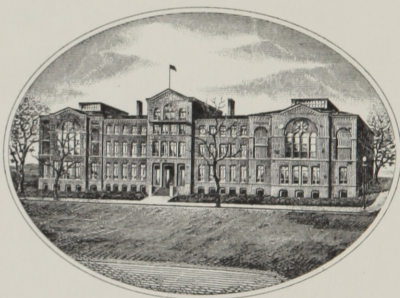


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*Conwell (6, 61)*  
**A Dissertation**

ON

**VEGETABLE CHEMISTRY;**

CONTAINING

A SUMMARY OF THE

PRINCIPAL FACTS OF THE SCIENCE,

WITH A SERIES OF RESEARCHES ON THE

PROXIMATE PRINCIPLES OF VEGETABLES.

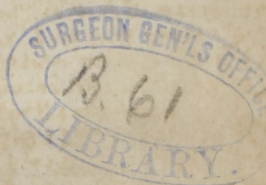
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By COLUMBUS C. CONWELL, M.D.  
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A Classification

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PROXIMATE PRINCIPLES OF VEGETABLES

BY COLLEGE C. CORWELL, M.D.

NEW YORK

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1877



TO HIS PRECEPTOR,  
*DR. SAMUEL JACKSON,*

THIS HUMBLE TESTIMONY  
OF THE AUTHOR'S  
SINCERE ESTEEM AND RESPECTFUL ATTACHMENT  
IS GRATEFULLY INSCRIBED.





DISSERTATION

ON

**VEGETABLE CHEMISTRY.**



MINERAL CHEMISTRY has nearly monopolized the attention of investigators, probably because it is more exempt from confusion in its data and less complex in its products than its sister sciences; for such elements as analysis can isolate, synthesis can recombine. This is not the case in Vegetable or Animal Chemistry, nor can we ever hope to form in our laboratories, substances developed by the long and incessant work of organization:—we may destroy, but cannot reproduce; we may analyze, but cannot effect a similar assemblage of particles unaided by the phenomena of vitality.

Yet Organic Chemistry is not without importance nor destitute of fascination. It presents a wide and brilliant field for philosophical research, serves as a key to many physiological arcana, enables the physician to prescribe his remedy with more efficacy and less liability to failure, and derives no inconsiderable degree of importance from the reflection, that the object of our study is one which confers on animals the blessing of life, by affording us every species of nutriment, and in all probability furnishing our atmosphere with its exclusive source of oxygen.

This harmonious dependence of animals on vegetables and vice versa, is worthy of observation. They exhale oxygen, a fluid deleterious to vegetables; we inhale it, as a stimulant to vitality; they inspire carbonic acid as an aliment, we expire it as a poison. We sustain life by consuming substances, which they reject as superfluous, or diseased; they flourish best in the excrementitious matter of animals. Thus nature, infinitely admirable in all her operations, has by this sublime harmony, blended the two kingdoms so intimately together, that the absence of the one would infer the consequent destruction of the other.

In the mineral kingdom substances may be said to combine two by two; in the vegetable, three by three—oxygen, hy-

drogen, carbon; and in the animal, where this gradation of complication is at its maximum, four by four—oxygen, hydrogen, nitrogen, carbon. The chain of affinities connecting these elements becomes less firm and durable as their complication increases; hence, in the two last mentioned kingdoms are observed the spontaneous phenomena of fermentation in the one and putrefaction in the other, on the cessation of life, that principle which, as it were, agglutinates the organic molecules.

The principal sources of nutriment are furnished to vegetables by water, heat, light, carbonic acid, and perhaps earth.

**MOISTURE** is a stimulant so essential to vegetables, that without it they languish and die. This fact is finely illustrated in the case of the squill, onion, &c., which perform the functions of life, even while suspended in a moist atmosphere. In the burning deserts of Arabia, whose soil, sun-parched and sandy, affords no traces of vegetation, the wanderer's eye is occasionally delighted with the prospect of isles of verdure (oasis) which appear around the margin of springs. The sunflower is said by Ray to exhale a quart of water in twenty-four hours; and Navarette, in his account of China, mentions a wreathing plant called the Bejuco, from whose nib or melon, when punctured, there exude several quarts of cool, limpid water.

Passing through the assimilative organs, water suffers decomposition.—Its oxygen is evolved, while the hydrogen remains to form the base of oils, resins, &c.

**HEAT** is also a necessary stimulant. Vegetable nature is more vigorous in tropical than in polar climates; hence we find that warm countries abound in trees and forests, while shrubs, underwood, and arbustæ, are the only kind of vegetables met with in cold regions:—nay, the very plant, whose size and majesty may render it the pride of Turkish groves, when transported to the soil of Lapland becomes small, wrinkled, and contracted, because the rapidity of digestion is proportional to the intensity of the heat.

**LIGHT** possesses considerable influence on vegetables; the ray emanating from a lamp produces an effect analogous to that of the sun.

**EARTH.** Can the substance of the earth, though often regarded as the most indispensable aliment, be considered nutritious? an ingenious experiment of Van Helmont seems to set the question at rest. He dried 200lb. of earth, and in it



planted a willow weighing 2lb. In order to secure it from the admission of other earth, he covered it with a perforated tin hemisphere, carefully watering it with distilled water twice a day for five years. He found the willow then weighed 169 lb. and the earth had lost but two ounces.\* It is certain from this experiment that vegetables receive little or no nutrimental matter from the earth. The experiment gives origin to a more important chemical question. From what source could the willow have derived the many pounds of potassa which it must have contained? Potash is not volatile; it could not have procured it from the atmosphere, and certainly not from the distilled water?—Is potassium really elementary, or could it have been developed in the plant, by gaseous combination, assisted by organic action?—Does potash exist in plants during vegetation?† If so, why can we not detect it by our tests, or extract it by our acids? If not, have we not every reason to believe that it is literally *generated* by combustion?

I confess myself sceptical enough to doubt whether potash exists ready formed even with charcoal; for how comes it that after extracting from charcoal, all matter capable of being acted upon by acids, we can afterwards convert it partly into potash by ignition and combustion? if the alkali had an anterior existence, the acids would undoubtedly have indicated it. I feel perfectly convinced, though I never performed the experiment, that carbon, precipitated from cyanogen or from prussic acid, would, if burned, leave a residue of potash; and who would be hazardous enough to maintain that the alkali pre-existed in hydrocyanic acid!

It would be deemed romancing in me to offer the hypothesis that charcoal and potassa have the same metallic base, differing only in degree of oxidation. And yet they are both combinations of oxygen with a known base. The potassium of Davy, and the carbonium of Doebereiner, are described with properties scrupulously analogous; and I am confident they are identic; for during Doerbereiner's process, the charcoal was oxidized, and converted partly into potassa, from which the base carbonium was obtained.

Another fact totally irreconcilable with the established theories of carbon and potash, and one explicable only by admitting the doctrine of different degrees of oxidizement, is the following: If a pound of ligneous fibre be submitted to

\* Vide, Martin's Phytographia.

† I do not here speak of that scarcely appreciable or doubtful minim of potash said to be occasionally found in combination with a few vegetable acids.

the action of heat in close vessels, it will be found to be converted into charcoal, not an atom of potash being produced, whereas, if the same quantity of wood be reduced to shavings and burned in the open air, it will be converted almost totally into potash. The minute state of division in the latter case gives the oxygen a more ready and free play upon the base which it alkalinifies, but under the former circumstances, the base receives merely enough oxygen to carbonize it.

For the purpose of assisting myself by method, and rendering this essay more perspicuous, I have presumed to offer an arrangement of Vegetable Chemistry founded on the element which predominates in each proximate principle: thus all principles in which carbon is the predominant element, as lignin, suberin, tannin, &c. will be comprehended under the Genus *Carbonia*; those in which hydrogen predominates, under the Genus *Hydrogenia*, &c. &c.

### GENUS I.—CARBONIA.

*Under this head are classed all immediate principles in which Carbon predominates.*

#### *Species 1.—LIGNIN.*

The dense fibrous tissue composing the parietes of the vegetable vessels after desiccation and extraction of all soluble matter by alcohol and water, is denominated lignin. It contains 52 parts of carbon in 100, affords to distillation acetic acid combined with an empyreumatic oil (pyroligneous acid), and produces, when treated with nitric acid, artificial tannin, colouring matter and oxalic acid.

Braconnot's experiments, relative to the convertibility of lignin into sugar, are perhaps the most curious and interesting ever recorded in the archives of Chemistry.

Lignin heated with its own weight of caustic potassa, affords a substance of easy solubility, analogous to ulmin.

#### *Species 2.—SUBERIN.*

The term has been applied by Chevreul to the outer bark of the cork tree. From lignin it may be contradistinguished by its greater combustibility, lightness, and compressibility, and by the absence of distinct parallel fibres; its principal peculiarity is its conversion into suberic acid, by reaction with nitric acid.

Boiled in alcohol, and evaporated, suberin affords a crystalline principle, called by its discoverer, cerin. For distinction sake it has been entitled suber-cerin.



By distillation I procured from cork an aromatic acid, which may be called pyrosuberic acid, with the same propriety as the disguised acetic acid of lignin has been termed pyroligneous.

*Species 3.*—GOSYPIN.

Cotton is certainly a peculiar principle, though very trivially examined: it affords, with nitric acid, an acid substance resembling the suberic.

*Species 4.*—FUNGIN.

The tissue of the mushroom possesses properties which entitle it to a separate consideration. It is inelastic, insoluble in water, in alcohol or in ether; soluble in the alkalies and in nitric acid. The latter converts it into a ceruminoid mass.

*Species 5.*—TANNIN.

The vegetable astringent principle may be obtained by pouring lime water on a strong solution of tan. The tannate of lime is formed, and may be decomposed by nitric acid, which uniting with the lime, precipitates the tannin. After filtration, there remains a black pulverulent matter, which has been described as pure tannin (Virey.) Tannin may be isolated in all its purity, according to Proust and Lagrange, by precipitation from an infusion of galls, by carbonate of ammonia. The most distinctive property of tannin is that of forming an insoluble compound with animal gelatine. It is met with in the state of a blackish brown powder, soluble in water. There exists however, in cinchona and other tonic barks, an insoluble tan, first detected by Pelletier and Caventou in Jesuit's Bark.\*

Artificial tannin is formed by reaction of nitric acid with several vegetable substances; as charcoal, lignin, &c.

*Species 6.*—CHLOROPHYLLIN.

This term is of Greek origin, being derived from *χλωρος*, green, and *φυλλον*, a leaf. The green colouring matter of the leaf, erroneously represented as a resin, forms a peculiar principle abounding in hydrogen. It may be obtained by digesting buds or young leaves, in highly rectified alcohol; after a slow evaporation of the alcoholic solution, a splendid green substance remains. Thus obtained, it may be distinguished by the following properties. It is soluble in alcohol, oil, and ether, insoluble in water, and burns like a resin. It

\* Journal de Physiologie par Magendie, Paris, Janvier 1821.



is discoloured by chlorine and iodine, is dissolved without alteration by sulphuric acid, strikes a bright yellow hue with hydrochloric, and a grey with nitric acid, unattended by the production either of mucic or oxalic acids.

*Species 7.*—GUM-RESIN.

This term is obviously incorrect, being not only vague and gratuitous, but absurd, and calculated to impress on the mind, the idea of a compound formed of a gum and a resin. There exists not in nature, nor can there be produced by art, any immediate combination of resin and mucilage, without the interposition of some chemical re-agent. Why then will not the Chemists furnish us with a title less calculated to mislead us?

All substances classed under this head are produced by spontaneous exudation, from natural fissures or incisions made in the plants which afford them. They are soluble in water, oil, and alcohol, burn, and after combustion leave a bulky charcoal. They are converted by the stronger acids into artificial tannin and charcoal. They appear at first under the form of a milky juice, and subsequently inspissate. Such for example are assafœtida, opium, lactarium, aloes, gamboge, galbanum, scammony, &c.

GENUS II.—HYDROGENIA.

*All the proximate principles comprehended under this genus are inflammable, from the predominance of hydrogen. Their specific gravity is less than that of water.*

*Species 1.*—CERUMINOUS MATTER.

α BEESWAX.

Whether beeswax be a vegetable secretion, or the product of entomic elaboration, is a point yet remaining at issue, and it is quite amusing to observe with what animated hostility this nugatory contention has been maintained. Beeswax is found on the glossy surface of the leaf and on the anthers of flowers: commonly, however, it is obtained from the beehive, in which it is found disposed in hexagonal cells. Sparman\* suspects, without much reason, that it is deposited on the berries of the myrica cerifera by insects, and Du Halde † alleges that a tree in China, called tong-sing, is absolutely plastered with a white wax, formed there by insects: But travellers

\* Voyage to the Cape.

† Du Halde's Description of China.

are chartered by nature to deal in the mythic and the marvellous, and to them, as well as to painters and to poets,

Quidlibet audendi semper fuit æqua potestas.

The absence of nitrogen in bees-wax is a sterling chemical proof that it does not belong to the animal kingdom.

It is straw coloured and insipid, possessing a peculiar odour, insoluble in water, soluble in the fixed oils, inflammable, fusible at  $150^{\circ}$ , rendered saponaceous by the alkalis, unaffected by digestion in the acids, and bleached by exposure to chlorine and atmospheric air. It is partly soluble in boiling alcohol, water, and ether. Dr. John has contrived the terms cerin and myrcerin to denote the soluble and insoluble portions of wax: cerin is soluble in the aforementioned menstrua when hot; myrcerin is insoluble under all circumstances.

The following is the result of a few experiments which I performed, for the purpose of ascertaining whether beeswax resisted the action of our stronger chemical re-agents.

Immersed in boiling nitric acid, a minute portion of it, probably the cerin, entered into solution, the rest remained fluid on the surface, and on refrigeration the whole of it became concrete, white, and semidiaphanous.

Treated in the same manner with hydrochloric acid, similar phenomena were developed. Boiled with sulphuric acid, its tissue and ceruminous character were destroyed. It acquired a greenish black colour, a saponaceous greasy feel, and a taste like that of an acid soap, its inflammability being materially impaired.

About twelve parts of wax were heated to fusion with one of iodine in a florence flask; a peculiar combination of wax and iodine resulted. This compound was heavier than water, more brittle than wax, assumed a metallic lustre, and displayed a rich dark purple hue. Formed into a taper with cotton wick, it burned with great splendour.

#### $\beta$ SAPOCERIN.

I have presumed to attach this name to a singular compound of acid and elain, analogous in all its chemical relations to beeswax. I obtained it from soap, by the following process. Fine white soap was triturated with water until the whole acquired a gelatinous consistency; being heated in the sand bath and a few drops of nitric acid poured upon it, it instantaneously separated into two parts, the one limpid, the other ceruminous and insoluble. After boiling down for some time I separated one of these products, and from the striking resemblance it bore to beeswax, repeated on it every experiment I had performed on the subject of wax, in order



to ascertain whether it would coincide with wax in chemical analogy, as well as in external appearance. My results were decidedly satisfactory, and justified me in believing that this substance was, with trifling modification, endowed with every property and character of beeswax.

Sapocerin is of a reddish yellow colour, unalterable by the acids, slightly unctuous, insoluble in water, alcohol, and ether; its specific gravity being about .96, and its point of fusion below that of beeswax.

γ ADIPOCIRE, discovered by Braconnot in the mushroom, is solid, white, and entirely soluble in boiling alcohol, from which it falls on cooling.

δ Vegetable butters might be comprehended in this stage of the discourse, as bearing some analogy to waxes; but as they evince no striking peculiarities, and as I conceive they differ from fixed oils merely by being principally composed of stearin, which renders them concrete at atmospheric temperature, it is unnecessary to consider them as separate principles.

### *Species 2.*—FIXED OILS.

These oils are commonly obtained from vegetable substances by cold pressure, and may be distinguished by the following properties. They are viscid, insipid, immiscible with water, heavier than alcohol, lighter than water, form soaps with alkalis, dissolve sulphur, phosphorus, caoutchouc and the resins, are incapable of assuming the aeriform state without decomposition, convertible by weak nitric acid into a kind of wax and resin, and may be decomposed by chlorine or iodine, which uniting with their hydrogen, renders them concrete and becomes a hydracid. Two immediate principles, elain and stearin, have been separated from these oils, by congelation and pressure between folds of bibulous paper (Braconnot). During the process of saponification, the stearin produces margaric acid, and the elain, oleic. Olive oil is composed of stearin 28, elain 72;=100.

The decomposition of the sweet principle of Scheele, or vegetable mucus, which all these oils contain, is alleged by many chemists to be the cause of their rancidity. Professor Hare supposes rancidity to result from a sort of slow combustion, during which oxygen is absorbed.

From the necessary presence of a certain temperature and the rapid generation of acetic acid, I should attribute rancidity to the process of *fermentation*, which indeed is but another term for Dr. Hare's rationale.

A few of these oils by exposure to the atmosphere lose their oleaginous character, inspissate, and become covered with a pellicle—these are the siccative or drying oils.



*Species 3.*—ETHERIAL OILS.

There is a class of oils, never, so far as I have read, noticed by any writer. They can be obtained neither by expression nor distillation; but by digesting such substances as afford them in ether, and leaving that menstruum to spontaneous dissipation. As they are obviously distinct in appearance, as well as in chemical relations, from the immediate vegetable oils, resembling rather naphtha or petroleum, I have thought proper to denominate them from the fluid through whose instrumentality they were obtained, etherial oils—a term formerly synonymous with volatile oils, but happily for my purpose that application of the term is now absolescent.

Etherial oils are yielded by all articles in which the aromatic quality predominates, and may be known by the following characters: Their consistency is bituminous, their colour varying, their odour penetrating, and their taste intolerably warm and acrimonious. They afford to distillation acetic acid, with an essential oil, or more properly a pyro-etherial oil, far less powerful than themselves: a considerable portion of their aromatic principle being decomposed or obtunded by assuming the gaseous form.

Etherial oil of capsicum is perhaps the warmest and most pungent substance known in nature. I make no doubt but it may be applied as an aromatic tonic, or to purposes of endermic medication, with the most decided advantage.

Etherial oil of pepper was first obtained by Mr. G. W. Carpenter, and to this principle, not to the piperin, is to be referred the stimulant action of the *piper nigrum*.

Etherial oil of cloves communicates to the smell an odour highly fragrant, and to the taste an agreeably stimulating warmth.

Etherial oil of mustard consists principally of stearin.

With regard to the etherial oils of allspice, ginger, mace, cubebs, and others which I obtained, it is only necessary to state that they embody all the sensible properties and medicinal virtues of their respective plants.

*Species 4.*—VOLATILE OILS.

With the exception of oil of bergamot, orange, and lemon, all these oils are obtained by distillation, and may be regarded as empyreumatic distilled etherial oils.

They contain a free acid (acetic?), are capable of volatilization at common temperatures, perfectly soluble in alcohol, ether, or fixed oils, and soluble in water in sufficient quantity to make it acquire their odour and taste. Exposed to the at-

mosphere they inspissate into resins, and lose their aroma by oxygenation. They dissolve camphor, phosphorus, and sulphur, and precipitate gold in its metallic state from its nitromuriatic solution; but the most distinctive character of these oils is that of forming on paper a transparent stain, which may be dissipated by holding it to the fire.

Chlorine and iodine seize upon their hydrogen and pass into the state of hydracids.

By reaction with nitric acid they inflame, and leave a spongy cellulated resin, called the philosophic *mushroom*. Sulphuric acid imbrown, resinifies, or carbonizes them, according to its degree of concentration.

When a current of hydrochloric acid is passed through an essential oil, a crystalline deposit analogous to camphor is obtained, and has been called *artificial camphor*.

These oils are divided by Virey into three orders :

1. The light oils, as oil of thyme, rosemary, sage, &c. most of which deposit crystals of *camphor*.

2. The heavy, as oils of cinnamon, cloves, mace, ginger, allspice, lauro-cerasus, &c. most of which deposit crystals of *benzoic acid*.

3. The concrete, as butter of roses, anniseed, fennel, &c. for the distillation of which more heat is required in the refrigerant vessel.

#### *Species 5.*—RESINS

May be regarded as concrete volatile oils. They are obtained from several trees by exudation through natural fissures or incisions. In a state of purity, they are friable, vitreous, inflammable, insipid and inodorous. Such of them as possess sapidity or odour derive it from an essential oil or benzoic acid. They are insoluble in water, soluble in alcohol, ether, oils, acids and alkalies; acetic and hydrochloric acids dissolve them without decomposition; sulphuric acid destroys them, and nitric acid converts them into a bitter yellow matter, entitled, in honour of its discoverer, the bitter principle of Welther—a portion of artificial tannin is simultaneously developed.

Bonastre, who analyzed the natural resins with extreme accuracy and minuteness, found in them : 1. a resin properly so called, translucent and soluble in cold alcohol; 2. an acid, sometimes acetic, occasionally succinic; 3. an essential oil; 4. a bitter matter; 5. a sub-resin, opaque, crystallizable, and nearly insoluble in boiling alcohol. This last appears to be to resins what elain and stearin are to the fixed oils.

*a* Guaiacum is partially soluble in water, becomes by expo-



sure to atmospheric oxygen, green, blue, and brown. May be rendered blue by torrefaction with gum arabic, (Virey) or by zimome. The intensity of the hue struck by the latter, is proportional to the quantity of gluten present in flour. (Taddei.)

β Feruline. The resinous portion of assafœtida, gum ammoniac, &c. which rubesces by exposure to the air, has received the appellation of Feruline.

γ Resinoids. This term is applied to substances which possess many of the characteristic properties of resins. They exist in quinquina, jalap, gentian, &c.

δ The bitter resins, so abundantly found in the colocynth, elaterium, scammony, and all panchymagogic extracts, are tanno-resinoids or combinations of substances resembling resin, with a peculiar bitter drastic principle.

ε The terebinthinates are resins rendered semi-fluid by an essential oil, separable by distillation.

ζ The balsams are resins impregnated with benzoic acid, which may be disengaged by sublimation.

#### *Species 6.*—CAMPHOR.

This singular substance may be looked upon as intermediate between resins and volatile oils. Like the former, it is light, solid and inflammable, soluble in alcohol, oil and ether: like the latter, it is volatile, aromatic, and nearly insoluble in water.

Camphor is concrete, crystalloid, white, semidiaphonous, volatile, and combustible. It has the property of arresting the progress of fermentation and putrefaction in vegetable bodies. Its principal peculiarity is that of forming by repeated distillation with nitric acid, an acid substance grouped in plumose crystals, which has received the name of camphoric acid, and which constitutes with the alkaline bases a class of salts called the camphorates.

### GENUS III.—NITROGENIA.

*Proximate principles of vegetables containing nitrogen.*

#### *Species 1.*—GLUTEN.

This name is appropriated to that portion of farina, which remains after all the starch is washed away, by forming it into a paste, and edulcorating repeatedly in a small stream of water. It was first observed by Beccaria and Kessel-Meyer, and may be known by the following properties.

It is a flabby, tenacious, elastic, grey, substance; soluble in most of the acids and caustic alkalies, and susceptible of acetous and putrid fermentation; after desiccation it becomes hard, and



vitreous. When heated it produces ammonia, phosphoric acid, caseic acid, sulphuretted hydrogen and a pyrozoonic oil. With alkalis, it forms an imperfect soap, and affords with alcohol, which dissolves a portion of it, a fine yellow varnish. The portion of gluten soluble in alcohol, has received from Taddei the name of gliadine; the insoluble portion, that of zimome. The latter is found in little spherules, which adhere with difficulty and exhale the odour of putrifying urine.

Gliadine, when dry, is brittle, yellowish, and translucent. It is, I find, subdivisible into two portions, and were it worth the expenditure of time, ink or paper, to attach pompous academical appellations to products in themselves so trifling, (the most efficacious method of turning chemical science into ridicule,) I might, pursuant to the example of Taddei and with equal propriety, subdivide his gliadine into two portions, the one as a matter of course, soluble in boiling alcohol, the other insoluble. To each of these might be annexed a series of properties, as long, as uninteresting and as nugatory as those which characterise his products of gluten.

### *Species 2.—ZOOID PRODUCTS.*

$\alpha$  VEGETABLE ALBUMEN bears a very intimate resemblance to animal albumen. It is found in a few juices which are milky and coagulable by heat or by the acids, as in cabbage, houseleek, gombo, poppy, lettuce, convolvulus, and several of the cruciform plants. Submitted to destructive distillation, it affords animalized products, azote and ammonia. It is eagerly dissolved by the alkalis, and partially soluble in alcohol.

$\beta$  GELATINE, found in the pollen of the date, is incoagulable by heat, and precipitable from its solution by an infusion of galls, with which it forms an insoluble compound.

$\gamma$  OZMAZOME, observed by Vauquelin in mushrooms, coincides in all its properties with the animal product whose name it bears.

$\delta$  CAOUTCHOUC is tenacious, elastic, and semi-transparent, insoluble in water and alcohol, soluble in ether, in oils, and in nitric acid. It resembles gluten, and exhales nitrogen with ammonia when heated. Opium is said, by Bucholz, to contain it.

### *Species 3.—ORGANIC ALKALIES.*

QUINIA.—The alkali, to which the tonic power of quinquina is referable, was first observed by Dr. Gomez, and afterwards examined by Pelletier and Caventou. It may be obtained by the following process. The alcoholic extract of quinquina is treated with hot water, rendered acidulous by

hydrochloric acid, and boiled down with excess of magnesia. After filtering and edulcorating with cold water the matter which remains on the filter, digesting in strong alcohol and evaporating, pure quinia is deposited (Pelletier and Caventou.)

Cinchonia, as it exists in the pale bark, differs but little from the preceding, and may be developed by a similar process.

#### QUASSA.

This new vegetable alkali was detected by me in the quassa amara, in which it is intangled with a variety of principles; as tannin, colouring, matter, a peculiar new acid (the quassic,) gallic acid, and resin. It was thus isolated: One pound of powdered quassa was digested a few days, in two quarts of water, with about three drachms of sulphuric acid; after boiling for some time, it was filtered while hot, and subsequently evaporated, until the solution became perfectly concentrated; on refrigeration the sulphate of quassa precipitated in snow-white prismatic acicular flocks.

By boiling the sulphate in water with excess of magnesia nearly to dryness—treating the residuum with hot alcohol, filtering, to get rid of the Epsom salts, and slowly evaporating the alcoholic solution, I obtained pure quassa.

Quassa concentrates all the medicinal energy and bitterness of quassa. It is white and eminently alkaline, it precipitates the metallic oxides, neutralizes the acids, and renders the tincture of alkanet blue. Per se, quassa is uncrystallizable. It is very soluble in hot alcohol, less in cold, and perfectly insoluble in cold water unless acidulated. It constitutes the basis of a class of intensely bitter salts.

Sulphate of quassa is easily crystallizable and groups in acicular prisms. It is a permanent salt, remaining solid in any quantity of cold water.

In the common pharmaceutical preparation, “decoctum Quassiae cum sulphate zinci,” a double decomposition results. The sulphuric acid abandons the zinc to combine with the quassa, while the quassic acid neutralizes the metallic oxide: Thus sulphate of quassa, and quassate of zinc, are the products.

Hydrochlorate of quassa forms starry configurations, and is more soluble than the preceding.

Nitrate of quassa is uncrystallizable.

Acetate of quassa forms in shining plumose fibres.

Oxalate of quassa aggregates in fine bundles.

#### SERPENTARA.

By pursuing a plan similar to that employed for the devel-



opement of quassa, I succeeded in isolating, from the aristolochia serpentaria, a new alkali to which the medicinal energies of the snake-root are referable. It is better in every case first to procure the sulphate, or what may be more eligible, the acetate; sulphuric acid being liable, if not cautiously used, to derange the product. The sulphate may be disentangled from the glutinous extractive substances, which entoil and obstinately adhere to it, by repeated washing, and pressure between folds of bibulous paper. This salt being boiled in water with excess of magnesia, evaporated to dryness, digested in alcohol, and filtered while hot, if the alcohol be left to slow or spontaneous evaporation, pure serpentaria is deposited. Thus obtained, it appears in white and exquisitely delicate crystals of a fragrant smell and a slightly bitter taste; it precipitates the metallic oxides and renders the syrup of violets viridescent.

Sulphate of serpentaria crystallizes in quadrangular prisms, terminated by inclined facets. It is nearly insoluble in cold water, but soluble in hot water and alcohol.

Hydrochlorate of serpentaria forms brilliant plumose fibres, more soluble than the sulphate.

Nitrate of serpentaria is not susceptible of crystallization, or to speak more justly, nitric acid decomposes serpentaria as well as most of the other vegetable alkalies,—at least I could never recover them after having once immersed them in that acid, however diluted.

Serpentaria naturally exists in union with a peculiar aromatic acid, the serpentaric, which I have not examined, not being able to obtain it in sufficient quantity for the purposes of investigation. The serpentarate of lime is found in the caput mortuum with extractive matters.

#### COLUMBIA.

Besides fécula, resin, starch, tan, and etherial oil, there exists in the columbo root an alkali, which Professor Coxe, in his sterling work the American Dispensatory, suspects to be cinchonia, a principle to which it is certainly intimately allied in its chemical relations, though it differs from cinchonia in a few respects, as for example the almost perfect uncrystallizability of columbia and the colour of its hydrochloric solution.

It was obtained by the same process which I employed for the isolation of quassa.

Columbia is white, and appears in the form of an arid opaque powder.

With sulphuric acid it forms minute prisms, and with hydrochloric, starry points somewhat deliquescent.



Nitric acid destroys its alkalinity. Combined with acetic acid it forms very fine needles, resembling amianthus.

#### GENTIA.

A new organic alkali which I separated in the state of sulphate, exists in the gentiana lutea in combination with a peculiar yellow acid.

The method of obtaining it does not differ from that employed for the development of the preceding alkalies. The process is exceedingly simple, and I feel thoroughly convinced that all other immediate alkaline principles may be brought to light by the same easy method. This would save our chemists, who seem to vie with each other in the prolixity and intricacy of their formulæ for obtaining these principles, an enormous deal of pains, and would exonerate the mind of the student from much perplexity and unprofitable fatigue.

Gentia embodies with little variation all the characters and properties of columbia. The sulphate of gentia, which like the sulphate of columbia appeared in small needleform crystals, and the muriate, which like that of columbia grouped in stellated points, were the only combinations I procured.

#### GALLIA.

Together with gallic acid, ellagic acid, tannin, colouring matter, a green mossy substance, mucus, and extractive, there exists in the gall nut a new vegetable alkali which I isolated by means of sulphuric acid.

Gallia is found in the state of bigallate. I was unable to obtain it in a crystalline form, per se.

The sulphate is insoluble in cold water, partially soluble in hot, and perfectly dissolved by boiling alcohol, from which it precipitates in fine fasciculi on refrigeration.

#### ANGUSTURIA.

This salifiable base, I obtained in large quantity, from angustura bark (*cusparia febrifuga*), in which it is neutralized by a new acid.

The bark affording it has been confidently alleged by respectable practitioners of the West Indies, to possess a decided superiority over cinchona in the treatment of intermittent fevers. This granted, we need not hesitate in assuming that angusturia will at least prove a valuable substitute for quinia.

Angusturia, to which I have given but a very desultory and superficial examination, crystallizes in minute deliquescent fibres.

Sulphate of angusturia crystallizes in stars insoluble in cold water.

## QUERCIA.

This alkali I obtained from the epidermis and cortical layers of the quercus robur, in which it is united with gallic acid, tannin, inert substances, and a peculiar colouring matter.

The invigorating properties of oak bark gratuitously ascribed to tannin in the Pharmacopœias, are unquestionably dependent on this principle.

Divested of foreign matter, by digestion in water, ether and alcohol, oak bark contains quercia in the enormous proportion of seventy grains of the latter to four drachms of the former. This alkali is liable to be mistaken for *lime* by a superficial manipulator; for if to any of the saline combinations of quercia, oxalate of ammonia be added, a copious snowy precipitate will appear—a circumstance which among chemists gives indication of the presence of lime, and has doubtless been a source of deception. Oxalic acid is therefore a very ambiguous test for lime.

Quercia may be distinguished from lime by the following circumstances :

1. Its destructibility by heat.
2. The insolubility of its muriate.
3. Sulphuric acid added to its hydrochlorate produces no decomposition.
4. Its muriate is not decomposed by proto-sulphate or by per-sulphate of iron. The reverse of all these obtains with regard to lime,

My intelligent young friend, Mr. J. Scattergood of this city, to whom I am principally indebted for a minute account of the properties and combinations of this interesting alkali, and who obtained it without being aware of my having isolated it, has detected its presence in almost every species of American oak.

Quercia is the most refractory of all the vegetable alkalies : with the exception of sulpho-muriatic acid it has no proper solvent, being insoluble in water, alcohol or ether, whether hot or cold ; it is insipid, inodorous, and per se uncrystallizable, though with most of the acids it forms the most brilliant and beautiful salts.

On refrigeration of an acidulated decoction of oak bark, a splendid yellow pigment precipitates in company with quercia. This principle is insoluble in cold water, soluble in hot, of a bitter taste and a peculiar smell. It stains paper of a yellow colour, little inferior in brilliancy to that of gamboge. The isolation of this pigment is said to be an object of great request and importance to the dyers.



## STRAMONIA.

This alkali has been mentioned under the appellation of daturia, and its discovery attributed to Brande, but as neither his formula for obtaining it nor an account of its properties has ever been issued from the press, so far as I can learn, I am warranted in believing that I present the first series of investigations on this invaluable article.

The bruised seeds of stramonium were washed in cold water and alcohol, for the purpose of removing extraneous matters. Without this preliminary precaution, the manipulator will find it extremely difficult to extricate the alkali from the mass of feculencies which enter so abundantly into the composition of this seed. After repeatededulcoration, the stramonium was boiled in dilute sulphuric acid, evaporated, and the sulphate obtained.

This salt, boiled in water nearly to dryness, with excess of magnesia, and strong boiling alcohol poured on the residue and filtered while hot, pure stramonium falls, on refrigeration.

Stramonium crystallizes in prismatic acicular flocks, insoluble in cold water or alcohol, but eagerly dissolved by the latter when hot.

Sulphate of stramonium aggregates in quadrilateral prisms. Hydrochlorate of stramonium assumes the form of small cubes.

Acetate of stramonium crystallizes in acicular fibrils.

By the action of nitric acid a silky crystalloid matter is obtained. Whether this be a nitrate of stramonium I am not prepared to assert. The acid by which stramonium is naturally neutralized is crystalline, and exhales the odour of ripe apples.

## CERASIA.

This alkali I separated in the state of sulphate from the wild cherry-tree bark, in which it is probably combined with hydrocyanic acid. The only combination of cerasia I examined was the sulphate. This however sufficed to convince me of its alkalinity, and to this principle may chiefly be ascribed its medicinal powers, and not, as is suspected, to the prussic acid which is suppositiously alleged to exist in the bark.

## MAHOGONIA.

This alkali exists in prodigious quantity in the bark of the swietenia mahogoni, in combination with a splendid colouring principle. The sulphate, the only salt I examined, is nearly tasteless, and crystallizes in long prismatic needles, insoluble in cold, but partially soluble in hot water.

## CROTONIA.

The alkali in which resides the tonic energy of the croton eleutheria or cascarilla bark, I obtained by the process so often alluded to. After being pressed in soaking paper, dissolved in boiling alcohol, and recrystallized by evaporation, sulphate of crotonia appeared in long acuminate prisms interlacing each other.

## CANELLIA.

From the canella alba I extracted this alkaline base by sulphuric acid. Like sulphate of crotonia, it presented itself in long delicate interwoven fibres.

## CORNIA.

An alkali discovered in small quantity in the cornus florida, by Mr. G. W. Carpenter, and described by Dr. S. G. Morton, is reported to have been advantageously exhibited as a substitute for quinia. It crystallizes in quadrangular prisms.

## VIOLIA.

The emetic principle of the viola odorata, discovered by M. Boullay, possesses very feeble traces of alkalinity, and is said to be a species of the genus emetia, whose type has been furnished by Pelletier.

Viola is found in the state of a white opalescent powder, slightly attractive of humidity from the atmosphere.

## MORPHIA.

This salifiable base was discovered by Sertuerner in opium, from which it may be isolated by boiling an aqueous solution of opium with magnesia and filtering. The matter remaining on the filter, consisting of the meconate of magnesia and impure morphia, is to be treated with boiling alcohol, which seizes on the alkali and deposits it on cooling, in pyramids and four sided prisms.

## BRUCIA.

This poisonous alkali, was observed by Pelletier and Caven-  
 tou in the bark of the brucia antidysenterica, in the nux vomica, and in the bean of St. Ignatius. In the two last it is found in company with strychnia, from which it may be distinguished by its being more easily soluble, and less deleterious to the animal economy. The relation between brucia and strychnia is, however, as intimate as that existing between quinia and cinchonina. Brucia crystallizes in oblique prisms, with parallelgrammatic bases.



## STRYCHNIA.

The alkali which exists in the nux vomica and bean of St. Ignatius, in combination with a crystallizable acid substance (the igasuric), may be obtained by any of the processes employed for isolating morphia. It is found in prismatic crystals terminated by quadrangular pyramids. It is a horrible and intensely bitter poison.

## PICROTOXIA.

This alkali was first separated by Boullay from the cocculus indicus. It crystallizes in quadrangular prisms, and may be converted by nitric into oxalic acid.

## ATROPIA.

It has been a point of contention, whether the active narcotic principle of the belladonna be alkaline. It is decidedly so. I procured two of its salts; the sulphate and the muriate. The former is soluble in water, and crystallizes in slender prisms; the latter is nearly insoluble, and forms brilliant silky needles. Both these salts, as well as atropia, are destructive of animal life.

## DAPHNIA.

Vauquelin has detected in the bark of the daphne alpina a crystalline principle, which neutralizes the acids and forms the basis of a class of salts.

Hyoscyama, cicutia, and aconita, the supposed alkaline bases of black henbane, hemlock, and monkshood, were reported some time ago in the European periodicals to have been observed by Brande: they have not however stood the test of rigid scrutiny; no chemist has since been able to obtain cicutia.

## SOLANIA.

The active matter of the solanum dulcamara is reported by Desfosses to reside in a white opaque powder, which however possesses feeble claims to alkalinity. Its salts are all insusceptible of crystallization, and the change effected by it on syrup of violets is scarcely appreciable.

*Species 4.*—PROXIMATE CRYSTALLINE PRINCIPLES NEITHER ACID NOR ALKALINE.

## PIPERIN.

This term is bestowed on a crystalline matter separable from black pepper. Mr. G. W. Carpenter, who published an in-

teresting and elaborate memoir on the preparation and properties of this article, employs the following formula for its isolation. It may be obtained by digesting black pepper in alcohol, evaporating, adding very dilute hydrochloric acid and concentrating the solution by evaporation; on adding potash to neutralize the acid, piperin falls in crystals. As a tonic it has been extensively employed in intermittent fever, and is said to be an invaluable remedy. Per se, however, piperin is totally inert, and owes its tonic power to a portion of ethereal oil almost inseparably combined with it.

#### CATHARTIN.

The principle which renders senna purgative is yellow "nauseabonde," and uncrystallizable. It is soluble in all proportions in water and alcohol, insoluble in ether, and attractive of humidity from the atmosphere.

The persulphate of iron strikes a fine brown colour with its aqueous solution.

#### NARCOTIN.

To obtain pure narcotin, opium should be macerated in water and its aqueous solution filtered: the residuary matter being digested several days in hot ether, and the ethereal tincture decanted and distilled, crystals of narcotin will appear at the bottom of the retort in rectangular prisms with rhomboidal bases. (Robiquet.)

Sertuerner, the discoverer of the alkali in opium, and the greatest living vegetable chemist, considers narcotin to be a meconate of morphia.

#### ASPARAGIN,

Obtained by Robiquet and Vauquelin from the asparagus and potatoe, crystallizes in rhomboidal prisms, dissolves in hot water, and when chewed stimulates the salivary glands.

#### GENTIANIN.

To a crystalline substance said to have been separated from gentian this term is given; but from the number of agents employed and the tediousness and intricacy of the process represented as essential to the developement of this pseudo-principle, I am inclined to consider it rather as an educt of the materials used, than a product of the plant. It is erroneously stated to possess all the tonic virtues of the root; the sanative efficacy of gentian resides in the alkaline principle which I have described.

#### AGEODOÏTE.

Liquorice was observed by Robiquet to contain a peculiar



matter which he describes as being colourless, crystalline, insipid, insoluble in water, and unaltered by solution in nitric and sulphuric acids.

#### RHUBARBARIN.

A barbarous term for an inert powder found in rhubarb by M. Nani, who very prudently cautions the public to use but little of it, a grain being sufficient for a dose. Mr. G. W. Carpenter informs me that he took twenty grains of it, with no more effect than if he had swallowed so much starch.

#### JALAPIN.

Though the gazettes eulogized the discoverer of this substance, and a few practitioners extolled it as the very flower of cathartics, it has been found to be neither more nor less than acetate of ammonia.

The catalogue of these articles might be swelled with accounts of such substances as colocynthin, columbin, digitalin, &c. but I will not offend my reader by asking him to wade with me through the stupid jargon of the ignorant and despicable pretenders to chemistry.

#### NICOTIN.

It is inconceivable how a chemist so deservedly illustrious as M. Vauquelin, should contrive a process so palpably absurd as that which he has fabricated for the developement of nicotin; and what appears still more anomalous, if possible, is that chemical compilers should inconsiderately adopt and republish an operation, whose glaring inconsistencies the most superficial empyric might detect.

#### NEUTRAL PRINCIPLES.

The following is a list of neutral principles, some of which I obtained in crystals, and all of which may be readily obtained by the process noticed for the developement of the etherial oils. In a state of purity they are insipid, and as all the remediate energy of the substances which furnish them resides in an etherial oil or alkali, it will be superfluous to mention more than their names, and indicate at the same time the names of such plants as afford them.

CUBEBIN	Cubebis
ZINGIBERIN	Ginger
CAPSICIN	Capsicum
CALAMIN	Calamus Aroma
GENTIANIN	Gentian
MYRISTICIN	Mace
CARYOPHYLLATIN	Cloves

## SCILLITIN.

Vogel has isolated the active medicinal matter from the squill; it is bitter, viscous, white, resinous, and deliquescent.

## EMETIN.

To this principle is ipecacuanha indebted for its emetic quality. Pelletier, its discoverer, describes it as being white, crystalline, and very feebly if at all alkaliescent.

## CAFFEIN.

A crystallizable matter has been observed by Robiquet in the *coffea arabica*, and but loosely examined by him, is said to be white, and *insoluble in water*;—a decisive evidence that the activity of coffee does not depend upon this principle.

## GENUS IV.—OXYGENIA.

*Proximate principles in which oxygen is predominant.*

## VEGETABLE ACIDS.

It is highly culpable in a chemist to indulge in the vanities of hypothesis; generalization is unwarrantable, and analogy itself, unsanctioned by experiment, should be employed to a very limited extent. Thus Thenard, by generalizing on the vegetable acids, falls into the error which Lavoisier had promulgated with respect to the mineral acids; viz—that oxygen is the sole acidifying base. Thenard assumes, that, if the oxygen be in a greater ratio to the hydrogen than in water, the compound will be found acid. Succinic, benzoic, and hydrocyanic acids, contain more hydrogen than is necessary to convert them into water, and yet they are all eminently acid: in this section, however, I shall class them as they tally in chemical relation with other acid substances.

## OXALIC ACID.

(*Scheele.*)

In the *oxalis acetosella*, and *corniculata*, this acid is found in the state of a binoxalate of potassa; for common purposes however, it is obtained by action of nitric acid on sugar, or starch. It crystallizes in quadrilateral prisms, and is received as the best test for lime. The recognition of lime by oxalic acid is, however, very ambiguous, as has been remarked under the article *Quercia*.

Oxalic acid is rendered very volatile by ebullition with water, which when boiling, dissolves an equal weight of it and precipitates half its weight on refrigeration. It is used in the art of dyeing for the purpose of discolouring certain parts over which it is applied.



## TARTARIC ACID.

*(Scheele.)*

This acid is found in wines and in the grape in the state of bitartrate of potassa. It predominates in sumach and tamarinds, is susceptible of crystallization, and has the property of forming a pyro-tartaric acid, which does not precipitate the acetate of lead.

## BENZOIC ACID.

This is a sublimate obtained from the resinous exudation of the styrax benzoe and the balsams of Tolu and Peru. It appears in white plumose fibrils.

## ELLAGIC ACID.

*(Braconnot and Chevreul.)*

This acid (the word galle reversed,) is found very intimately united with gallic acid in the gall-nut. It is pulverulent, white, insipid, insoluble in boiling water, and rendered blood red by nitric acid, which converts it into oxalic.

## MALIC ACID.

*(Scheele.)*

This acid abounds in the apple, the pear, the elder, the barberry, and in all unripe fruits and wines. It is suspected by Vogel and Bouillon Lagrange, that malic acid is acetic combined with vegetable matters which disguise it; the suspicion is quite gratuitous. Malic acid is uncrystallizable, though it affords to distillation a crystalline pyro-malic acid. It forms insoluble salts with lead, mercury and silver: such is not the case with acetic acid.

## FUNGIC ACID.

*(Braconnot.)*

The mushroom and many other vegetables contain this acid in combination with potassa. It is very sour and deliquescent.

## JATROPHIC ACID.

*(Pelletier.)*

According to Pelletier, this acid abounds in the oil of the seeds of the *jatropha curcas*, and is said to be uncrystallizable.

## CITRIC ACID.

*(Scheele.)*

By pouring lemon juice on lime, an insoluble calcareous citrate is formed, which, after being washed in water for the pur-

pose of separating mucilaginous substances, and treated with dilute sulphuric acid, leaves the free citric acid in solution in the supernatant liquor. This process of Scheele may be extended to the development of almost all the vegetable acids. Citric acid crystallizes in rhomboidal prisms, terminated by a summit with four trapezoid faces.

M. Lassaigne has obtained by distillation, a pyro-citric acid, which is uncrystallizable, and forms a class of salts totally different from those produced by ordinary citric acid.

#### GALLIC ACID.

(*Scheele.*)

An aqueous infusion of galls, after a few months exposure to the atmosphere, deposits this acid in white filamentose crystals. The acid obtained from the gall-nut by sublimation, is a true pyro-gallic, and differs in many essential properties from natural gallic acid.

Mr. J. Scattergood of this city, is, I believe, the first who separated it in a crystalline form from oak bark, in which it is combined with quercia. It may be extracted in considerable quantity from the tea leaf, where it is probably neutralized by an anodyne alkali, which I have frequently attempted to isolate, and have as often been foiled in my attempts, from the mass of feculencies which envelop it, though I am perfectly assured it exists in the leaf, and will at some future period be detected.

The most distinctive feature of gallic acid, is that of precipitating iron, and striking with it an intense blue black.

#### MUCIC ACID.

(*Saccholactic of Scheele.*)

When strong nitric acid is permitted to react with sugar of milk, gums, resins, and mucus, a factitious acid is formed. Mucic acid groups in white needle-form crystals, and when submitted to distillation produces a crystalline pyro-mucic acid.

#### CAMPHORIC AND SUBERIC ACIDS.

These are artificial acids: the former being developed by reaction of nitric acid with camphor, the latter by reaction of the same acid with cork.

#### MECONIC ACID.

(*Robiquet.*)

The magnesian precipitate which falls during Robiquet's process for obtaining morphia, holds meconic acid in the state



of a submeconate: from the alkali it may be separated by the more powerful affinity of sulphuric acid. Meconic acid crystallizes in reddish scales or micaceous plates, and strikes a deep red hue with solutions of iron.

#### SORBIC ACID.

(*Donovan.*)

This acid occurs in the berries of the sorbus aucuparia, and in apples, in which it is associated with malic acid. It is uncrystallizable, and bears some resemblance to malic acid, with which it is probably identic.

#### MORIC OR MOROXYLIC ACID.

(*Klaproth.*)

The acid principle of the morus alba is said to possess many curious and interesting peculiarities: it is white and crystalline.

#### KINIC ACID.

(*Deschamps.*)

Quinia and cinchonia are naturally combined with an acid, which has a crystalline structure, forms by aid of heat a pyrokinic, and precipitates iron from its solutions, striking with it a rich green colour.

Kinovic acid has been separated by Pelletier from the kina-nova.

#### STRYCHNIC ACID.

(*Pelletier and Caventou.*)

The salifant base of strychnia, found in the nux vomica and bean of St. Ignatius, crystallizes in minute white bundles.

#### MENISPERMIC ACID.

(*Boullay.*)

This acid is found in combination with picrotoxia, in the cocculus indicus.

#### BOLETIC ACID.

(*Braconnot.*)

The existence of a peculiar acid principle in the boletus pseudo-ignarius, has recently been detected: it is capable of crystallization, and of undergoing sublimation without decomposition.

#### KRAMERIC ACID.

(*Peschier.*)

This acid exists in the astringent root of the krameria triandra.

Aceric acid is supposed to have been found in the juice of the maple.

#### CEVADIC ACID.

(*Pelletier and Caventou.*)

This acid has been observed in combination with veratria, in the veratrium sabadilla: it is white and crystallizable.

#### HYDROCYANIC ACID.

Prussic acid has been discovered in bitter almonds, in peach leaves, and in several flowers: It is a shocking poison, developing the most serious phenomena on the nervous system. With ferro-cyanate of potash it furnishes a splendid blue colour.

#### SUCCINIC ACID.

Though generally classed in the domain of mineralogy, this acid might with more propriety be arranged among organic products, as amber, of which it is a sublimate, is evidently of vegetable origin.

Succinic acid forms yellow prismatic crystals of a yellow sub-acid taste.

To these acids I might add *quassic*, *stramoniac*, *gentic*, *columbic* (which is crystalline and yields to distillation a pyrocolumbic), *serpentaric*, *cornic*, and *atropic*, all of which I obtained, though not in sufficient quantity for purposes of minute investigation.

### GENUS V.—HYDROXYGENIA.

*Proximate principles in which oxygen and hydrogen combine in the proportion necessary to form water.*

#### *Species 1.*—FECULA.

This species exists ready formed in such vegetables as contain it. In order to give a free exit to the starch, the parenchyma of the grain should be torn up by rasping or grinding, and the powdered grain steeped in water, for the purpose of separating mucus and mucilage. This done, the water should be strained off, and the liquor which passes, after standing some time, will deposit the fecula at the bottom of the vessel.

Pure starch is snow white, light, inodorous and nearly insipid; it is not acted on by cold water, but forms a thick gelatinoid solution with that fluid when hot. This solution, by mixture with a caustic alkali, loses its consistency, but recuperates it on the addition of an acid. Starch is insoluble in alcohol or ether, but convertible into sugar by boiling with di-



lute sulphuric acid. Kirchoff obtained a crystalline sugar from starch by long continued boiling with gluten.

Exposed to the temperature of  $220^{\circ}$ , starch acquires a blush, and exhales the odour of baked bread. To this torrefied fecula, Saussure has applied the term amyidine; and Caventou maintains that starch gelatinized with hot water, undergoes a similar change, and is identic with amyidine; 1, because from neither of these states can starch be recovered; 2, from a presumption that it is amyidine and not starch which has the property of striking a blue colour with iodine. This illustrious chemist does not speak from experiment; for if a small portion of iodine be diffused through cold water, holding starch in suspension, a bright blue will be produced on agitation—the result of iodic action on starch.

$\alpha$  HORDEIN, a variety of Starch observed by Proust in barley, is a yellow arid powder, convertible into sugar and fecula by the fermentation of barley.

$\beta$  ORYZEIN, an amylaceous substance which I extracted from rice, dissolves in water without producing viscosity, and like ordinary starch strikes a fine blue with iodine.

$\gamma$  ZEIN, a species of fecula existing in Indian corn, may be distinguished by its solubility in hot alcohol.

$\delta$  ULMIN, found in an exudation from the elm, is solid, tasteless, black, and brilliant, soluble in water, and insoluble in alcohol. Pure potassa triturated with saw dust, furnishes ulmin by abstracting from the lignin, oxygen and hydrogen in the proportions necessary to form water.

$\epsilon$  INULIN, extracted by Rose from the root of elecampane, dissolves in hot water without producing viscosity, and precipitates on refrigeration. It strikes a green colour with iodine, and is dissolved without decomposition by sulphuric acid.

### *Species 2.—GUM.*

In a state of purity gums are insoluble in alcohol and ether, soluble in the oils, insipid, inodorous, and translucent: they dissolve in water forming mucilage, and speedily pass from their aqueous solution into acetous fermentous: by distillation they furnish an impure acetic acid, which has received the vague appellation of *pyro-mucic* acid.

Digested in nitric acid, their elements form new combinations, attended by the production of malic, mucic, and oxalic acid.

CERASIN, a generic term applied to such gums as are insoluble in cold water, but analogous in every other relation to

common gum. Cherry tree gum and gum tragacanth are considered as fair specimens of this division.

SACCHO-GUMMITE, a sweet gummy matter, remarked by Robiquet in liquorice, is solid and yellow, feebly soluble in cold water, but very soluble in hot water and alcohol, and capable of being transformed by nitric acid into a viscous, pellucid, resinoid mass.

### *Species 3.*—SUGAR.

This principle which forms the nutrimentitious portion of all vegetables, is ordinarily extracted from the arundo saccharifera or sugar cane, in which there exist two distinct varieties: v. g. a crystallizable and an uncrystallizable sugar. The former is exported to this climate under the names of muscovado, raw sugar, candy, &c.; the latter is called melasses, or treacle.

When sugar is perfectly detached from treacle, gelatine, gluten, and saccho-mucus matter, it crystallizes in incomplete cuneiform octoëdra, or in tetraëdral prisms. It is diaphonous, soluble in water, slightly soluble in alcohol, and becomes phosphorescent by friction. Long exposure to the heat of boiling water robs it of the property of crystallizing. It is the only substance in nature which is capable of forming alcohol by spirituous fermentation; for all other matters, arriving at this point of fermentation, pass first into the state of sugar (Virey.)

Sugar dissolved in hot water, is endowed with the property of restoring to the metallic state, several oxidized metals and metallic salts. The oxydes of copper, so pernicious to animal life, are reduced and rendered innocent by sugar. Hence it may be advantageously exhibited as an antiloimic.

$\alpha$  MANNITE, sugar of manna, has the property of dissolving the yellow oxide of lead, and of acting like an alkali on vegetable blues. It is soluble in boiling water and alcohol, but on cooling falls in crystalline flocks.

$\beta$  FUNGITE, sugar of mushrooms, possesses some peculiarities; it is white, crystalline, and efflorescent.

$\gamma$  HONEY is by some called a vegetable sugar, by others considered an animal product. That it undergoes some modification in the stomach, or honey bag, of the bee, scarce admits of a doubt; but that it is essentially of vegetable origin may be demonstrated, as well by the untutored peasant who sucks from the clover blossom, or observes the honey dew, as by the physiologist who demonstrates on the plant, the nectary, the melliferous glands, and the whole complicated apparatus, which nature has admirably constructed for the defence of a secretion, so indispensable to the vegetable economy.



Honey, like sugar, consists of a crystallizable and an uncrystallizable portion ; and like sugar, may be converted by nitric acid into malic and oxalic acids.

δ **SARCOCOLLIN**, obtained from sarcocoll, is brown, brittle, unctuous, and of a sweetish bitter taste.

ε **OLIVILE**, observed by Pelletier in the gum resin of the olive tree, is white, brilliant, and crystalloid, tasting like sarcocollin.

ζ **CASSITE**, a saccharine principle which I separated from the cassia fistulata, is yellow, crystallizable, and more soluble in alcohol than the ordinary varieties of sugar.

I have now completed a rapid and succinct sketch of a science, which owes its existence to the industry and talents of Scheele, Sertuerner, Robiquet, Braconnot, Caventou, and his indefatigable collaborator, Pelletier—men whose memory must ever be hallowed by the votary of natural knowledge, and revered by the medical world, as being the parents of a science, which has already tendered the most eminent services to suffering humanity, and one which puts forth the promise of becoming the most important, as it unquestionably is the most useful, branch of its generic science.

FINIS.







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