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ANALYSIS OF THE VOLATILE OIL OF HEDEOMA PULEGIOIDES

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[From an Inaugural Essay.]

But very little information, regarding the chemical composition of this oil, was published, until the recent contribution to the American Pharmaceutical Association, by Ed. Kremers; and nearly all of the following chemical results were obtained before the appearance of his paper.

Description.—A yellowish liquid, slightly turbid, of a pungent, mint-like odor and taste, soluble in all proportions of alcohol, and having a faint acid reaction, which might easily be overlooked. Specific gravity of the dried oil at 15°C., 0.931 ; boiling from 180°-206°C.

Reactions of the dried oil.—No greasy stain was left on paper, showing the absence of fixed oil. It gave no reactions with solution of ferric chloride, alcoholic solution of ammonium sulphide, nor with saturated solution of sodium bisulphite, indicating the absence of phenols or aldehyde-like bodies; and nothing crystallized out when subjected, for three hours, to a temperature of -17°C.

Fractional distillations.—About 900 grams were subjected to distillation. The first portion was found to have a strong acid reaction, this fraction was therefore not taken until all of the acid had been distilled over. This was then shaken with water, and separated, until all of the acid had been dissolved out; this acid solution was marked X and set aside for further investigation. The oil was then thoroughly dried, mixed with the remainder, and subjected to repeated fractional distillation, until the following fractions were obtained:

Fraction.	Boiling.	Quantity.	Fraction.	Boiling.	Quantity.
I.	below 165°C.	2c.c.	VII.	215°-217°C.	50c.c.
II.	165°-170°	6 "	VIII.	217°-218°	300 "
III.	170°-180°	20 "	IX.	218°-220°	125 "
IV.	180°-185°	25 "	X.	220°-222°	85 "
V.	185°-200°	50 "	XI.	222°-225°	25 "
VI.	200°-215°	160 "	XII.	225°—	50 "

After removing the fifth fraction the neck of the flask broke, and, on examination the next morning was found to be studded with small, fine, needle-shaped crystals; it was accordingly marked Z, and set aside for further investigation. These fractions were all placed in a freezing-mixture of -17°C. for two and a half hours, but nothing separated. Fraction xii was fluorescent and became solid though not crystalline.

ULTIMATE ANALYSIS.

FRACTION II. (165°-170°C.)—In the first 0.1375 grams, and in the second 0.1412 grams of oil were used, with the following results: The formula corresponding most nearly is $C_6H_{12}O$.

Found.			Calculated for $C_6H_{12}O$.
I.	II.	Average.	
C. 72.098 per cent.	72.115 per cent.	72.106 per cent.	72.00 per cent.
H. 12.288 “	12.039 “	12.164 “	12.00 “
O. 15.614 “	15.846 “	15.730 “	16.00 “
100.000 per cent.	100.000 per cent.	100.000 per cent.	100.00 per cent.

FRACTIONS X AND XI. (220°-225°)—In the first 0.1414 grams, and in the second 0.1678 grams of oil were used. The liquids were then mixed, refractionated, and an analysis made of the fraction obtained between 220° and 225°, and marked T, of which 0.144 grams of oil were used. The formula corresponding most nearly to these results is $C_{10}H_{17}O$.

Found.			Calculated for $C_{10}H_{17}O$.
X.	XI.	T.	
C. 78.40 per cent.	78.34 per cent.	78.503 per cent.	78.43 per cent.
H. 11.19 “	11.22 “	11.189 “	11.12 “
O. 10.41 “	10.44 “	10.308 “	10.45 “
100.00 per cent.	100.00 per cent.	100.000 per cent.	100.00 per cent.

FRACTION VIII. (217°-218°)—Specific gravity at 16°C. 0.928. In the first analysis 0.1372 grams of oil, and in the second 0.1416 grams of oil were used with the following results, the formula corresponding most nearly to these being $C_{10}H_{18}O$.

Found.			Calculated for $C_{10}H_{18}O$.
I.	II.	Average.	
C. 78.21 per cent.	78.00 per cent.	78.105 per cent.	77.922 per cent.
H. 11.62 “	11.69 “	11.655 “	11.688 “
O. 10.17 “	10.31 “	10.240 “	10.390 “
100.00 per cent.	100.00 per cent.	100.000 per cent.	100.000 per cent.

VAPOR-DENSITIES.—These were determined by V. and C. Meyer's method. See "Berichte der deutschen chemischen Gesellschaft," 1877, page 2253. Paraffin was used as the bath and heated to from 10°-20°C. above the boiling point of the oil. The density of the vapor is calculated by the formula:

$$\frac{S. 760 (1 + 0.003665 t)}{(B-W) V. 0.001293.} \quad \text{or} \quad \frac{S. (1 + 0.003665 t) 587780.}{(B-W) V.}$$

This gives the density in comparison with air, and then by multiplying by 14.45 we get the vapor-density compared with hydrogen, which equals one-half the molecular weight.

S denotes the amount of oil. T is the temperature of the water. B is the barometric pressure reduced to 0°C. W is the tension of aqueous vapor, and V is the volume of air displaced. 0.003665 is the coefficient of the thermal expansion of gases. 0.001293 is the weight of a cubic-centimetre of air at 0°C. and 760 m.m. pressure. 587780 is a figure obtained by dividing 760 by 0.001293.

Fraction VIII. (217°-218°).—First determination: 0.0467 gms. of oil were used at 759 m.m. pressure and 20° C.; 7.5 c.c. of air were displaced, the temperature of the water being 14° C., which gives a vapor-density of 75.24+.

Second determination: 0.0574 gms. of oil were used at 759 m.m. pressure, and 20° C. ; 8.8 c.c. of air were displaced, the temperature of the water being 16° C., which gives a vapor-density of 79.37. The average of these two determinations is 77.31. The average percentage composition obtained by ultimate analysis is C 78.105 %; H 11.655 %; O 10.240 %, and the formula corresponding most nearly is C₁₀H₁₈O.

Half the molecular weight of C₁₀H₁₈O is 77.00.

Half the molecular weight obtained by calculation from the vapor-density is 77.30.

Fraction T. (220°-225°).—First determination: 0.0406 gms. of oil were used at 767 m.m. pressure, and 21°C.; 6.5 ex. of air were displaced, the temperature of the water being 22°C., which gives a vapor-density of 76.88.

Second determination: 0.0499 gms. of oil were used at 767 m.m. pressure, and 22°C. ; 8.2 c.c. of air were displaced, the temperature of the water being 22°C., which gives a vapor-density of 75.05 +.

The average of these two determinations is 76.97+. The percentage composition obtained by ultimate analysis is C 78.503%; H 11.189%; O 10.308%, and the formula corresponding most nearly to this is C₁₀H₁₇O.

Half the molecular weight of C₁₀H₁₇O is 76.50.

Half the molecular weight obtained by calculation from the vapor-density is 75.97.

Fraction II. (165°-170°).—0.0487 gms. of oil were used at 759.5 m.m. pressure, and 25°C.; 12.2 c.c. of air were displaced, the temperature of the water being 23°C. This gives a vapor-density of 50.18+.

The average percentage composition obtained by ultimate analysis is C 72.106%; H 12.164%, and O 15.730%. The formula corresponding most nearly to this is $C_6H_{12}O$.

Half the molecular weight of $C_6H_{12}O$ is 50.00.

Half the molecular weight obtained by calculation from the vapor-density is 50.18.

Polarization. The rotatory power was determined by a Wild polari-strobometer or shadow polarimeter; both the 100 and 200 millimeter tubes were used, but as the former only serves to determine whether the substance is dextrogyre or laevogyre, only the figures obtained with the latter are given.

Original oil boiling from	180°–206°C	+46.0
Fraction T.	“ “ 220°–225°	+45.6
“ IX	“ “ 218°–220°C	+44.6
“ VIII.	“ “ 217°–218°	+43.6
“ VI.	“ “ 200°–215°	–11.0
“ V.	“ “ 185°–200°	–20.0
“ IV.	“ “ 180°–185°	–25.9

Analysis of the Acids.—About 150 grams of the original oil were repeatedly shaken with water, until the separated water had a neutral reaction, this was marked X¹, and set aside for further examination. The oil was then shaken with lime-water to take out any remaining acid, until after filtering, the oil had a neutral reaction. A portion of it was placed in a flask connected with an upright condenser, the top of which was connected with a piece of glass tubing so that the end dipped beneath the surface of water, contained in a test-tube, so as to absorb any volatile substance which might possibly not have been condensed. After taking this precaution the oil was actively boiled for three hours. The water in the test-tube was then tested and found to be neutral. Water was next poured into the condenser, to wash down any remaining substance into the flask containing the oil, and the flask was well shaken; the oil and water separated, both giving neutral reactions with test paper.

The remaining portion of the oil was distilled; all of the distillates, obtained at different temperatures, gave a neutral reaction, when tested with test paper, thus showing that no acid is liberated by the decomposition of a compound ether in the oil, on boiling or distilling, but that all of the acid present is in a free state.

Portion X—This acid solution was treated with barium carbonate in excess, filtered and evaporated over sulphuric acid; a sticky mass and only a few crystals were obtained. This was dissolved in water, filtered from the excess of barium carbonate, and the filtrate evaporated to dryness on a water-bath, when a large quantity of

crystals was obtained which were again dissolved in water; on evaporating the solution over sulphuric acid again a sticky mass was left. This was dissolved and gave the following reactions:

I. With solution of ferric chloride a bright-red color was produced, which, on heating, gave a slight precipitate.

II. With solution of silver nitrate a white precipitate, which, on slightly heating, was soon reduced.

III. With solution of mercuric chloride a white precipitate, reduced, when heated for some time.

IV. When heated gently with sulphuric acid and alcohol, an odor resembling formic ether was produced.

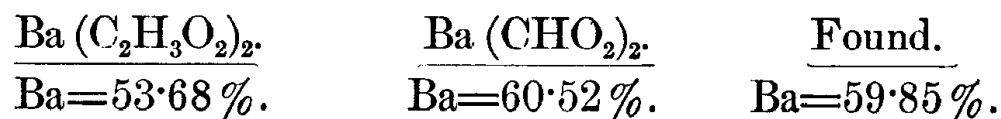
These all seem to show the presence of a formate, especially reactions III. and IV. Reactions I. and II may have been partly caused by an acetate, as will be seen by the following experiments:

V. To a small quantity of the barium solution very dilute sulphuric acid was added as long as a precipitate was produced, filtered, distilled and treated with magnesium oxide (See method of Dr. A. Meyer, *Chemische Analyse*, page 55), which on evaporation remained somewhat sticky while warm.

VI. 0.216 gms. of the barium salt were dissolved in water; very dilute sulphuric acid was added as long as a precipitate formed; the liquid was filtered, the precipitate dried and weighed, giving 0.220 gms. of barium sulphate. The percentage of barium present was calculated as follows: 232.8: 136.8: : .220: .1292;

Then .216: .1292:: .100: 59.85.

Calculated:



VII. The acid set free in the foregoing reaction was treated with excess of freshly precipitated carbonate of lead, filtered, evaporated and treated with alcohol and filtered; only a small amount was found to have been dissolved, an aqueous solution of which gave with mercuric chloride no precipitate, but, with ferric chloride a bright-red color showing the absence of formic and the presence of acetic acid. The portion insoluble in alcohol was dissolved in water, and gave a white precipitate with solution of silver nitrate, reduced on heating. Thus it will be seen that reactions V., VI. and VII. show the presence of a small quantity of acetic acid. X1 gave the same reactions for formic and acetic acids as X.

Crystals found in the broken flask.—The flask was first rinsed with petroleum spirit and allowed to evaporate, but no crystals were observed. The flask was then rinsed with ether, and evaporated, showing a number of small needle-shaped crystals on the side of the beaker. on heating a few of these they were found to be easily volatilized. The flask was rinsed with more ether, which was added to the crystals, to evaporate over night, with a view of obtaining a larger quantity, but unfortunately the ether drove the crystals up the sides of the beaker, into the filtering paper used as a cover, and so were lost.

Experiments with hydrochloric acid.—I. Portions of different fractions of the oil were placed in a freezing mixture and dry hydrochloric gas passed in until saturated. They at first acquired a dark color, which on standing gradually became lighter, but nothing separated out.

II. Other portions of these fractions were shaken with ether, and saturated with dry hydrochloric acid gas (See). Wallach, in "*Annalen der Chemie*," vol. 239, 1), but with no better result.

III. Other portions were shaken with glacial acetic acid and saturated with dry hydrochloric acid gas, with the same result as before.

EXPERIMENTS WITH ZINC DUST AND METALLIC SODIUM.

Several light fractions were treated with these substances separately and distilled, with a view of obtaining a hydrocarbon if possible, but without success. The residue left in the still was a yellowish, sticky mass, showing a decomposition of oil. Two ultimate analyses were, made of a fraction boiling between 180°-185°C. as follows:

In the first 0.1125 grams and in the second 0.1175 grams of oil were used.

The formula corresponding most nearly is $C_{23}H_{39}O$.

		Found.			Calculated.
		I.	II.	Average.	for $C_{23}H_{39}O$.
C.	83.44 per cent.	83.37 per cent.	83.405 per cent.	83.38 per cent.	83.38 per cent.
H.	11.85 "	11.63 "	11.740 "	11.78 "	11.78 "
O.	4.71 "	5.00 "	4.855 "	4.84 "	4.84 "
100.00 per cent.		100.00 per cent.	100.000 per cent.	100.00 per cent.	

Summary.—The results of the analysis may be summarized as follows:

I. A body of the composition of $C_{10}H_{18}O$, boiling from 217°-218°C. and constituting about 33% of the original oil.

II. A body of the composition of $C_{10}H_{17}O$, boiling from 220°-225°C. and constituting about 12% of the oil.

III. A body of the composition of $C_6H_{12}O$, boiling from 165°-170° and constituting

about 0.7 % of the oil.

IV. Formic acid existing in a free state about 0.5 %

V. Acetic acid also in a free state a small quantity only.

Specimens of seven different fractions and also the decomposition product, obtained on distilling the oil which had been treated with metallic sodium, are banded in with this essay.

The oil was obtained from a reliable wholesale house of this city, and known to be pure.

The investigation was conducted in the chemical laboratory of the Philadelphia College of Pharmacy, and under the supervision of Professor Henry Trimble.

Note by the Editor.—In the October number (1887) of this Journal, page 535, will be found a synopsis of the results obtained by Mr. Kremers, whose paper has been referred to in the foregoing essay. To facilitate the comparing of the results obtained with oil of pennyroyal by the two investigators, we append the summary prepared by Mr. Kremers, according to which oil of pennyroyal was found to contain :

1. A low boiling alcohol, the products obtained from two different quantities of oil, and, according to slightly modified processes, apparently differing. The nature of this body, therefore, remains to be determined.

11. A body of the composition $C_{10}H_{18}O$, which may be designated as hedeomol, occurring in two modifications of different boiling points. Their derivatives and oxidation products remain to be studied.

III. Formic acid:

1. Its salt became reduced almost immediately.
2. Its barium salt reduces $HgCl_2$ to $HgCl$.
3. Its lead salt is insoluble in alcohol.

IV. Acetic acid:

1. Its iron salt is soluble in water, imparting to it a bright red color, and becomes precipitated on boiling.
2. Its silver salt is white, and does not become darkened within five minutes.
3. Its lead salt, when heated with arsenic trioxide, gives the kakodyl reaction.
4. The free acid causes the formation of white fumes with ammonia.

V. Isoheptoic acid:

1. Determined by the analysis of its salts.
2. Its barium salt is amorphous and readily soluble in water, which distinguishes it from the normal heptoic acid.

APOCYNUM CANNABINUM.
By Henry A. C. Poppenhusen, Ph. G.

From an inaugural essay.

The commercial roots are nearly cylindrical, rather long, from three sixteenths to one half inch thick, longitudinally wrinkled. The bark of the thinner ones is transversely fissured. It has but few branches. Externally it is of a brownish appearance and internally whitish, breaking with a very short fracture. When pounded in a mortar, the bark is readily reduced to a powder, but the woody portion becomes spongy and very resistant. Odor faint, but peculiar; taste very lasting and persistently bitter, the woody portion almost tasteless.

Structure.—The bark is about as thick as the wood, consisting of an outer thin layer of cork and an inner fleshy layer made up of parenchyma, which contains laticiferous ducts and small patches of resin. The cells of parenchyma are filled with starch.

The central portion consists of a small central pith, of wood-wedges which are very narrow, and separated by delicate medullary rays, and of ducts, forming concentric circles.

A longitudinal section shows the ducts to be scalariform in appearance when enlarged about ninety diameters. They are then very plain and are of a beautiful appearance. (See also AMERICAN JOURNAL OF PHARMACY 1881, p. 510 and 551.)

Portions of the upper stem were found attached to some of the roots, of which sections were made and examined. The greater portion consists of woody tissue enclosing a large central pith. The bark consists chiefly of bast tissue, which is very fibrous.

Analysis.—The roots for analytical examination were reduced to a very fine powder (No. 100). Only a qualitative examination was made; which was carried out after the directions in "Dragendorff's Plant Analysis."

Three grams of the powdered root were heated upon a water bath for several hours, for determining the moisture, which equaled to .285 gram, or 9.5 per cent. This dry drug was then subjected to a high heat with the addition of a small quantity of nitrate of ammonium after carbonization for completing incineration. The total amount of ash equaled .35 gram or 11.6 per cent.; it contained iron in traces, aluminium and potassium, combined with sulphuric and hydrochloric acids.

Ten grams were treated in succession with the different solvents in a graduated bottle by maceration, for a period of eight days, shaking the bottle frequently. The extract obtained by treatment with petroleum benzin was found to contain wax, fat and some resin. The ether extract yielded about two-thirds of its weight to absolute alcohol, and the residue was insoluble in water; the extract contained a crystallizable resin and a glucoside, the latter soluble in alcohol, and decomposed by boiling with dilute hydrochloric acid.

About twenty-eight per cent. of the extract obtained with absolute alcohol was soluble in water, and it was totally insoluble in ether; it contained tannin, glucose, a glucoside, bitter principle, etc., but no alkaloid.

The water extract of the drug contained mucilage, albuminoids, an organic acid, etc., and yielded an ash weighing nearly seven per cent. of its weight. Diluted alkali took up from the drug mucilage, albuminoids, phlobaphene and other principles; and in the extract made with dilute acid parabin was found, but no calcium oxalate.

Starch, resin and mucilage were also recognized microchemically in the drug.

A portion of the drug was carefully separated into wood and bark the latter weighed 62.25 per cent. of the weight of the drug, and yielded notably larger amounts of extract than the entire root, with both ether and alcohol.

MOSS MUCILAGES AS EMULSIFIERS.

By Albert John Staudt, Ph. G.

From an inaugural essay.

The new National Formulary, which is in course of preparation under the direction of the National Formulary Committee, appointed by the American Pharmaceutical Association, having adopted as emulsifier for fixed oils the mucilage obtained from Irish moss, a species of algae, which yields a mucilaginous jelly with water, it was thought not inappropriate to investigate the subject of so called moss mucilages and determine their value for the dispensing pharmacist as a substitute for the well known gum acacia. This mucilage is present in certain thallophytes, like the officinal *Chondrus* or Irish moss, and *Cetraria* or Iceland moss.

The last recorded examination of Irish moss was made by Church in 1877, who found its composition to be as follows: Mucilage, 55.4; water, 18.8; mineral matter, 14.2; albuminoids, 9.4; and cellulose, 2.2. As may be seen the principal constituent is mucilage, which may be obtained by boiling the drug with water, straining and allowing to cool. Although the mucilage thus formed, in comparison with other mucilages, keeps fairly well, it in time, becomes mouldy on top and no longer fit for use, hence it is scarcely appropriate for the dispensing pharmacist to use except when freshly made; and to the manufacturer who could use a large quantity of the fresh mucilage it would serve admirably as an emulsifier.

Mr. Emlen Painter, of New York, thinking it would be very desirable if this mucilage could in some way be preserved, made a few experiments to this end, the results of which he read at the last meeting of the American Pharmaceutical Association; but all attempts to preserve the mucilage being unsuccessful, the only method remaining to present the Irish moss in a form that could be kept on hand by the pharmacist was by evaporating the mucilage to dryness and forming a gelatin; and to this end I also directed my efforts. I took four ounces of good, bleached Irish moss, and first washed it well in cold water, removing admixtures and impurities, then placed it on a steam bath, with two hundred ounces of water, and by the aid of steam under pressure was

able to obtain a constant and safe beat. After continuing this heat for a half hour, with frequent stirring, the mixture was transferred to a strong muslin strainer, which had previously been soaked in warm water, and although a slow process, by taking the precaution to use no pressure, but to constantly keep a clean surface on the bottom of the strainer by means of a wooden stirrer, a clear mucilaginous liquid was obtained, which, upon cooling, was found to be in the form of a jelly.

This mixture was again transferred to the steam bath and evaporated, with constant stirring, to a semi-fluid consistence, when it was spread as evenly as possible on all sides of the kettle, and the heat continued until a perfectly dry gelatin was formed. Upon cooling the kettle by passing a stream of cold water through the jacketed portion, I was able, by careful manipulation, to remove the gelatin in one entire piece, which was afterwards cut in strips suitable for use. It is, thin, yellowish brown in color, light, and slightly translucent, breaking with a short fracture, but not enough so to be brought to a powder under the pestle. While it is but sparingly soluble in cold water, it dissolves completely in boiling water, and a mucilage may in this way be obtained resembling in appearance and viscosity the acacia preparation, and possessing as little taste.

Emulsions were first prepared by agitation as suggested by Mr. Painter (see AMERICAN JOURNAL OF PHARMACY, 1887, p. 535); 10 grains of Irish moss gelatin were dissolved in 1 $\frac{1}{4}$ ounces of boiling water, an operation taking some ten minutes time. After the mucilage had become perfectly cold, a precaution always to be observed, it was transferred to a four-ounce bottle; and 2 ounces of cod liver oil were gradually added in divided portions, shaking vigorously after each addition until a perfect emulsion was formed; $\frac{1}{2}$ ounce of syrup and three drops of oil of wintergreen were added and lastly, enough water to make four fluid-ounces shaking the whole thoroughly together.

The emulsions thus formed seem to be practically inseparable, they having stood for over three months showing no apparent separation. Examined under the microscope the particles of oil are not so minutely or uniformly divided as in emulsions made by some other agents, or made in a mortar in the usual way.

An emulsion was also prepared according to the same formula, by mixing the mucilage of Irish moss with the oil and other ingredients in a mortar in the usual way for preparing emulsions with acacia, instead of in a bottle as before. Examined under the microscope it was found to be almost perfect, the particles of oil being very uniformly and minutely divided. But as to its standing qualities it appears to be not better than those made by simply shaking in a bottle. It is not always the most perfect emulsion as seen under the microscope, that stands the best and is the best, but those in which the oil is not so finely divided often stand without separation longer than the others.

Iceland moss is officinal in the Pharmacopoeia as *Cetraria*, species *Cetraria islandica*.

Its principal constituent is lichenin, which may be obtained as a starchy, mucilaginous substance by boiling the drug in water. The bitter taste is due to

cetraric acid, or cetrarin, which may be removed by treating with a weak alkaline solution. In preparing the Iceland moss gelatin for trial as an emulsifier, the operation was conducted in the manner given above for making the Irish moss gelatin, excepting that the Iceland moss was first garbled and then macerated for two hours in tepid water containing a little carbonate of sodium in solution and afterwards washed well in cold water. The four ounces of cetraria used yielded one ounce of gelatin, or twenty-five per cent. less than the amount obtained from the same quantity of Irish moss. It has a slightly brownish color, is semi-transparent and somewhat hygroscopic, as when freshly made it had a decidedly short fracture, while in a few days it was found to be very pliable and even tough.

On attempting to make an emulsion according to the formula given above, using Iceland moss gelatin in place of the Irish moss gelatin, it was a complete failure, the mucilage apparently not having the adhesive qualities necessary; but upon the addition of a small quantity of gum acacia to it an emulsion was easily formed, which, although it separates in a short time, readily shakes up to a fairly good emulsion.

In conclusion I would say that while the mucilage prepared from Irish moss has proved to be a sure and safe emulsifier, I doubt its advantage over gum acacia to the dispensing pharmacist in prescription use, excepting, as remarked before, where it could be used when freshly made in making a stock emulsion or a large quantity at one time.

The difficulty experienced with the apparatus at the command of the pharmacist, and the time occupied in making a good quality of the gelatin and again in making the mucilage from the gelatin, and allowing it to cool, when required for use, places gum acacia *first* as an excellent emulsifier when rightly used, both as to convenience, time occupied and quality of the emulsion, and expense also if the pharmacist figures time necessary to the manufacture of the gelatin.

PATCHOULI OIL AND LEAVES.

In the March issue of the *Kew Bulletin* a few pages are devoted to information of a botanical and commercial character regarding *Pogostemon Patchouli*, the herb from which the patchouli oil of commerce is obtained, and about which, although patchouli was introduced into this country nearly forty-five years ago, much uncertainty still appears to prevail. The information collected by the Kew authorities is therefore doubly welcome, in so far as it serves to clear up certain points at issue concerning the habitat and varieties of the plant.

The supply of the dried herb as well as of the oil of patchouli has lately been very uncertain and insufficient, probably because the steamers plying between Europe and the Indian ports, from which the article is mostly shipped (viz. Penang and Singapore), refuse to accept consignments of patchouli on account of the danger that the powerful odor of the oil may be communicated to other goods stored in the vicinity. It is scarcely possible that such communication could take place to any inconvenient extent if the patchouli were packed with sufficient care, and if the goods placed in the immediate neighborhood of the shipment were selected with some discrimination. But

the fact remains that for a considerable time there has been a great scarcity, and that a market could be found in Europe for considerable quantities of fine leaves and pure oil, as patchouli, though perhaps its popularity as a perfume is slightly on the wane, is still used largely in conjunction with other essential oils, notably otto of rose, while the dried leaves are well liked as a sachet powder. Peisse, in fact, states that if the oil could be obtained more cheaply, the consumption would be increased tenfold. Planters in the Straits Settlements appear to have paid close attention lately to the propagation of the plant, and the head of the Straits Settlement Forest Department announces that during the year 1886 there has been a steady inquiry for young plants, which are easy of cultivation, and require but little attention. In August 1886 samples of three different varieties of patchouli were sent home to the Kew authorities, with a request for information concerning their commercial value and employment in Europe. The first two samples consisted of selected leaves of the entire flowering tops, the system of drying having been the same for both. The third represented leaves of the *Urena lobata*, which are used in the East to adulterate the true patchouli. The *Urena lobata* grows wild to a large extent in the cocoa-nut gardens near the coast, and its leaves are worth, locally, 1 1/4d. to 1 1/2d. per lb., whereas, for true selected patchouli leaves, as much as 6 1/2d. per lb. is paid in Penang. The object of the Forest Department in sending home specimens of the adulterant was to know whether it contained any valuable ingredients or was merely added to the true herb in order to increase the bulk. The Kew authorities placed themselves in communication on the subject with a West-end firm of perfumers, a city wholesale drug-house, and a Mincing Lane importer of essential oils, but the answers of these three firms do not agree in every respect, The perfumers value the selected leaves at from 8 1/2d. to 10 3/4d. per lb., and the flower-tops at a less figure, on account of the worthless stalks, and they state, with regard to the adulterant, that they know it well, as it always occurs in the leaves bought by them for perfumery purposes. The value of the patchouli oil they consider to be 2s. 6d. to 3s. per oz. The wholesale drug firms value the selected leaves at 1s. per lb., and the flowering tops at 4d. to 5d. per lb. The adulterant, they say, is not known in the market, and is quite worthless. Lastly, the Mincing Lane importer estimates the picked leaves at 1s. to 1s. 3d., the tops at 9d. to 1s., and the oil, if pure, at 3s. to 3s. 9d. per oz. He also believes that from 10 to 20 tons of good leaves would find a brisk sale in London, while the wholesale druggists, on the other hand, advise shippers to be careful in not overloading the market, as a shipment of, say, 20 tons would probably cause prices to decline.

Whichever of these three advisers may be nearest the truth, it is pretty certain that patchouli is one of the few articles for which, at this moment, the demand exceeds the supply, and if shipments of good picked leaves could be quickly made to London, which is the central market, and whence the distillers in Germany and Southern France, as well as the American consumers, draw their requirements, the shippers would be able to pocket a very good profit. But it is not improbable that we shall soon receive supplies of patchouli leaves and oil from other than the accustomed quarters. In 1886 only 5,280 oz. of oil and some 18 cwt. of leaves were exported from Penang, whereas a few years previously the imports of leaves alone in London reached between 600 and 800 cwt. per annum. In 1886 a large German firm, with the idea of emancipating our market from its dependency upon the East, forwarded a supply of seeds to Paraguay, in South America, and, although the head of the Straits Settlement Forest

Department reports that "plants raised from seed are said to have no scent, but they retain it when produced from cutting," the German house seem confident that their efforts will be successful. Patchouli-growing is also being tried in the island of Dominica, and we hear that experiments are said to have been set on foot in Guadeloupe, Martinique, and other French West Indian possessions. Some years ago supplies of patchouli leaves of very good appearance, though somewhat deficient in aroma, used to be imported into Europe from Java, but this source appears to have dried up lately. A few months ago inquiries were made at Kew by the India Office whether patchouli was known to grow to any extent in Assam and on the Khasia Hills, and whether it could be cultivated in Bengal. To these inquiries reply was given that Professor Oliver, of Kew, thinks it doubtful whether the patchouli plant is indigenous in India at all, a view shared by Mr. Thiselton Dyer, who adds that he thinks it probable that China may prove its true habitat, an opinion contrary to the generally prevailing one, which is that it is the Malay Peninsula. At Kew nothing is known of the existence of any form of *Pogostemon Patchouli* in the Khasia or Assam region, but some varieties of the plant in the wild state are found in British India, from Bombay southwards, and a plant with a patchouli odor, believed to be a variety of *Plectranthus*, is thought to be indigenous to Assam. The shipments of very stalky and feebly aromatic root which reach us occasionally from Bombay are perhaps derived from the former species. In connection with this it may be stated that the idea of the patchouli herb being a native of China probably originates from the fact that the block ink imported from that country possesses a distinct odor of patchouli. The introduction of the perfume to the European market is said to be due to the Lyons shawl manufacturers who, finding that the Indian shawls were always strongly scented with patchouli, imported the oil from the East to scent goods of their own manufacture.—*Chemist and Druggist*, March 17th, 1888, p. 360.

ON COCA.

By DR. H. H. RUSBY.

From a lecture at the Philadelphia College of Pharmacy, December 1, 1887,
stenographically reported by Dr. C. H. Morgan.

As an indigenous plant coca is perhaps unknown. It frequently occurs in a wild state and in situations where escape seems to have been impossible. Yet, in some such cases I have traced its origin directly to escape from cultivation. So it is difficult to determine its origin in any case. The varieties of coca are two, the Peruvian and Bolivian. I have here some specimens of coca which I gathered myself and I can therefore bear witness to the accuracy of determination. The specimen which I hold in my right hand is Bolivian coca. It is the finest variety of coca which exists. You will observe there are two plants represented on this sheet. One is without leaves, they having been picked for the market. On the other the leaves still exist. Observe the size and form of these leaves, if it is not too far away from you. This is Peruvian coca which I hold in my left hand—just see what a difference there is in the form, in the size and in the texture of the leaf. This specimen I collected under peculiar circumstances.

There are two rivers which unite at this point, they come from near the foot of the mountain, one from Cuzco, Peru, and the other from La Paz, in Bolivia. Now all the way down this river coming from Bolivia we find the wild coca exists. It is of the Bolivian form, but as soon as we strike the other we find the larger leaves, the Peruvian form. So that here we have two species, or not two species, but two varieties.

Here we have a form of diseased coca, called Taja. It is probably a fungus which produces this peculiar condition. We know this condition can be produced in the leaf by simply picking them carelessly so that the twigs are wounded. Then when the new leaves are produced they present this appearance.

This is a sufficient comment upon the idea which has lately been advanced by a writer to the effect that some of the coca leaves which reach the market are beaten off from the plants with pole, an opinion which is evidently erroneous. If an attempt were made to beat the leaves from the plant with poles, the owner would never get another crop.

In this specimen the lines are much less prominent than in the cultivated form. Two other forms of coca which I have here, I should rather say not of coca, but of *Erythroxyton*, are distinct species growing throughout the Eastern section and even through Brazil.

I wish, gentlemen, I had time to show you all my specimens. Perhaps many of you would be as much interested in them as I am myself, but it impossible for me to do so.

These two varieties of coca, the Bolivian and the Peruvian, are so different that one Bolivian writer has described the Bolivian form under the name of *Erythroxyton Bolivianum*. The name, however, is not correct, both are *Erythroxyton Coca*. I am not certain, however, that these two cultivated forms have not descended from distinct species. The two varieties are distinguished not only by the leaves but by the fruits which are much larger in the Bolivian species, while the leaves are much larger in the Peruvian species. The Bolivian variety is much higher esteemed by the Peruvians, they saving enough from their scanty earnings to purchase one-third of the Bolivian product, although you can obtain the native article at a much lower price. As you are students of Pharmacy, and I think are about to study up the subject, perhaps a few facts on the chemical constituents of the leaves might be interesting and I will give them to you very briefly.

You are aware that there are two methods of estimating the cocaine which the coca leaves contain. The first is to extract it in the pure form and weigh it. This method was impossible for me, traveling as I was through the country and not being able to carry the necessary apparatus, especially a balance, I was therefore obliged to resort to the test by titration, and this test is about as follows: We obtain the cocaine in an aqueous acid solution, about two drams of the solution representing two and one-half grams of leaves. This can now be tested with Mayer's reagent. As the precipitate is formed this precipitate is filtered, and the reagent again added. When no more precipitation occurs we assume that the right amount of reagent has been used, and for every cubic centimeter so used we have eight milligrams of cocaine in the leaves.

Now, estimating by this test in this country the leaves will yield from about one-half to three-quarters of one per cent. of cocaine. As I estimated them in their own country, the leaves being fresh or recently dried, taking an equal weight of fresh leaves, drying them, and then assaying them, I obtained from two to four per cent. of cocaine. I took specimens of the same leaves which I had thus assayed and sent them to the United States, where they were assayed and they yielded the same amount which they are said to yield in this country, namely, from one-half to three-fourths of one percent. It was evident that I had made a mistake in my process or that the composition of the leaves was very different in their own home. On my return to La Plaz for the second time I made a very elaborate series of experiments, looking towards the assaying of the different parts of the plants. I took the best methods I could, collecting and drying at the proper time of the year, taking into account the age of the leaves, and I found my former results confirmed.

But I found on this occasion that on rendering my solution slightly alkaline and washing it with ether, the ether carried away only the cocaine, which was found to be about three-fourths of one per cent., as in this country. This is then, one of the means of accounting for the difference, an entirely different substance from the cocaine, but producing the same reaction with Mayer's reagent, being left behind in the alkaline aqueous solution. This, then, seems to prove that the composition of the leaves is different in their own home from what it is after they are exported. Certainly those who have read anything on this subject must be aware that the effects alleged to be produced in this country by preparations of the exported leaves are very different from those which have been reported to us from its own home. For three centuries we have been hearing from travelers who have visited that country, some of them among the most eminent scientists like Humboldt, Poeppig, and others, of the wonderful effects which coca produces on the natives, the Indians, who chew it. I can only add my testimony to that which has gone before; it is useless to go over it as you all know about it. Every one has read it fifty times, and every one has read and knows what the physicians of Europe and the United States say about it. Those who have tested the exported leaves have found that they produced no such effects. I think the effects of coca chewing are produced in two ways. In the first place we know that if a man is obliged to put forth a certain amount of exertion it tires him to a certain definite extent. Supposing now that he is suffering some severe bodily pain at the time he puts forth this exertion, his fatigue would be very much greater. Part only of the fatigue is due to the muscular exertion which he makes; the other part must be mainly from the nervous waste which is added to the physical waste. This waste, then, which is produced by the suffering, this nervous waste, could be very easily produced by that most acute of all suffering, namely, long continued hunger. These people seldom have enough to eat. They must carry their food with them, and are unable to carry enough for their long journeys. By the chewing of coca leaves the sensation of hunger is deadened; they are freed from this kind of nervous waste of which I have spoken. This will account in part for the beneficial result of the free use of coca. But only in part. There is besides a kind of stimulation resulting from eating these leaves, entirely different from that produced by cocaine or the preparations of coca as we obtain them here.