to stand, a green gelatinous precipitate is formed, which becomes by the removal of the colouring matter, a grayish white substance, having all the properties of fibrine. This fibrine is contained in large quantities in the juice of grapes, and in the seeds of the cerealia. The gray, viscid, fibrous, elastic mass, which remains after the starch has been separated from wheat flour, is nearly pure fibrine, and bears the name of Gluten. Boiling alcohol separates it from the albumen with which it is mixed, and the pure gluten may be precipitated from the solution by water. Pure gluten is insoluble in water and ether, but forms a thick syrupy solution in alcohol, and dissolves in acetic acid, and alkaline solutions. When dry it is a hard, brittle mass of a yellow colour, which undergoes no change in dry air, but absorbs moisture in the damp, swells, becomes a soft, adhesive, elastic mass, which soon ferments and undergoes putrefaction.

571. *Albumen.*—This substance is diffused throughout the whole animal frame, and exists in two conditions, a soluble, and an insoluble one. Soluble albumen is in its purest form in the white of eggs, in which it is united with water, carbonate of soda, and saline matter. Liquid albumen is a thick, glairy fluid; insipid, inodorous, easily miscible with water, and perfectly soluble in a large quantity of that fluid. When dried at a low temperature, it becomes a solid, transparent mass, which retains its solubility. At 160°, albumen is coagulated, as it is also by alcohol, and the stronger acids. Dr. Turner supposes that liquid albumen is a solution of albumen in water, formed at the moment of being secreted, but that the

Fibrine appears to be formed of Gluten or more probably they are the same thing – Gluten must not be confounded with Gelatin which its name might lead to – Gluten is like glue in appearance but will not make glue or stick things together being insoluble

cerealia – what ?–

– and hence difference between it & Gelatin
it is not glue & has none
of its properties

see p 263

* Of this substance Macaroni & Vermicelli the chief food of the Italians is formed

† Milk also treated of p 282.

contains water, Butter Caseous matter or Curd Sugar of milk, Lactic acid, Chlorohydrate of Potassa Phosphate of Potassa and of Lime, with a trace of Iron. The Butyrine or Butter, Caseous Matter or Caseine and sugar of milk, rise to the surface when milk stands quietly in a cool place and constitute Cream. Cream consists of about 3 per cent of Caseine 4 of Butyrine and the rest is whey; and whey consists principally of water with a small portion of animal matter and a large quantity of the sugar of milk.

union is so feeble as to be broken by slight causes, which render the albumen quite insoluble, without effecting any change in its composition. The solubility of nascent silica, and its insolubility under all other circumstances, furnish an analogous case. Water diluted with $\frac{1}{1000}$ of its weight of albumen, is rendered opaque by boiling. Solutions of albumen coagulate at 212°, and are much used for clarifying turbid solutions; for the coagulated albumen carries with it, to the surface, the foreign particles which render the liquid turbid. Albumen is precipitated by several of the metallic salts, and is a useful test of the presence of corrosive sublimate, with which it forms an insoluble, inert precipitate. It is, therefore, an effectual antidote to the effects of that poison. So delicate a test is this chloride of the presence of albumen, that it will occasion a milkiness in water containing only $\frac{1}{20000}$ part of albumen. The precipitate is said to be a combination of oxide of mercury and albumen. Albumen may also be obtained from the liquid, which has been used in the separation of fecula from wheat flour. If the water, from which the starch has been deposited, be heated, it will become more or less cloudy, and white films separate, which have all the properties of coagulated albumen. It exists in plants in only small quantities; the seeds of the cerealia contain from $\frac{1}{10}$th to $3\frac{1}{2}$ per cent, the leaves of the cabbage, the stalks of asparagus, and the roots of turnips, yield it in larger quantities. The albumen from vegetables is destitute of elasticity when softened, and dries into a hard, white mass. It is soluble in water; its solution is coagulated by heat, and it has all the properties of animal albumen.

Milk + 572. *Caseine.*—This element is the principal substance of the curd of cheese, from which it may be obtained by digestion in water, and in alcohol, which dissolve out the foreign substances, with which it is

Curd

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ialy acetic acid.—

the first ranks)

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(Pr / is $C_{48}H_6H_{36}O_{14}$.
may be considered as
& Prostheses is
ers in different
present in albumen
matter indeed asserts that Protein is (Graham p 692)
the base or foundation upon which Albumen Fibrine
& Caseine are formed, and that it primarily exists only
in vegetables which being eaten & assimilated it is in
this way communicated to animal bodies (Liebig, Ani Ch p 105

mixed. Caseine dries into a semi-transparent, yellow mass, and is perfectly insoluble both in cold and hot water; although soluble in water to which acetic acid, or an alkali, has been added. It is unalterable in a dry atmosphere, and the changes which old cheese undergoes, are due to the foreign substances mixed with the caseine. Caseine also exists in the seeds of leguminous plants.

573. Fibrine, albumen, and caseine, like starch, gum, and sugar, closely resemble each other, and may be converted one into the other. By digestion at 80° in a solution of nitre, fibrine acquires the properties of liquid albumen; and caustic potassa throws down liquid albumen in the form, and with the properties of caseine. In the living organism, these principles are all liquid: the fibrine coagulates by mere exposure to the air, the albumen by heat, and the caseine by the addition of rennet, or an acid.

When these substances are dissolved in a solution of caustic potassa, and then exposed for some time to a high temperature, the addition of acetic acid, causes all the organic matter to fall in a gelatinous, translucent precipitate, of exactly the same character in all cases.

574. *Proteine.*—This substance, to which the name of proteine (the first element) has been given, is common to all these compounds, and the ultimate analysis of proteine, albumen, fibrine, and caseine, gives absolutely the same proportions of carbon, hydrogen, nitrogen, and oxygen, with small and varying quantities of sulphur and phosphorus. The formula, which, according to Liebig, best represents the composition of proteine (Pr) is, $C_{48}N_6H_{36}O_{14}$. Caseine differs from proteine in containing a minute quantity of sulphur; albumen and fibrine differ from it in containing sulphur and phosphorus; and their composition will be represented thus; caseine, Pr+S; albumen, Pr+P+S; and fibrine, Pr+P+2S. The quan-

† Milk also treated of p 282.
contains wa
Sugar of Milk, L
Phosphate of Potas
Iron. The Butyrin
Caseine and sugar
when milk standi
constitute Cream.
of Caseine & of Butyrine and the rest is whey; and
whey consists principally of water with a small portion
of animal matter and a large quantity of the sugar
of milk.

× ~~wanted~~ is dried stomach of the calf containing in a dry state what was gastric juice principally acetic acid. –

(Proteine is from πρωτεύω – I take the first ranks)

~~Till~~ The Fibrine & Albumen have been described as seperate & distinct proximate elements, Yet Mulder, Liebig and other modern chemists believe that they are but modifications of the same primitive element or radicle to which therefore ~~they gave~~ the name of Proteine or primitive principle has been given – Liebig says (Pr) is $C_{48} N_6 H_{36} O_{14}$, and that albumen & fibrine may be considered as compounds of Proteine with sulphur & phosphorus in different proportions – Sulphur is always present in albumen Mulder indeed asserts that Proteine is (Graham p 692) the base or foundation upon which Albumen Fibrine & Caseine are formed, and that it primarily exists only in vegetables which being eaten & assimilated it is in this way communicated to animal bodies (Liebig, Anal Ch p 105

Show Prussian blue

Show Ferrocyn. of Potassa

red oxide of ☿

cyanide of ☿

‡ Show this with Solution of Prussiate Potassa & of Sulphate of Iron

[illegible] some with Zn [illegible]

tities of sulphur, and phosphorus in the above formulæ do not represent equivalents; for were they so framed as to do this, the formulæ would thus stand; caseine, Pr_{20} $(C_{950}N_{120}, H_{720}O_{230})+S$; albumen, $Pr_{20}+P+S$; and fibrine, $Pr_{20}+P+S_2$. These numbers startle us by their magnitude, for they make an atom of fibrine to contain 2083 elemental atoms: and it is much safer in the present state of our knowledge, to take the simple statement of Liebig, as a sufficiently close representation of facts.

575. *Gelatine.*—Gelatine exists abundantly in many of the solid parts of animals, such as the skin, bones, and cartilages. It does not appear to exist in any of the animal fluids. It is distinguished from all other animal principles by its ready solubility in boiling water, and by the bulky, semi-transparent jelly, which the solution forms on cooling. One part of gelatine, dissolved in 100 parts of water, becomes solid on cooling. Isinglass, which is the dried air-bladder of the sturgeon, is the purest form of gelatine; common glue is gelatine prepared from the skins and hoofs of animals. Gelatine is soluble in most of the diluted acids, and in alkaline solutions; concentrated sulphuric acid dissolves it without charring, and converts it into a peculiar saccharine principle, which is soluble in water, and in alcohol, and crystallizes in large prisms, which consist of $C_{16}H_{15}N_5O_{11},+3Aq$. The composition of gelatine itself is calculated by Liebig, from Mulder's analysis, to be, $C_{54}N_9H_{42}O_{20}$.

If a solution of common salt, and one of alum, be poured into a solution of gelatine, the latter falls down in combination with alumina. On this principle is founded the manufacture of white leather, by the process called tawing.

576. *Bones.*—Gelatine constitutes about one third of the solid material of bone, and may be separated from the earthy skeleton which envelopes it, by long

of Prussian Blue.

Berlin in Prussia
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e state of well burnt
animal charcoal, which being coarsely powdered was
boiled in a solution of Copperas or Sulphate of Iron
when this beautiful Blue colour fell to the bottom
as a precipitate & was easily collected. Our Book tells us

digestion in boiling water. The earthy skeleton consists, in different animals, of from 80 to 95 per cent. of phosphate of lime, from 2 to 20 per cent. of carbonate of lime, a small portion of carbonate of soda and magnesia, and a trace of fluoride of calcium. The phosphate of lime yields by analysis, 8 atoms of lime, and 3 of phosphoric acid. The acid is the tribasic acid, and Graham supposes the bone phosphate to be a combination of two phosphates; viz: 2 ($3CaO, P_2O_5+Aq$)+($HO, 2CaO, P_2O_5+Aq$).

Begin a Lecture

SECTION II.

read this first

CYANOGEN.

Fibrine
Gluten
albumen

Show Prussian blue

Show Ferrocyn. of Potassa

red oxide of ☿

cyanide of ☿

‡ Show this with Solution of Prussiate Potassa & of Sulphate of Iron

577. When any of the foregoing animal matters are calcined with potash, there is obtained by lixiviation and evaporation, a yellow crystalline salt, which has long been known as yielding with sulphate of iron, the beautiful pigment, prussian blue.‡ When this prussian blue is boiled with half its weight of red oxide of mercury in four parts of water, the clear solution yields by evaporation, colourless, prismatic crystals. These crystals are a combination of mercury, with the substance which was combined with potassa and iron, in the prussian blue.

578. By heating the crystals in a glass flask containing no lead, the mercury is volatilized, and a gas escapes which may be collected over mercury. It is colourless, of a peculiar odour, and irritates the eyes. Its sp. gr. is 1.816; it extinguishes burning bodies, but is itself inflammable, and burns with a beautiful purple flame. When 100 measures of this gas are mixed with 200 measures of oxygen, and exploded, the products are 200 measures of carbonic acid, and 100 of nitrogen. The former contains 200

of bitter almonds

Cyanogen — Show Spec.n of Prussian Blue.

In 1710 one Diesbach a colour maker at Berlin in Prussia accidentally discovered a Blue paint or pigment more beautiful than any before known, and he made and exported it in considerable quantity keeping his process of making it a profound secret for more than 15 years so that it could not be procured any where but from himself, and on this account it obtained the name of Prussian blue by which the colour is now so well known that no one has attempted to alter it. — When the process of making this colour became public, it was perfectly unintelligible, in the then state of chemical science; for it turned out to be nothing more than collecting the blood and refuse of slaughter houses & evaporating these to dryness and afterwards burning the remainder of the bodies of animals that died, previously dried in close Vessels until the whole was reduced to the state of well burnt animal charcoal, which being coarsely powdered was boiled in a solution of Copperas or sulphate of Iron when this beautiful Blue colour fell to the bottom as a precipitate & was easily collected. Our Book tells us

x This explanation therefore unfolds the mystery of obtaining this beautiful blue colour from the burning of Blood & animal matter – Skin Hair & Blood contain Nitrogen in considerable quantity as well as carbon – The application of heat converts the animal matter into carbon and volatilizes it, while at the same time it discharges the nitrogen in the form of Gas & these 2 products unite under the influence of heat in their nascent states & form the Bi-carburet of Nitrogen, which is cyanogen.

This is afterwards boiled with solution of Copras or sulphate of Iron to permit the Cyanogen to combine with the protoxide of Iron which combined is Prussian Blue.

Cyanogen is one of the few compounds which was admitted by the chemists of late years to be of the nature of an element, notwithstanding it was compounded, because it unites with other matters without decomposition, and acts the part of an element. – It is of the same nature as the compound radicles now so largely admitted into organic chemistry.

Go to Para Cyanogen 50 next page

measures of vapour of carbon, so that the gas consists of 200 vapour of carbon, and 100 nitrogen, condensed into 100 measures. It is therefore a bi-carburet of nitrogen, and its formula is $N\,C_2$=26.39.

579. From its close affinity to the simple elements, and the multitude of its combinations, it has received a simple elemental name, and is called cyanogen from κυανος, blue, and γενναω, I generate, and its symbol is Cy. Beneath the pressure of four atmospheres, cyanogen becomes a limpid fluid. It supports a strong heat without decomposition. At 60°, water absorbs 4.5 times, and alcohol 23 times its volume.

580. *Paracyanogen.*—When the bicyanide of mercury is decomposed by heat, a brown carbonaceous mass is left in the retort, which is found to have the same composition as cyanogen, but which yields very different products by the action of the same reagents. This solid carburet of nitrogen, which is isomeric with cyanogen, has received the name of paracyanogen, and its formula is N_4C_8.

581. Cyanogen belongs to the class of salt radicals; it forms true haloid salts with the metals, and although it cannot be made to unite directly with oxygen, it can be indirectly combined with it, and forms a very remarkable group of isomeric acids.

582. *Cyanic Acid.*—CyO=34.39. Cyanic acid is obtained in combination with an atom of water, and is liquid, with a penetrating, pungent odour, like that of strong acetic acid; it excoriates and blisters the skin, is very volatile, and has strong acid properties.

Cyanic acid is remarkable for the facility with which its solution is converted into carbonic acid and ammonia. One atom of the acid combines with three atoms of water, and is resolved into two atoms of carbonic acid, and one of ammonia.

Cyanic acid is a monobasic acid, and forms crystalline salts of considerable permanency.

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which are cyanic acid - fulminic acid, and cyanuric acid - all of which are oxy acids or cyanogen combined with oxygen, and as this combination will not take place directly, cyanic acid is usually procured by a circuitous process from cyanuric acid which will be presently described. These oxy-acids are said by Pumfrey (Christison) are not poisonous

583. *Fulminic Acid.*—$Cy_2O_2+2HO=68.78$. This acid has never been insulated, and is known only in combination. It is a bibasic acid, and forms salts remarkable for the instability of their constitution. The most remarkable of these are the fulminates of silver and mercury. The former is prepared by dissolving silver in 10 parts of nitric acid, sp. gr. 1.35, and pouring the cold solution into 20 parts of alcohol. The mixture is made to boil gently, and is then slowly cooled, when it deposits the fulminate of silver in snow white, silky crystals. The formula of this salt is Cy_2O_2+2AgO. It detonates violently by the slightest friction, and by contact with sulphuric acid. The fulminate of mercury is prepared from a solution of mercury in nitric acid, in the manner above described. Its formula is Cy_2O_2+2HgO. It explodes by a smart blow, and is the salt used in the percussion guns. The paste with which the percussion caps are filled, is prepared by finely triturating 10 parts of the salt, with 30 of water, and then thoroughly mixing the soft mass with six parts of nitre.

584. *Cyanuric Acid.*—$Cy_3O_3+3HO=103.17$. This acid is obtained by dissolving the solid chloride of cyanogen in water. It is colourless, inodorous, and sparingly soluble in water. It feebly reddens litmus paper, and crystallizes in rhombic prisms, which contain 4 equivalents of water of crystallization permanently. It is a tribasic acid and forms soluble salts. The cyanurate of silver, $3AgO+Cy_3O_3$, may be heated to 600° without decomposition.

585. When dry cyanuric acid is heated to low redness in a retort, it is decomposed into hydrated cyanic acid, which distils over, and may be collected in a receiver surrounded by a freezing mixture. As soon as the vessel has acquired the common temperature, a violent molecular agitation, accompanied with a great rise of temperature, takes place, and the

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matters without decomposition, and acts the part
of an element. - It is of the same nature as the
compound radicals now so largely admitted into organic
chemistry.

40 to Para Cyanogen 50 next page

+ Has excited much attention from the detonating properties of its salts, all of which explode with violence when struck.

‡ The changes that occur in forming this salt are very complex. The nitric acid is decomposed that it may give up its nitrogen, to the carbon which is contained in the alcohol, so as to form cyanogen, which unites with 2 equiv.ts of the oxygen of the nitric acid - The rest of the oxygen uniting with the silver to convert it into an oxid wch is dissolved by the Fulminic acid, and the water of the alcohol remains without change

re Cyanic acid - Fulminic acid, and Cyanuric acid - all of which are oxy acids or Cyanogen combined with Oxygen. and as this combination will not take place directly, Cyanic acid is usually procured by a circuitous process from Cyanuric acid which will be presently described. These oxy-acids are said by Pimelia (Christison) are not poisonous

To make Cyanic acid

* as ammonia consists of $N.H_3$ so passing NH_3 in state of gas thro red hot charcoal in a porcelain tube, will produce this acid, all its elements being present with an excess of Hydrogen. The easiest way of obtaining it is from Cyanide of K in a small retort, adding 2/3d its weight of concd Chlorohydric acid, and distill by very gentle heat into a receiver kept cool by ice or snow and damp cloth.

† Hydrocyanic or Prussic acid is the most powerful poison known – a single drop will destroy life if pure – and it acts with equal power when applied to the skin, the eyes or a wound, as when taken internally – its effect is narcotic, acting probably on the sympathetic nerve, as it paralyzes the Heart, and stops all circulation and respiration almost instantaneously. Robiquet the celebd French Chemist had his hand paralyzed for several days by handling a Phial which had contained it. – Notwithstanding its virulence it is a most valuable medicine when carefully & properly administered. – For Medical use it is diluted with water which must not contain more than 3 per cent of it viz: 3 drops of acid to 1 oz of water – but even in this weak state it has produced death in several instances – Ammonia is best Antidote. Its taste and smell are very agreeable to most persons, and a good notion of it may be obtained from chewing Peach leaves or the Kernels of Peach Stones wch contain it. The flavour is admired in many articles of confectionary, such as Blanc Mange, Ratafia & macaroon cakes, the liquor called Noyau – also we have ache

liquid is transformed into a white, porcelanous mass, which is insoluble in water, alcohol, and ether, and which is reconverted into hydrated cyanic acid by again exposing it to great heat.

586. The apparent isomerism of the oxygen acids of cyanogen, is very satisfactorily explained by the new views of the constitution of salts and acids. According to these views the formula of the cyanates is $M+CyO_2$; that of the fulminates, 2M, or $M, H+Cy_2O_4$; and that of the cyanurates, 3M, M_2H_3 or $MH_2+Cy_3O_6$.

587. *Cyanohydric Acid.—Hydrocyanic Acid.—Prussic Acid.—Cyanide of Hydrogen.*—CyH= 27.39. This acid may be formed by the direct union of its elements; it is found native in combination with the oil of bitter almonds, and in the water distilled from the leaves of peaches, the wild cherry, and the cherry laurel. It is also formed by passing the formiate of ammonia, $(NH_4O+C_2HO_3,)$ through a red hot porcelain tube, by which it is converted into this acid, $(C_2NH,)$ and water, $(4HO.)$ * The anhydrous acid is a clear, limpid, inflammable fluid of the sp. gr. of .697. It boils at 80°, and congeals at 5°. It has a penetrating, bitter taste, a very peculiar odour, and mixes freely with water, alcohol, and ether. It is a most powerful poison, and is rapidly decomposed by exposure to light. changing in a few hours into ammonia, and throw down a brown precipitate called azulmic acid & it is then no longer poisonous * go to back W.S. page

588. *Metallic Cyanides.*—Cyanogen forms a series of true haloid salts with the metals, and so energetic is its affinity for some of them, that it will take palladium from all its other compounds, and that potassium, when heated in it, takes fire, combining with, but not decomposing the cyanogen.

The cyanide of potassium is fusible and soluble, crystallizes in cubes, has a pungent, alkaline taste, and is highly poisonous.

The bicyanide of mercury crystallizes in quadrangular prisms, is colourless, inodorous, soluble in

NC2

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that is now Hydro-
Prussic acid for
found always existing

Cyanide of Potas.

water, has a disagreeable metallic taste, and is highly poisonous. When heated it is resolved into mercury and cyanogen.†

589. With sulphur, iron, and cobalt, cyanogen forms compounds which are, like itself, genuine salt radicals, and which form with hydrogen, acids, which are decomposed by metallic oxides, in the same manner as chlorohydric acid, thus forming genuine salts.

590. *Ferrocyanogen.*—With iron, cyanogen forms two compounds; the constitution of the first, called ferrocyanogen, is $FeCy_3$; its symbol is Cfy, and its equivalent 107.17. It forms with hydrogen a bibasic acid, the *ferrocyanohydric acid*, of which the formula is $FeCy_3+H_2$. The acid is a white, crystalline mass, the salts of which were originally called prussiates. Thus the yellow prussiate of potassa, is the basic ferrocyanide of potassium, the formula of which is K_2Cfy. It is the yellow salt, prepared by calcining animal matters with potash, and is obtained in large, flat, quadrangular crystals, which contain 3 atoms of water. It is of a lemon yellow colour, and a slightly bitter taste. It forms double salts with the other ferrocyanides, and is much used as a test for iron.

591. *Ferridcyanogen.*—The second compound of iron and cyanogen, is called ferridcyanogen; it is isomeric with the former, and its formula is Fe_2Cy_6; its symbol, Cfdy, and its equivalent, 214.34. It unites with three atoms of hydrogen to form a tribasic acid, the ferridcyanohydric acid. The ferridcyanide of potassium is the salt, known by the name of the red prussiate of potassa, and is formed by passing chlorine through a solution of yellow prussiate of potassa, till it ceases to give a precipitate of prussian blue, with persulphate of iron. It crystallizes in crystals of a deep red colour, and is valuable as a test for the metals.

592. *Prussian Blue.*—There are several com-

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† Hydrocyanic
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more than 3
water – but
death in seve
its taste and
persons, and a
from chewing Peach
stones will contain it. The flavour is admired in
articles of confectionary, such as blanc mange, Rat
& macaroon cakes, the liquor called Noyau – all
like.

× what are now called cyanides, were in older chemical Books called Prussiates because what is now Hydrocyanic Acid was then called Prussic acid for no other reason than it was found always existing in Prussian Blue.

Show the Salt Prussiate of Potash or ferrocyanate of Potas

Show this test, if not before done.

Show Red prussiate of Potassa

have not got it

a few hours into ammonia, and throw down a brown precipitate called azulmic acid & it is then no longer poisonous * go to back W.S. page

+ It was a few years ago introduced into medicine as a substitute for Quinine in intermittent fevers, but was not found efficacious and has been abandoned. -

Liebig Name Melam in Brande's (meaning unknown)

Then dissolve some Iodine in strong aqua ammonia & then filter to make Iodide of Nitrogen which explodes on touching or moving the feathers, (see bottom of page 275).

pounds of cyanogen and iron, prepared under the name of prussian blue. The common prussian blue is prepared by mixing together solutions of yellow prussiate of potash, and sesquisulphate of iron. It contains Cy_9Fe_7+Aq, and consists of one atom of ferridcyanide of iron, $Fe_3+Fe_2Cy_6$, combined with one of the acid ferrocyanide of iron, $FeH+FeCy_3$.

A prussian blue, celebrated under the name of Turnbull's blue, is prepared from the red prussiate of potassa; it yields Cy_6Fe_5, and is the basic ferridcyanide of iron, $Fe_3+Fe_2Cy_6$. Antwerp Blue also

Prussian blue is insipid, insoluble, and inodorous, of an intensely pure, and beautiful blue colour. It loses its colour in the direct light of the sun, but recovers it in the dark.

593. The cyanide of cobalt, *cobaltocyanogen*, Co_2Cy_6, and the bisulphuret of cyanogen—*sulphocyanogen*, CyS_2, are compound radicals, resembling ferrocyanogen, which form acids with hydrogen, and salts with the metals.

The compounds of cyanogen with the salt radicals, resemble those of these elements with each other.

594. *Mellon.*—Sulphocyanogen is decomposed by heat into sulphur, sulphocarbonic acid, and an insoluble yellow powder, the constitution of which is C_6N_4. This carburet of nitrogen has received the name of *mellon*. It forms an acid with hydrogen, and haloid salts, and yields by the action of reagents, various singular and complicated products, the constitution, and relations of which, are imperfectly understood.

Section III.

AMIDE.

N. H2

595. Almost the only product of organic decomposition which is destitute of carbon, is ammonia.

In order to explain the changes which this substance undergoes, the existence of a hypothetical radical, called *amide*, of which the formula is NH_2, has been assumed.

596. *Ammonia.*—Ammonia is a constant and copious product of the putrefaction of organic bodies containing nitrogen. A salt known, and highly prized, from remote ages, received its name of sal ammoniac from the temple of Jupiter Ammon, near which it was found as a natural product. When this salt is mixed with caustic lime in a state of fine powder, and subjected to heat, a gas of a very pungent and penetrating odour, which powerfully irritates the eyes and nostrils, is evolved. The same gas is produced during the destructive distillation of animal matters, especially of bones, and being frequently obtained from the horns of the deer, its solution in water was long known by the name of *spirits of hartshorn.* It is an invisible gas which is liquefied beneath a pressure of 6½ atmospheres; its sp. gr. is .5898. It extinguishes burning bodies; the flame of a taper before going out is somewhat enlarged, and assumes a yellow colour; and a small jet of the gas burns in oxygen gas.

597. Ammoniacal gas, according to Kane, has no action on vegetable colours, when perfectly dry, but if damp, it is powerfully alkaline. It has a strong affinity for water, which absorbs 780 times its volume. The sp. gr. of a solution containing 690 times its volume is .875. The concentrated solution is prepared by decomposing chlorohydrate of ammonia by means of lime, and passing the disengaged gas through water, kept cool by surrounding the vessel with ice or wet cloths. Owing to its strong affinity for water, ammonia must always be collected over mercury. A piece of ice introduced into a vessel of this gas is instantly liquefied, and the gas as instantly absorbed. Ammonia has all the proper-

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i. Lybia — found as crude Sal Ammoniac or Muriate of Ammonia – explain meaning of word crude

Mix quick lime in power, with Muriate of Ammonia in powder – no odour in either untill mixed.

water takes 780 vol.s of Gas

Liquid ammonia or rather Solut.n of Ammonia

Wolfs apparatus