XLV.—*The Colouring Principle of Toddalia aculeata and Evodia meliæfolia.*

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Toddalia Aculeata.

THIS Indian plant, belonging to the *Rutaceæ*, is a rambling shrub found in the sub-tropical Himalayas, in the Khasia Mountains, and throughout the Western Peninsula, and Ceylon.

The root-bark is used in Madras as a yellow dyestuff, and it is also highly spoken of by various writers as one of the most valuable of Indian medicinal products, possessing tonic, stimulant, and antipyretic properties. It was introduced into European medicine in 1771, and at one time enjoyed some celebrity under the name of "Lopez Root," but it has long since fallen into disuse.

The toddalia root does not appear to have been ever satisfactorily examined. Flückiger and Hanbury state that they found the root-bark to contain an essential oil, and some substance, precipitated from the aqueous solution by tannic acid, which they regarded as an indifferent bitter principle rather than as an alkaloid. They state that they were unable to detect the presence of berberine.

For the small sample examined by us, we are indebted to Dr. G. Watt, from whom it was obtained during his official connection with the Colonial and Indian Exhibition, London, 1886.

The root, about $\frac{3}{4}$ inch in diameter, possesses a marked aromatic odour, and has a pale yellowish, almost white, woody centre, and a brown bark covered with a bright yellow, soft, powdery, pith-like substance. The central woody portion, the inner bark, and the external yellow powder were separately examined.

Ten grams of the *external yellow powder* were digested for two hours with 100 c.c. of boiling alcohol, filtered, and the residue again treated in a similar manner. To the orange-brown filtrate alcoholic lead acetate solution was added drop by drop as long as a colourless precipitate was formed, and after this had been removed by filtration, the filtrate was evaporated to a small bulk and poured into five times

its volume of dilute hydrochloric acid. A viscous, yellow precipitate was thus obtained, which increased in quantity on standing; this was collected upon calico, and, after being rinsed with cold, was digested with boiling water; the turbid, yellow liquid thus obtained contained resinous matter in suspension, but this was readily removed by means of ether. After boiling the clear aqueous solution, excess of hydrochloric acid was added, and on cooling, it deposited long, orange-coloured needles, which were collected and washed with dilute hydrochloric acid. To purify this product, it was dissolved in boiling dilute alkali and the solution digested with animal charcoal, filtered, treated with hydrochloric acid, and allowed to cool; the yellow needles which separated were collected, washed with water, and allowed to dry at the ordinary temperature. The product weighed 0.35 gram.

For analysis this was converted into the platinochloride in the usual manner, and the resulting amorphous, yellow powder dried at 100°.

0.294 on ignition yielded 0.0535 Pt. $Pt = 18.19$.

$(C_{20}H_{17}NO_4)_2, H_2PtCl_6$ requires $Pt = 18.02$ per cent.

The analytical numbers accorded therefore with those given by berberine platinochloride. Its identity with this substance was shown by a comparison of the reactions of the hydrochloride above referred to with berberine hydrochloride obtained from other sources.

The *inner bark* of this root (60 grams) was found, on examination by the above method, to contain but a trace of berberine, so small, indeed, that this was probably derived from traces of the preceding yellow powder still adhering to it. It contained, however, some quantity of a sticky, resinous product which was insoluble in water or dilute acids, but readily soluble in ether, and appeared to be identical with the similar substance present in the yellow powder. The quantity obtainable was too small for extended examination, and the preliminary experiments were not successful in extracting from it any crystalline substance. The *central woody portion* of the root yielded no berberine.

Evodia Meliæfolia.

This tree, belonging to the *Rutaceæ*, is found in China and Japan, where its bark is largely employed in dyeing as well as in medicine. It was formerly described by Loureiro and others as *Pterocarpus flavus*, but this error was eventually corrected by P. W. Squire (*Pharm. Jour.*, [3], 1888, 18, 785), who proved it to be really *Evodia glauca*, which is synonymous with *E. meliæfolia* (*Flora, British India*, 1, 490). Some time ago we received from Mr. James

Buchanan, of Shanghai, a small sample of bark called by the Chinese "hwang-peti," exhibiting all the characteristics described by Squire, and its identity with that of *Evodia meliæfolia* having been determined for us by Mr. Thistleton Dyer, Director of the Royal Botanic Gardens, Kew, we examined it both chemically and tinctorially.

The literature of this dyestuff is extremely meagre, the only references to its colouring principle we have met with being those of G. Martin, Tokio (*Archiv. d. Pharm.*, 1878, **13**, 337), and of P. W. Squire (*loc. cit.*). The former merely states the fact that he found the bark to contain berberine, and the latter that the reactions of the aqueous decoction of the bark with picric acid, hydrochloric acid, and calcium hypochlorite indicated the presence of berberine. Neither of these observers furnish analytical data, and it appeared to us therefore desirable to obtain conclusive confirmation of these statements.

Fifty grams of the finely ground bark were extracted with alcohol, and the extract treated in a similar manner to that described under *Toddalia aculeata* (p. 413); a crystalline yellow product was obtained closely resembling berberine hydrochloride, and this was converted into the platinochloride, and dried at 100°.

0.4555 gave on ignition 0.0825 Pt. Pt = 18.11.

0.2404 „ 0.3907 CO₂ and 0.0760 H₂O. C = 44.32; H 3.51.

(C₂₀H₁₇NO₄)₂.H₂PtCl₆ requires C = 44.47; H = 3.33; Pt = 18.02 per cent.

It was evidently berberine platinochloride. This bark also contains some quantity of a resinous substance soluble in ether, apparently identical with that found in the *Toddalia aculeata*.

Having some quantity of the root of the *Coscinium fenestratum* which contains berberine (Perrins, *Annalen*, **83**, 276), it was examined by the preceding method in the hope that it would contain sufficient of this resinous substance for examination. Berberine was readily obtained, though the resinous substance was found to be absent from the root.

Dyeing Properties.—A series of dyeing experiments were made with the evodia bark on silk, wool, and cotton. Wool and silk, without being mordanted, are readily dyed a bright yellow by boiling for half an hour in an aqueous decoction of the bark. The addition of 1 per cent. of sodium carbonate to the dye bath is beneficial by increasing the intensity of the colour without impairing its brilliancy. Larger additions of sodium carbonate give still deeper colours, but they are not so bright; prolonged boiling acts in the same direction. Evodia bark is best adapted for dyeing silk, on which a full, bright yellow is obtained with 20 per cent. of dyestuff.

Cotton has no attraction for the dye unless it has been previously mordanted with tannic acid, when it is dyed in neutral bath a dull yellow.

The foregoing experiments indicate that the bark contains a basic colouring matter which behaves in the normal manner. A comparative dyeing experiment on wool indicated that evodia bark contains the equivalent of 3 per cent. of berberine hydrochloride.

Experiments with toddalia gave similar results.

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