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Botanical Medicine Monographs and Sundry

PROXIMATE ANALYSIS OF THE BARK OF FOUQUIERIA SPLENDENS.

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In the published proceedings of the Mexican Boundary Survey of 1859, conducted by General William H. Emory, are found numerous references to *Fouquieria splendens*. No region of equal extent presents more marked illustrations of the relations of the vegetation of a country to its topography and geology than that lying along the Mexican boundary line. The traveler traversing the desert table-lands will not fail to unite in his recollections of these tracts the dull foliage of the creosote bush, the palm-like Yucca, and the long thorny wands of the *Fouquieria splendens*. The vegetation of the El Paso basin and the Upper Rio Grande valley is described as strikingly different from that of the immediately adjoining country; new and strange plants are seen on every side. Upon the table-lands many plants grow not to be found in the more fertile valleys; among these is *Fouquieria*, a tree locally known by its Mexican name ocotilla. A full description of the appearance of the plant is given in the Mexican Boundary Survey; also one in an article by Edward Lee Green.[2] The author describes *Fouquieria splendens* in these terms: "It is a splendid oddity and not more odd than beautiful, flourishing in great abundance in many places. It grows to the height of from eight to twelve feet, and in outline is quite precisely fan-shaped. The proper trunk, usually ten to twelve inches in diameter, is not more than a foot and a half high. A few inches above the surface of the sands this trunk abruptly separates into a dozen or more distinct and almost branchless stems. These simple stems rising to the height of eight or ten feet gradually diverge from one another, giving to the whole shrub the outline of a spread fan. Each separate stem is clothed throughout with short gray thorns and small dark green leaves, and terminates in a spike, a foot long, of bright scarlet trumpet-shaped flowers. The stems are not so thickly armed with thorns, but that they can be handled if grasped spectly, and being very hard and durable, as well as of a convenient size, they are much employed for fencing purposes about the stage stations and upon the ranches adjoining the desert." The author states: "Give a skillful Mexican ocotilla poles and plenty of raw hide thongs and he requires neither nail nor hammer to construct a line of fence, which for combined strength, neatness and durability fairly rivals the best work of that kind done in our land of saw-mills and nail factories."

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[1] Paper read before the Chemical Section of the American Association for the Advancement of Science, at Philadelphia, 1884, by H. C. De S. Abbott.

[2] Botanizing on the Colorado Desert, "American Naturalist." 1880.

The plant is botanically described under the order *Tamariscineæ*, tribe III, *Fouquiereæ*, new genus and species.[3] For other sources of information see "A Tour in New Mexico;"[4] and in "Plantæ Wrightianæ Texano-Mexicanae."[5] The writer has not been able to find any notice of chemical studies made upon it.

The specimens of ocotilla, at the writer's request, were collected and transmitted from Lake Valley, Southwest New Mexico, through the kindness of Professor E. D. Cope. The portions of the stem, similar to those used in the analysis, vary in diameter from an inch to an inch and a half. The bark shows a thickness of over an eighth of an inch, and is of a sage color generally. The exterior surface is made rough by an interlacement of hard projecting material; some of the smaller stems are encircled with the gray thorns described, arising in regular series from the projecting portions of the bark. Between the interlacements, are oblong and diamond-shaped intervals, which are filled with superimposed layers of a yellowish color and looking as if coated with a wax. They appear to be cemented together by a glistening substance which on warming the bark exudes and possesses a resinous or gum-like consistency.

In the present investigation, the scheme proposed by Dragendorff[6] has been followed out, with the exception of the maceration at the ordinary temperature; an apparatus similar to the one devised by Tollens[7] has been used for the extractions. The air dried material reduced to a very fine powder was again dried at 100º C. giving 9.4 per cent. moisture. The great importance of powdering the material for the various estimations as insisted upon by Dragendorff[8] was fully confirmed in these examinations. Quantitative determinations with ocotilla bark reduced to fine pieces gave 2 per cent. and 3.5 per cent. less than the percentage obtained from the estimations with the powdered substance. Determination of total ash gave 10.26 per cent.; a qualitative ash analysis showed the presence of calcium, magnesium, aluminum, potassium, sodium and a trace of iron, sulphates, phosphates and chlorides.

Ten grammes of the air-dried powder treated with petroleum spirit of boiling point 46ºC. extracted a substance without aromatic odor, communicating to the liquid a light color. From 100º C.C. a measured portion was evaporated for determination of total amount of substances brought into solution. The residue dried at 100º C. gave 9 per cent., at 110º C. 8.87 per cent., at 120º C. 8.875 per cent. and a loss of .125 per cent. showing scarcely appreciable trace of volatile oil. The remainder of the petroleum spirit extract on evaporation at the ordinary temperature left a solid yellowish-green way substance of specific gravity .984, melting from 84º C. to 85º C., insoluble in water, slowly soluble in boiling 95 per cent. alcohol, readily in absolute alcohol, in cold ether, chloroform, amyl alcohol, benzol, carbon disulphide, oil of turpentine and linseed oil; slightly dissolved in aqueous alkalies, but not saponifying with them. It is colored yellow by nitric acid, acted upon by concentrated sulphuric acid, and not by hydrochloric acid nor aqua regia. By means of combining sulphuric acid and solvents, I was able to obtain several color reactions that may prove upon

[3] Bentham and Hooker. Genera Plantarum.
[4] By Dr. N. Wislizenus
[5] Gray, Smithsonian Contributions to Knowledge. Vol. iii, Part 1, p. 85 and Pt. ii, p. 63
[6] Plant Analysis, Qualitative and Quantitative. G. Dragendorff, Ph.D. Translated from the German by H. G. Greenish. London, 1884.
[7] "Zeitschrift f. anal. Chemie," x iv, 82, 1875, and xvii, 320, 1878.
[8] Loc cit.

further investigation of value in identification of the different vegetable waxes. With Japanese wax, the only specimen of vegetable wax, I could obtain, the color reactions differed in each test from the substance under ,consideration. The following color reactions were obtained with the petroleum, spirit residue. When small fragments were stirred on a watch crystal with two or three drops of concentrated sulphuric acid of 1.84 sp. gr. the substance at once changed color to a clear garnet red and was slowly dissolved by the acid, the liquid remaining colored; with different portions of the red acid liquid stirred on a watch crystal with various solvents used in excess, it was noted as follows: With absolute alcohol the color was instantly dissipated leaving a white precipitate; petroleum spirit discolored the acid solution, leaving no precipitate; ether discolored with gray precipitate; chloroform changed the red acid liquid to yellow, no precipitate; with benzol the red color was changed to snuff-brown gradually passing to red-brown; amyl alcohol gave a rose-pink and slowly passing through varying tints to a fine purple. So called pure amyl alcohol was used and when tested did not give a color reaction alone with sulphuric acid. The petroleum spirit residue on boiling with absolute alcohol and when warm, thrown into several times its volume of cold water separated out as a white cloud.

Employing a method by which melissyl alcohol has been obtained from Carnauba wax,[9] the petroleum spirit residue was submitted to a like treatment. It was boiled with alcoholic potash and saponified, the alcohol distilled off and lead acetate added; a heavy light-yellow colored precipitate formed, and on boiling yellow masses separated out. They were washed, dried, and boiled with absolute ether. The filtered liquid on cooling deposited a yellow crystalline substance, which on heating on platinum foil turned black and disappeared. Beyond ascertaining the fusing point, solubilities, and color reactions, the substance was not further examined. It was found to fuse between 43º C. and 60º C., the greatest change occurring between 57º C. and 60º C.; to be soluble in chloroform and ether; scarcely soluble in cold absolute alcohol; very slightly soluble in boiling 95 per cent. alcohol; not acted upon by nitric acid nor aqua regia. Sulphuric acid dissolved the substance and gave an orange color reaction discolored on adding alcohol, ether, chloroform and ammonia to the acid liquid, with no precipitate; with amyl alcohol a pale rose pink quickly fading, and with benzol a brown color, were obtained. The color tests differed from those obtained with the substance before saponification and treating with boiling ether, indicating that the petroleum spirit residue can be separated into at least two substances and possibly more, which remain to be determined by a future study.

The powder exhausted by petroleum spirit, was dried and similarly treated with absolute ether as in the previous extraction. The ethereal extract of a greenish color gave an acid reaction with litmus, and on addition of alcohol the liquid became turbid. Spectroscopic examination failed to detect the characteristic chlorophyll bands. The ethereal residue on evaporation presented differences in color and solidity from the petroleum spirit residue. It was quite brittle, and was not appreciably softened at 120º C. It gave when dried at 100º C. 4.52 per cent. solids extracted, at 110º C. 4.44 per cent. and at 120º C. 4.42 per cent. The residue when evaporated at ordinary temperature was insoluble in petroleum spirit, slightly soluble in 95 per cent. alcohol and carbon disulphide, quite soluble in cold absolute alcohol, amyl alcohol, chloroform, benzol and oil of turpentine. Nitric acid gave no reaction. With sulphuric acid and

[9] Liebig, Annalen, 183, p. 344; Watts Diet. Chem.

small portions of the ethereal residue, I obtained a dark mahogany color. This solution on adding absolute alcohol was partially discolored, no precipitate. With ether the sulphuric acid solution gave a greenish precipitate, with amyl alcohol the acid solution was discolored changing to pale red, then green. These tests show in each case a wide difference in color reactions from those obtained with the petroleum spirit residue. The amount of solids taken up on treating the ethereal residue with water was .36 per. cent. The aqueous liquid was neutral to litmus, portions tested for alkaloids gave negative results; on warming and addition of dilute sulphuric acid, Fehling's solution was reduced, indicating possibly glucosides. The portion insoluble in water was then treated with absolute alcohol. The liquid gave an acid reaction with test paper. A measured part of the liquid was evaporated and the weighed residue showed 1.6 per cent. of solids dissolved. The residue from the evaporated alcoholic liquid was partially dissolved by aqueous alkalies. It readily saponified with alcoholic soda, forming a soft brown soap, which on boiling with lead acetate yielded a yellow precipitate. This was collected on a filter and washed. When the precipitate was boiled with absolute ether and the filtrate allowed to slowly evaporate, a white organic crystaline substance separated out. Under the microscope particles of coloring matter were found to be interspersed among the crystalline structures.

The indications would show an acid resin to have been extracted by the ether.

The ten grammes of powdered bark, after exhaustion with petroleum spirit followed by absolute ether, were treated with absolute alcohol. A measured quantity of the alcoholic extract was evaporated in a weighed platinum dish, dried until weight noted was constant. After incineration the amount of ash was found to be .15 per cent. of the original material. The alcoholic extract for determination of total amount of organic solids dissolved, was evaporated in a current of carbonic acid, when the residue dried gave 8.6 per cent, and 7.98 per cent. of solids respectively. A cloudiness formed on the addition of water to the residue, which cleared up on addition of alkalies. It was restored by acid. The aqueous liquid gave precipitates with calcium and lead salts. It reduced Fehling's solution on adding dilute acid and warming. Negative results followed tests for alkaloids. Treating with two volumes of absolute alcohol, according to Dragendorff for detection of gum, vegetable mucilage was separated. Tests failed to detect the presence of tannin.

The residue of the powdered bark, after exhaustion with absolute alcohol, was treated with cold water. A deep red mucilaginous liquid which became frothy on shaking, was extracted. The amount of solids in this solution on, evaporating the liquid and weighing the residue was found to be 19.11 per cent.; in absence of acid or boiling glucose was identified by Fehling's solution, also by Mulder's test. A gum separated by absolute alcohol and quantitatively estimated, showed 4.8 per cent. of the amount of substances dissolved in water. The powdered residue, after treatment with water, was macerated with dilute acid, and gave negative tests for alkaloids. The extraction with caustic soda for identification of albuminous substances, followed by chlorine water for the estimation of lignin and cellulose, have not yet been determined.

The results of the proximate analysis, as so far completed, may be stated as follows:

Moisture	09.4
petroleum spirit residue	09.
Ethereal residue	04.52
Alcoholic residue	08.6
Water residue	19.11
Total ash	10.26
Alcoholic extract ash	00.15
	61.04

The difference of 38.96 per cent. would include pectose, coloring matter and cellulose or woody fibre.

Petroleum spirit extracted a solid substance, yellowish green in color of sp. gravity .984, melting from 84º C. to 85º C., insoluble in water slightly soluble in boiling 95 per cent. alcohol, soluble in absolute alcohol, cold ether, chloroform, amyl alcohol, benzol, carbon disulphide, oil of turpentine and linseed oil. It was slightly acted upon by aqueous alkalies; but readily saponified with alcoholic soda. Treating the soap with lead acetate and boiling the precipitate with ether, a yellow crystalline substance was obtained, melting from 43º C. to 60º C. Sulphuric acid combined with. solvents gave characteristic and distinct reactions with the yellowish-green petroleum spirit residue, and with the crystalline substance separated from it.

A scheme has been proposed for the identification of various waxes based upon quantitative experiments.[10] The examination rendered division into two groups possible, according to the solubilities of the waxes with chloroform. Again their action with ether, and acetate of lead solution added to the alcoholic solutions, allow the several varieties of waxes to be distinguished from each other.

The petroleum spirit residue was submitted to the tests proposed in Hirschsohn's scheme. It was boiled with ten times its volume of chloroform and when cool the liquid became cloudy. By this test the petroleum spirit residue was placed in the group with Carnauba and Bahia wax. An ethereal solution of the petroleum spirit residue, on adding an equal volume of alcohol, remained clear. According to Hirschsohn's Scheme,[11] an ethereal solution of Bahia wax similarly treated remains clear, and by this means the wax is distinguished from Carnauba wax, which it is said to resemble in most of its properties. The wax from *Copernicia cerifera*, the Carnauba tree of Brazil, and Carnauba wax obtained from the leaves of *Corypha cerifera*, are related very closely by their chemical properties and possibly are identical.[12]

Carnauba wax is described as a clear yellow wax with a greenish tinge, and harder than bees' wax. It contains a notable percentage of free melissyl alcohol and other alcohols very difficult to separate. Insoluble in water, it is dissolved with difficulty by alcohol and ether, though readily soluble in carbon disulphide and oil of turpentine. It is not acted upon by linseed oil; it is changed yellow by nitric acid; with sulphuric acid no appreciable effect. The melting point is variously stated from 82º C. to 85º C. The

[10] Contributions to the Chemistry of several varieties of wax, by E. Hirschsohn, Pharmaceutical Journal and Transactions, vol. x, March, 1880.
[11] Loc. cit.
[12] Gmelin. Handbook of Chemistry, vol. xviii. Translated by H. Watts, London.

specific gravity from .998 to .999.

A table of the specific gravity of the different kinds of waxes prepared by Dietrich[13] shows the density of animal wax to be notably low compared with vegetable waxes. Allen[14] states that the presence of vegetable wax in adulterations of bees' wax is positively established if the density of the sample exceed .970.

By the method followed out in this analysis, petroleum spirit extracted from the powdered bark a substance of constant melting point which is identified as a wax. It resembles, in its ethereal solution not clouding on addition of alcohol, Bahia wax; in melting point and specific gravity, Carnauba wax, also the latter wax by its insolubility in water and action with nitric acid. It differs from Carnauba wax in its greater degree of solubility in absolute alcohol, ether and aqueous alkalies. Linseed oil is an active solvent for it, but does not dissolve Carnauba wax. The color reaction of the petroleum with sulphuric acid have been described above. It is stated that sulphuric acid produces no effect with Carnauba wax.[15]

The wax obtained from the bark of *Fonquieria splendens* differs generally in its properties from known vegetable waxes, and is evidently a new wax, peculiar to this plant. I propose that it be called Ocotilla wax.

In the ether, absolute alcohol, and water extracts, the presence of an acid resin, a white crystalline substance, gum resin, glucose, possibly glucosides, gum, and a red coloring matter were indicated.

The investigations described in the preceding pages were conducted in the Chemical Laboratory of the Philadelphia College of Pharmacy, August and September, 1884.

[13] Dietrich. Specific Gravity of Wax. Journal of Chemical Society, 1882, vol., xlii, p. 1139.
[14] A. H. Allen. Commercial Organic Analysis. (Also see in same work tables of sp. gr. waxes.)
[15] A.B. Prescott. Outline of Proximate Organic Analysis

SOME NATIVE SOUTHERN REMEDIES.

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The following information is taken from the author's paper, based upon a report and collection of plants sent him by Dr. E. W. Lane, Scarboro, Ga.

NATURAL ORDER SARRACENIACEAE.

1. *Sarracenia variolaris,* Mx., Spotted Trumpetleaf, Spotted Pitcher Plant, Spotted Side-saddle Flower, or Small-pox Plant, reported under the additional name of the "Hood-topped Fly-catcher." The last name possesses interest as being the first reference in the common names to a peculiarity of this and other species of the genus, which has lately been the subject of special scientific investigation, namely, their carnivorous habits. A narrow line of sugary secretion is deposited on the outside of the pitcher-shaped leaves, running from near the ground up to the edge of, and a little way down into, the cup. Insects ascending and feeding from this viscid line, become intoxicated by the time they have reached the interior, and fall into the fluid contained within the leaf. This fluid contains a substance closely akin to the gastric juice, by means Of which certain portions of the insects' bodies are digested. This proteid matter is then absorbed. The only medical virtue heretofore attributed to this genus is that of a small-pox specific, which, as pointed out by Dr. Lyons, is probably on the "absurd theory of signatures." But Dr. Lane describes it as tonic and slightly anodyne, and of use in dysenteries. These properties would seem to accord well with the physiological habits above given. A secreted substance capable of intoxicating insects would be likely to give it "slightly anodyne properties," and its digestive principle would be likely to render it tonic. As to its use in dysenteries, its abundant astringency would render it serviceable in diarrhoeas which often assume a dysenteric type, but scarcely in a real dysentery. The same remarks are applicable to the next and other species of Sarracenia.

2. *Sarracenia flava,* L., the Yellow-flowered Pitcher-plant, etc., now reported as the "Umbrella-topped Fly-catcher."

NATURAL ORDER CALYCANTHACEAE.

3. *Calycanthus laevigatus,* Willd. Sweet-scented Shrub. Reported as "Southern Peruvian;" the bark said to have done good service as a tonic and anti-periodic.

NATURAL ORDER LEGUMINOSAE.

4. *Phaseolusdiversifolius,* Pers. Wild Bean. Reported under the name of "King Cure-all." It grows in sand, from an immense, stout club-shaped root, which abounds in starch. It is reported as beneficial to dyspeptics, the root being chewed and the saliva swallowed. The doctor judges the benefit to be derived from the increased amount of saliva swallowed.

NATURAL ORDER RUBIACEAE.

5. *Galium pilosum*, Ait., var. Hairy Bed-straw. Reported as “Snake-bite-weed” and “Flux-weed,” and the absurd name “Four-corners-of-the-earth,” which last it has probably received in allusion to its four-angled stem. It is one of the innumerable weeds, of which every village has one or more, said to be a specific for the bite of the rattlesnake and other venomous creatures, and without much doubt worthless in this respect. Belonging to a family which yields the cinchonas and other powerful stimulants, and being so near to the *Galium aparine*, L., it very possibly has medicinal properties; but the objection to the property here proposed rests on our knowledge of the nature of the rattle-snake's venom.

NATURAL ORDER COMPOSITAE

6. *Eupatorium foeniculaceum*, Willd., the Fennel-like Boneset. Reported as the “White-flowered Dog-fennel” (but the true Dog-fennel is *Anthemis Cotula*, L.). Dr. Lane testifies to it as a strong diuretic and one used with success for both man and beast. One pint of the strong decoction is an effectual drench for horses afflicted with “what is commonly called gravel.”

7. *Eupatorium perfoliatum*, L. Boneset or Thorough-wort.

8. *Eupatorium rotundifolium*, L. Reported under the name of “Wild Horehound.”

9. *Eupatorium aromaticum*, L. Reported as “Upland Wild Horehound.” The report on the three last confirms the well-known properties of these plants. It is a noteworthy fact that *E. foeniculaceum* should possess such marked diuretic power, while its congeners are nearly or quite deficient in that respect.

10. *Sericocarpus tortifolius*, Nees. One of the White-topped Asters. Reported as “Edgeweed,” and said to be useful for colic in horses.

11. *Solidago odora*, Ait., the Odorous Golden-Rod. Used as a styptic; in the case of wounds, by applying the bruised plant; in the case of epistaxis, by snuffing up the powdered dried leaves. It may be noted here that attention has recently been called to the fact that in certain parts of the country an infusion of the leaves of this plant is very generally used as a beverage, as a substitute for tea, a regular trade in the article having sprung up in the shops.

12. *Chrysopsis graminifolia*, Nutt., the Grass-leaved Silver Aster. Reported as “Blue-grass” and “Fevergrass.” Used as a poultice to sprains.

13. *Helenium nudiflorum*, Nutt., the Naked-flowered Sneeze-weed. Report refers to its well-known irritating properties when applied to the nostrils.

14. *Gnaphalium purpureum*, L., the Purple-flowered Everlasting. Reported as “Cough-weed,” and as a remedy for coughs and colds.

15. *Gnaphalium polycephalum*, Mx., the Sweet-scented Life-everlasting. Reported as a diaphoretic and a poultice in tympanitis.

16. *Plerocaulon pycnostachyum*, Ell., the Indian Black-root. Said to posses tonic and emmenagogue and oxytocic properties. The latter is an interesting announcement as bearing on its well-known narcotic properties.

NATURAL ORDER GENTIANACEAE.

17. *Gentiana ochroleuca*, Froel., the Sampson Snake-root. Dr. Lane confirms its value as a substitute for the other gentians.

NATURAL ORDER LOGANIACEAE,.

18. *Gelsemium sempervirens*, Ait., the Yellow Jessamine. Concerning this, the most important and valuable upon the list, and one of the most valuable plants in the entire materia medica, the doctor speaks in no stinted terms. In his bands, and in the hands of his acquaintances, it has sustained the reputation it has generally gained. An interesting fact is that a majority of the country practitioners in that section prepare their own extracts, using eight ounces of the bark of the green root to the pint of dilute alcohol. If this practice is general throughout the south, it would materially affect the estimate of the consumption of this drug.

NATURAL ORDER AMARANTACEAE.

19. *Telanthera polygonoides*, Moq. Reported under the name “Piss-a-bed,” and as a diuretic and anti-spasmodic, used in cases of strangury.

We would repeat that it is most desirable that similar reports, accompanied in all cases by specimens showing as much as possible of the plant, mailed flat between sheets of pasteboard, should be contributed, particularly from the south and southwestern regions.—*Therap. Gaz.*, Dec., 1884, p. 546.