

III. "Results of the Examination of certain Vegetable Products from India."—Part I. By JOHN STENHOUSE, LL.D., F.R.S.  
Received November 14, 1855.

(Abstract.)

Through the kindness of my esteemed friend Dr. Royle, I have been permitted to select such vegetable products from the extensive collection at the India House as seemed most likely to repay the trouble of investigation. My attention, during the last twelve months, has been chiefly directed to three of these vegetable substances; and the results of their examination I now take the liberty of submitting to the Royal Society, to be followed by those of the others as they may be completed.

*Datisca cannabina.*

The first of these substances which I examined consisted of a quantity of the roots of the *Datisca cannabina*, from Lahore, where this plant is employed to dye silk of a fast yellow colour. The roots, which had been cut into pieces about 6 or 8 inches long, were from a half to three-quarters of an inch in thickness. They had a deep yellow colour. A decoction of the leaves of the *Datisca cannabina* was examined by Braconnot in 1816, who discovered in it a crystallizable principle, to which he gave the name of *datiscine*. Braconnot, of course, did not subject this substance to analysis, but he described its appearance and properties in an exceedingly accurate manner\*. The observations of Braconnot had fallen into such entire oblivion, however, that for many years past, we find in most of the larger systems of chemistry the term *datiscine* used as synonymous with *inuline*. Thus in Brande's 'Chemistry,' vol. ii. p. 1168, we find it stated that a variety of names had been given to *inuline*, such as "dahline, *datiscine*," &c.

The bruised roots were extracted in a Mohr's apparatus by long-continued digestion with wood-spirit. The liquor obtained, which had a dark brown colour, was concentrated by distilling off a portion of the wood-spirit. The brown syrupy liquid remaining in the retort, on being poured into open vessels and standing for some

\* Annales de Chimie et de Physique, 1816, iii. 277.

time, deposited a resinous matter containing merely traces of a crystalline substance. When this syrupy liquid, however, was treated with about half its bulk of hot water, the greater portion of the brown resin was rapidly deposited, and the mother-liquor having been poured off and left to spontaneous evaporation, deposited a considerable quantity of an imperfectly crystallizable substance resembling grape-sugar. These crystals are datiscine containing a considerable amount of resinous matter. The datiscine, however, is rendered perfectly pure by treatment with a solution of gelatine, to remove any trace of tannic acid, and repeated crystallizations out of weak spirits of wine.

*Properties of Datiscine.*—Datiscine, when pure, is perfectly colourless. It is very soluble in alcohol, even in the cold, boiling alcohol dissolving any amount of it. By slow spontaneous evaporation, its alcoholic solutions yield small silky needles arranged in groups. Cold water does not dissolve much of it, but it is tolerably soluble in boiling water, the hot solutions on cooling depositing it in shining scales.

Datiscine is not very soluble in ether; but an ethereal solution, when evaporated, yielded larger crystals than were obtained by any other method. On adding water to an alcoholic solution of datiscine, no precipitate is immediately obtained, unless the solution is greatly concentrated; but on standing, very pure, pale yellow-coloured crystals of datiscine separate.

When datiscine is heated to about  $180^{\circ}\text{C.}$ , it melts, and if the heat be increased, it burns, evolving an odour of caramel, and leaves a voluminous charcoal. If datiscine be heated in a close vessel while a stream of dry air is slowly passed over it, a small quantity of a crystalline substance sublimes. Datiscine and its solutions have a very bitter taste; and though it does not produce any change on test-paper, I think there is reason to regard it as a feebly acid body.

It dissolves in solutions of the fixed alkalies and ammonia, also in lime- and baryta-water. The addition of an acid to these solutions causes the precipitation of the datiscine.

The aqueous solution of datiscine is precipitated by neutral and basic acetates of lead, and chloride of tin. These precipitates have a bright yellow colour. Salts of copper produce greenish, and those of peroxide of iron brownish-green precipitates. In con-

sequence of the lead salts forming such gelatinous precipitates, they could not be employed for determining the equivalent of datiscine.

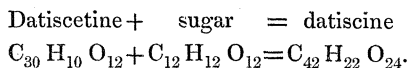
*Action of dilute Sulphuric Acid on Datiscine.*—When an aqueous solution of datiscine is boiled for a few minutes with very dilute sulphuric acid, it deposits a crystalline substance. On examining the solution filtered from the crystals, very distinct evidences of the presence of sugar were obtained. These experiments show therefore that datiscine, like salicine and similar bodies, belongs to the class of glucosides, and is a copulated compound of sugar and another substance which I shall call “datiscetine.”

*Datiscetine.*—Datiscetine in its general appearance and properties closely resembles datiscine, but on a closer examination these two substances are found to differ essentially both in composition and properties. Datiscetine when pure assumes the form of fine needles which are nearly colourless. It is easily soluble in alcohol, a hot alcoholic solution, on cooling, depositing the greater portion in crystalline groups. It is almost insoluble in water, consequently datiscetine is precipitated from its alcoholic solutions by the addition of water. It dissolves in ether in almost any quantity, and is deposited on the evaporation of that liquid in needles. These properties of datiscetine enable us to obtain it in a tolerably pure state, even when very impure datiscine is employed in its preparation.

*Properties of Datiscetine.*—Datiscetine has no taste. When heated it melts like datiscine, but the heat required is much higher than for that body. It recrystallizes on cooling. By operating very cautiously, a portion of the datiscetine may be sublimed. The sublimate, however, appears to be altered datiscetine. Datiscetine when burned does not emit the odour of caramel. Datiscetine, like datiscine, dissolves in alkaline solutions, and is reprecipitated by the addition of an acid. An alcoholic solution of acetate of lead added to an alcoholic solution of datiscetine produces a deep yellow precipitate, which can be easily washed both by alcohol and water. This precipitate therefore was subjected to analysis, and from the results obtained, the formula  $C_{30}H_8O_{10} + 2PbO$  was calculated, which agrees with the formula  $(C_{30}H_{10}O_{12})$  derived from the analysis of datiscetine.

*Analysis of Datiscine.*—It is difficult to calculate a formula for

datiscine, the numbers of which shall agree with those found by analysis. When, however, the decomposition of datiscine into datiscetine and sugar is taken into consideration, it seems probable that the formula for datiscine is



If the formula  $\text{C}_{42} \text{H}_{22} \text{O}_{24}$  be correct, the decomposition of datiscine by dilute sulphuric acid would be analogous to that of salicine when treated in the same way.

Dilute hydrochloric acid, like dilute sulphuric acid, decomposes datiscine, converting it into datiscetine and sugar. On boiling an aqueous solution of pure datiscine for some hours, traces of sugar could be detected, thus showing that a small portion of the datiscine had been decomposed.

It has been already shown that datiscine dissolves in cold solutions of potash without decomposition. When boiled, however, with a strong solution of potash for some time, decomposition takes place, and the precipitate, thrown down by the addition of an acid, has all the properties of datiscetine. In this respect, therefore, datiscine agrees with tannin and similar glucosides, which yield the same products when acted upon by acids and alkalis. Yeast and emulsine appeared to exert no action on solutions of datiscine.

*Action of Nitric Acid on Datiscine and Datiscetine.*—Cold nitric acid of the ordinary strength acts violently upon datiscetine, brown vapours are disengaged, and a resinous substance is produced, which is ultimately dissolved, forming a dark red liquid, which, when evaporated, yields crystals of nitropicric acid.

Datiscine treated in the same way yields nitropicric and oxalic acids.

When datiscine is boiled with dilute nitric acid it dissolves, and the solution obtained, when cooled, deposits pale yellow crystals, which agree in every way with the properties ascribed to nitrosalicylic acid.

On allowing datiscine to stand in contact with dilute nitric acid in the cold it gradually dissolves, the solution, when left to evaporate *in vacuo*, depositing a mixture of oxalic and nitropicric acids.

*Action of Potash on Datiscine and Datisctetine.*—It was stated in a previous part of this paper that datiscine and datiscetine dissolve in cold solutions of the alkalies without decomposition, and that datiscine, when boiled with potash, is decomposed with the formation of datiscetine. It only remained, therefore, to try the action of fused hydrate of potash. Datisctetine, when added in small successive portions to fused hydrate of potash, assumed a deep orange colour, and then dissolved with the evolution of hydrogen gas. When the disengagement of hydrogen had ceased, the mass was dissolved in water and supersaturated with hydrochloric acid. A partly resinous substance separated, which, by sublimation, yielded perfectly colourless, long crystals closely resembling benzoic acid. Their solution in water on the addition of perchloride of iron gave that deep violet tint which disappears on the addition of hydrochloric acid, and is so characteristic of salicylic acid.

*Action of Chromic Acid on Datisctetine.*—On distilling datisctetine with bichromate of potash and sulphuric acid a liquid came over, containing no oily drops, but having the smell of salicylous acid, and which, when tested with a persalt of iron, formed a purple-coloured solution characteristic of that acid.

It follows therefore, I think, from the experiments already detailed, that datiscine, like salicine, phloridzine, &c., is a glucoside, and that it approaches nearer to salicine than any other glucoside, with the exception of populine, yet known.

I will conclude this account of datiscine by proposing the following practical application. As is well known, the colouring matter of madder, when boiled with dilute sulphuric acid, is changed into sugar and garancine, a new dye-stuff, which, for many purposes, is found superior to that originally present in the madder. Within the last twelve months Mr. Lieshing, by treating the colouring matters in weld and quercitron bark with dilute sulphuric acid, has resolved them into new colouring matters, which are but slightly soluble in water, and are found nearly three times more powerful as dye-stuffs than the original colouring matters from which they had been produced.

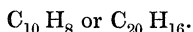
As datiscine, when boiled with dilute sulphuric acid, undergoes a perfectly similar transformation, being resolved into sugar and datisctetine, which has a much higher colouring power than the

datiscine which has produced it, I have not the least doubt that silk dyers, who may hereafter employ solutions of *datisca cannabina*, will find it highly advantageous to convert their datiscine into datiscetine by boiling it with dilute sulphuric acid.

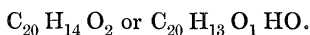
*Oil of the Ptychotis Ajowan.*

The *Ptychotis Ajowan* is an umbelliferous plant well known in India for its aromatic and carminative properties. When its seeds are distilled with water they readily yield between five and six per cent. of an essential oil resembling in smell that of oil of thyme. When this oil is left in shallow vessels to spontaneous evaporation at low temperatures, it deposits a large quantity of beautiful crystals, which are identical with the stearopten brought from India by the late Dr. Stocks, and described by me in a short notice in the December Number of the 'Pharmaceutical Journal' for 1854.

The crude oil was rectified, and the portion which came over between 160° C. and 164° C. was collected separately and carefully rectified over sodium. Its boiling-point was found to be 172° C., and its composition isomeric with oil of turpentine, namely



The stearopten obtained from the less volatile portion of the oil was purified, and formed large flat rhombohedral crystals, which have been carefully measured by Professor Miller of Cambridge. When subjected to analysis it gave the formula



In the notice of the stearopten of this oil which appeared in the 'Pharmaceutical Journal,' from the examination of the small quantity then at my disposal, a different formula was deduced, which I now withdraw, and substitute the preceding formula,  $\text{C}_{20} \text{H}_{14} \text{O}_2$ , in its stead.

When the crystalline stearopten is digested for eight or nine days with the strongest nitric acid, it is gradually converted into a crystallizable acid, apparently containing no nitrogen. This acid is but slightly soluble even in boiling water, but is deposited in needles on the cooling of the solution. It is very soluble in alcohol and ether, from which it is deposited in crystals. Both its silver and its baryta salts are crystallizable, and appear very stable. It

seems to me to be a new acid, and this I hope soon to be able to ascertain.

When the stearopten is gently warmed with oil of vitriol it dissolves, and, on cooling, solidifies into a crystalline mass. This new compound, which is a copulated acid, dissolves readily in hot water, and, on cooling, is deposited in large scaly crystals, of a mother-of-pearl lustre. It forms both a crystallizable lead and baryta salt.

When the stearopten is distilled with a mixture of peroxide of manganese and sulphuric acid, it yields a substance exceedingly analogous in almost every respect to the thymöl obtained by Lallemande by subjecting the stearopten of oil of thyme to similar treatment. As the details of Lallemande's experiments have not yet been published, it would be premature to pronounce with absolute confidence on the identity of the stearoptens from the *Ptychotis* and oil of thyme; but if not identical, as I rather apprehend they are, they are certainly extremely similar bodies\*.

*Gum of the Gardenia lucida, Roxb. (the Decamalee Gum of Scinde).*

The specimen of this gum on which I operated was evidently very old. It formed a hard, dry mass, of a dark brown colour, with numerous patches of a greenish-yellow matter disseminated through it. It had but a faint odour, unless freshly fractured or gently heated, when it smelt like the urine of the cat.

A comparatively recent specimen of this gum, which I saw in the hands of the late Dr. Stocks, had merely the consistence of candied honey, and an exceedingly offensive odour. Dr. Stocks informed me that the fresh gum was employed as a dressing for wounds, as it kept off the flies. The resin was digested in strong spirit of

\* Since this paper was communicated to the Royal Society, a notice of the Ptychotis oil, by Dr. Haines, of the Bombay College, was read before the last meeting of the Chemical Society. Dr. Haines has generally arrived at similar conclusions to my own. He regards, however, the carbohydrogen portion of the oil not as isomeric with oil of turpentine, but as  $C_{20}H_{14}$ .

His formula for the stearopten is the same as that given in this paper; and he regards it as identical with Lallemande's thymole.

Dr. Haines, however, appears not to have observed the crystalline acid produced by the action of nitric acid on the stearopten.

wine, till a saturated solution was obtained. This, on cooling, immediately deposited some yellow amorphous flocks. These were separated by filtration, and the clear liquid slowly evaporated *in vacuo*. On standing a few days, it deposited a quantity of golden yellow slender crystals, about half an inch in length. The crystals had considerable lustre, and were very brittle. To this crystalline substance I purpose giving the provisional name of Gardenine. Gardenine is nearly insoluble both in cold and hot water. It dissolves pretty readily in alcohol, but much less readily in ether; ether yielding bright yellow solutions, out of which it crystallizes on cooling. Alkalies, such as ammonia, do not appear to increase its solubility. It is more soluble in hot hydrochloric and sulphuric acids than in water, and is precipitated, apparently unchanged, on the addition of water. Its alcoholic solutions give no precipitate with ammonio-nitrate of silver, or with basic acetate of lead. When gardenine is digested with concentrated nitric acid, it is rapidly decomposed; nitropicric acid, but apparently no oxalic acid, being produced.

Unfortunately, from the very small quantity of resin at my disposal, I was unable to prepare a sufficient amount of the gardenine either to subject it to analysis or to examine it more particularly. Dr. Royle has, however, commissioned a large quantity of the resin from India, which I trust will ere long enable me to complete its examination. Gardenine appears to belong to the tolerably numerous class of indifferent crystallizable resins, of which it is certainly one of the most beautiful.

IV. "On the Representation of Polyhedra." By the Rev. THOMAS P. KIRKMAN, A.M. Communicated by ARTHUR CAYLEY, Esq., F.R.S. Received August 6, 1855.

This paper constituted an addition to the paper by the same author read June 21, 1855.

The author observes that to every p-acral q-edron corresponds a p-edral q-acron, the summits and faces of either having the same order and rank as to the number of edges with the faces and summits of the