THE ANALYSIS OF LIQUID AND AROMATIC EXTRACTS OF CASCARA SAGRADA, AND THE INTRODUCTION OF A MANGANESE NUMBER FOR THE SAME.*

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Much work[1] has been carried out in connection with the examination of *Rhamnus purshiana* bark (cascara sagrada) from the viewpoint of establishing its various constituents and their chemical nature. For the analyst who is called upon to examine extracts of this drug there is no very definite data or procedure available and the relative meaning of constants obtained is not easily judged from results so far published. When it is considered that anywhere from 500 to 2,000 tons of this bark comes upon the American market annually, it would seem that more than odd partial analyses of extracts and trade preparations made from it would be of some value. Having the opportunity to work on a very large number of different samples, we have attempted to supply some general averages for constants observed from commercial samples just as they are found on the market. The most important objective was, however, to devise a means of estimating quantitatively the amount of actual cascara extractive present. Within limits this has been done by the development of a manganese number for these extracts.

Tichborne[2] reports the examination of some 29 samples of liquid extract of cascara sagrada. He found that liquid extracts of this drug when prepared according to B. P. methods yielded 24 to 25% solids. The drying and non-drying properties of these preparations were examined. The non-drying samples were found to contain glycerin, and excessive reduction with Fehling's solution was taken as an indication of adulteration of the sample. Mort and Rothe[3] reports the analysis of a single sample of cascara. The tests they make are in no respect very distinctive.

Before approaching work of this kind a comparative knowledge of the requirements of the various pharmacopoeias is essential as a constant guide. This information is outlined below for the reason that there seems to exist sufficient differences in methods of percolation to give rise to a wider range of values for certain determinations than is generally taken into account.

In the British Pharmacopoeia[4] and Codex, Cascara Sagrada is defined to be "The dried bark of *Rhamnus purshiana* D. C. and collected at least one year before being used." The official liquid preparations as defined in this edition are: (1) Liquid Extract of Cascara Sagrada containing the extract from 100 Gm. of No. 20 powder made up to 1000 Cc. with distilled water and 250 Cc. of 90% alcohol. Instructions are given to exhaust the bark with distilled water by the percolation process. This reads as follows:[1]

"Moisten the solid materials with the prescribed quantity of menstruum, set aside for four hours in a well closed vessel, pack in a percolator and add sufficient of the menstruum to saturate the materials and leave a layer of liquid above. Macerate for 24 hours. Then allow percolation to proceed slowly until the percolate measures about three-fourths of the volume required for the

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finished tincture. Press the marc, mix the expressed liquid with the percolate and add sufficient of the menstruum to produce the required volume. Clarify by subsidence or filtration if necessary."

Following this the percolate is evaporated to 600 Cc. and the alcohol, previously mixed with sufficient distilled water to produce the required volume, is added.[26] An aromatic Syrup of Cascara, containing liquid extract of cascara, tincture of orange, alcohol, cinnamon water, and syrup is also an official preparation. This syrup is a solution of sucrose and water of a Sp. Gr. of about 1.330. The B. P. Codex 1911 mentions[4] 17 extracts and compounds in which cascara may be employed. Four of these are compound tablets or pills. The rest are liquid, fluid, or aromatic extracts or mixtures. They may contain, in general, any combination of harmless aromatic oils, tinctures, licorice, glycerin, alcohol, alkalies, ammonia, or chloroform water. In order to destroy the natural bitter taste of the cascara, lime, magnesia, potassium hydroxide, ammonia, sodium and ammonium salts, and zinc oxide[8] have been used during percolation. Chloroform water is added to prevent active fermentation, while the use of alkalies follows from the incompatibility of extracts of cascara with acids or strong solutions of mineral salts.

Three official preparations are mentioned in the United States Pharmacopoeia. They are the extract[9], the fluidextract,[10] the aromatic fluidextract.[11] The fluidextract contains a gramme equivalent of the bark per Cc. as well as 250 Cc. of alcohol in every 1000 Cc. of standard extract. No. 40 powder is used and the method of percolation is as follows:[12]

"To 1000 Gm. of the dried drug add 5000 Cc. of boiling water, mix thoroughly and allow it to macerate in a covered container in a warm place for two hours. Then transfer the moist drug to a tinned or enamelled percolator and allow percolation to proceed, gradually adding boiling water until the drug is exhausted. Evaporate the percolate on a water bath to the volume specified and when cold add the alcohol directed and mix thoroughly."

The official aromatic fluidextract of cascara in U. S. P. is a product debittered by magnesium oxide and contains glycerin, licorice and alcohol along with small amounts of benzolsulphimide, methyl salicylate, oil of cinnamon, oil of anise, and oil of coriander.

In evaluating relatively a large number of preparations the following data grouped under various headings has been derived. We have divided the samples into two classes, as follows:

Class (1). Aromatic extracts of cascara sagrada and unofficial trade preparations containing licorice, glycerin and aromatics.

Class (2). Samples deemed to be genuine fluid extracts of cascara sagrada.

SPECIFIC GRAVITY

By this determination alone a close line may be drawn between those samples which are likely to prove to be aromatic and those likely to be found to be liquid or fluid extracts of cascara. Determinations were made directly at room temperature (20° C.) by means of a set of hydrometers. Finer work than this does not yield correspondingly more valuable results. The following table[13] deals with 136 samples, which are divided into two classes as defined above:

TABLE 1.

Class (1). Range of sp. pr.	No. of samples in range.
1.000 to 1.100	5
1.100 to 1.200	22
1.200 to 1.300	9
1.300 to 1.400	1
	37
Class (2).	
Below 1.030	None
1.030 to 1.040	1
1.040 to 1.050	3
1.050 to 1.060	14
1.060 to 1.070	33
1.070 to 1.080	40
1.080 to 1.090	4
1.090 to 1.100	4
	99

Squire's Companion to the B. P.[14] gives the Sp. Gr. of liquid extracts of cascara sagrada as 1.06. It would appear from our work that a suitable range would be from 1.05 to 1.08. Working by the method quoted above for B. P. percolation, we obtained on two trials, values of 1.058 and 1.057, as the Sp. Gr. of the finished extract. By the U. S. P. method, working on the same bark we obtained 1.078 and 1.079 as the Sp. Gr. of the extract thus prepared. It is thus necessary to recognize a large range in order to include all the possibly genuine samples. Preparations below this range could, by other determinations, be shown to be diluted extracts, while samples above this range invariably contain more solids than is normally possible to extract by any official method of percolation.

No such limits of Sp. Gr. as have been prescribed for fluid extracts of cascara sagrada can be laid down for preparations of the order of class (1). The Sp. Gr. of aromatic syrups of cascara B. P. and of aromatic fluidextract of cascara sagrada U. S. P. calculated from pharmacopoeal requirements, should be 1.17 and 1.18, respectively, and in class (1) 18 samples very closely approach these figures, yet from the Sp. Gr. alone it would be rash to infer that any given sample were one or the other of these official preparations. Indeed the majority of the samples in class (1) are not official, although the greater number show Sp. Grs. which are approximately those of the official aromatic preparations.

ALCOHOL.

The alcohol content V/V of the various official liquid preparations of cascara sagrada may be readily shown by reference to the requirements of the various pharmacopoeias to be approximately as follows:

Name of extract.	Alcohol V/V %.
Fluid Extract Cascara Sagrada B. P.	22.5
Aromatic Syr. Cascara Sagrada B. P.	13.5
Fluidextract Cascara Sagrada U. S. P.	24.0
Aromatic Cascara Sagrada U. S. P.	24.0

From an inspection of the above figures, and from consideration of the alco-

hol table which follows it may be seen to what extent these requirements have been met by the samples examined.

TABLE II.

Class (1). Range of alcohol.	Samples in range.
Below 1.0%	7
1.0 to 3.0	15
3.0 to 5.0	3
5.0 to 10.0	4
10.0 to 14.0	4
14.0 to 19.0	1
19.0 to 22.0	3
	37
Class (2).	
Below 10.0%	1
10.0 to 15.0	7
15.0 to 17.0	18
17.0 to 19.0	19
19.00 to 21.0	24
21.0 to 23.0	13
23.0 to 25.0	10
25.0 to 27.0	2
27.0 to 29.0	3
29.0 to 31.0	2
	99

It is evident that only a small proportion of the samples of either class comply strictly with pharmacopoeial requirements for alcohol.

TOTAL SOLIDS (MATTER NON-VOLATILE AT 110° C.).

Total solids were determined W/V by drying 10 Cc. portions of the extracts to constant weight in platinum. In this way aromatic and near aromatic extracts may be easily distinguished from genuine liquid extracts. This is due to the presence of licorice, glycerin or sugar in the former class, substances not present in the latter. The remarkable inconstancy of aromatic extracts and trade preparations is also very clearly shown from a tabulation of the data obtained by this determination. The table covers 136 samples.

TABLE III.

Class (1). Range of total solids.	Samples in range.	Class (2). Range of total solids.	Samples in range.
15.0 to 20.0%	1	Below 18.0%	6
20.0 to 30.0	3	18.0 to 20.0	5
30.0 to 40.0	5	20.0 to 25.0	27
40.0 to 50.0	8	25.0 to 30.0	45
50.0 to 60.0	7	30.0 to 35.0	16
60.0 to 70.0	5		—
70.0 to 80.0	4		99
80.0 to 90.0	3		
90.0 to 95.0	1		
	37		

The problem of relatively evaluating a fluid extract on the basis of its total solids is more complicated than would appear at first sight. Squire would allow a range of from 17 to 27%.[1] Reasonable commercial practice and theoretical possibilities conflict on this point. The chief causes of this variation are: (1) In the hands of different operators results obtained by the same official method of percolation may differ. (2) The Official U. S. P. and B. P. methods of percolation themselves differ and yield correspondingly different results in extracting the same drug.

We extracted two 50 Gm. samples of genuine cascara bark by the B. P. method of percolation and obtained two liquid extracts yielding 21.79 and 21.03% of total solids. Working on equal amounts of the same bark, but following the official method of U. S. P. percolation, we obtained extracts yielding 30.50 and 31.48% of total solids. This difference may be traced directly to the variation of pharmacopoeial directions. The U. S. P. requires the drug to be exhausted with boiling water, and the percolate, to be evaporated to a definite volume. Neither the amount of boiling water to be used nor the size of the portions are specified. We found the volume of water necessary to completely exhaust the cascara bark to be exceedingly large compared with the volume to which the percolate must subsequently be evaporated. To completely exhaust 50 Gm. bark 2000 Cc. of boiling water in 75 Cc. portions were required, and this had to be evaporated to 37.5 Cc. Such a rigorous extraction, although theoretically official, would be very impractical commercially. At the same time it may be pointed out that extracts of cascara sagrada containing a greater proportion of total solids than Squire would allow may very readily be prepared by following official methods of percolation.

A well-known firm of manufacturing pharmacists in a private communication supplied us with data relative to the possibility of obtaining a uniform extract from cascara bark. Out of 24 lots of this drug, working on a commercial basis, the extractive never fell below 18.8% and exceeded 22% in only one instance. On this particular lot the extractive measured 26.6%. They were using the official U. S. P. method of percolation. It seems evident then that the official methods may be translated into a number of uniform procedures which may differ in results over a wide range according as the detail varies. All these considerations must be taken into account before passing an opinion on any sample based on a determination of its total solids.

SOLIDS PRECIPITATED ON DILUTION WITH WATER.

On dilution with water an aromatic extract of cascara sagrada which contains licorice or glycerin in pharmacopoeial proportions will retain all its solids in solution. On the other hand, a liquid extract of cascara whose solids are held in solution by virtue of its alcohol content will, when diluted, give a measurable precipitation, when the alcohol content drops below 10.0%. Our determination of this value was made by dropping 5 Cc. of extract into 95 Cc. of water and filtering off on a tared filter.

We tested 75 samples in this manner with the following results:

TABLE IV.

Class (1). Range of solids precipitated on dilution.	Number of samples in range.	
None	20	
1.0 to 2.0%	2	
	22	
Class (2).		
None	1	(this sample contained only 3% alcohol and no precipitation was to be expected.)
0.5 to 1.0%	5	
1.0 to 2.0	24	
2.0 to 3.0	17	
3.0 to 4.0	4	
4.0 to 4.5	2	
	53	

It is more than probable that any sample of Class 2 that is found to give less than 1.5% solids on dilution by this method will be found to be a diluted extract, from alcohol or other determinations.

REDUCING SUGARS.

We adopted the practice of making up to a definite volume the filtrate from the determination of solids on dilution and determining the reducing sugars in an aliquot thereof by means of Fehling's solution. In our results sugars are reported as glucose. There is evidently a normal content of such sugars for genuine fluid extracts of cascara sagrada, which varies within quite narrow limits from 5 to 7.5%. Aromatic extracts are always much lower than this and run from 1 to 3%.

TABLE V.

Class (1). Range of reducing sugars calculated as glucose.	No. of samples.	Class (2). Range of reducing sugars calculated as glucose.	No. of samples.
0.0 to 5%	16	4.0 to 5.0%	9
5.0 to 10.0	7	5.0 to 8.0	33
	23	8.0 to 10.0	12
			54

All genuine aromatic extracts in Class 1 come in the group from 0.0 to 5.0%. Samples above this range in this class are nondescript trade preparations. All samples in Class (2) running above 7% gave abnormally high total solids.

LICORICE, GLYCERIN AND AROMATICS.

These substances are used to disguise the bitter taste of the cascara. No quantitative work was attempted save in the case of glycerin and even in this case an exact determination presents considerable difficulty. An approximation was arrived at by the method of boiling off the glycerin in steam. Ten Cc. of the aromatic extract were slowly heated to 160° C. and by the addition of small quantities of water from time to time, the glycerin was boiled off. The difference in weight between the solids remaining at this temperature and those remaining after drying at 110° C. was considered to represent the glycerin. A certain increase in weight occurs owing to the slow oxidation of cascara solids at 160° C. and it is also possible that some glycerin may become non-volatile during the

process. The sum total of these errors as determined through such suitable blanks as could be devised is not sufficient to destroy the usefulness of the method. The former is the greater of the two errors and may account to a 2% increase of the total solids present after 8 hours at 160° C. By subjecting a mixture of pure glycerin and cascara extract to this treatment it was found that practically all the glycerin could be driven off. It may be calculated that there should be about 25% of glycerin W/V present in U. S. P. aromatic extract of cascara sagrada. Out of 17 samples examined 8 contained less than this amount. The exposure of a few drops of cascara extract on a porcelain plate[16] serves as a very simple and useful test of the nature of any cascara extract. A genuine liquid extract will dry up in a short time to a hard glassy varnish; an extract containing licorice or glycerin will not dry up even after long exposure over days and weeks, while an extract which has been so diluted as to lose the solids held in solution by virtue of its alcohol forms a sticky semi-crystalline mass which does not lose its stickiness for some days. All aromatic extracts examined were found to be non-drying, owing to their licorice and glycerin content.

ASH.

The value of an ash determination becomes evident from a consideration of its variation. If some attempt has been made to debitter the extract by application of lime, or application of the ordinary alkaline debitterants it is quite possible that through contamination or solution these might greatly increase the amount of ash. We found this to be the case. The color of the ash when heated strongly in a muffle is also a good indication of the nature of the sample. The ash from an aromatic extract containing licorice and glycerin will be greyish white; that from samples containing excess of lime salts will be pure white, while the ash of a genuine extract will be some shade of green, depending upon the amount of manganites present. This manganese comes from the bark and is sufficiently soluble in water to be found in this way in the ash. The calcium in the ash is not a constituent which might result from solution of the calcium salts of the bark during percolation. These salts are not removed to any extent by boiling the bark in water but are evidently present in the plant as oxalates and carbonates. From an inspection of the following table it will be seen that samples in Class (1) give ash values of a very wide range. In Class (2), however, the variation would seem to be within more reasonable limits.

TABLE VI.

Class (1).		Class (2).	
Range of ash.	No. of samples.	Range of ash.	No. of samples.
Below 1%	1	Below 0.5%	1
1.0 to 1.5	1	0.5 to 1.0	33
1.5 to 2.0	2	1.0 to 1.5	18
2.0 to 2.5	3	1.5 to 2.0	5
2.5 to 3.0	0	2.0 to 2.5	1
3.0 to 3.5	1	Above 2.5	1
3.5 to 4.0	8		—
4.0 to 5.0	1		59
5.0 to 5.5	2		
	—		
	19		

It would seem from our work that a range of 0.75 to 1.1% for the ash of genuine fluid extracts of cascara would not be unjust. Any extracts yielding ash above or below these limits were found to be abnormal in some other respect.

COLOR REACTIONS AND TESTS.

Hubbard[17] reviews the generally known color reactions for the emodin-bearing drugs and we shall not attempt to do more than supplement this work. The presence of emodin (trihydroxymethylanthraquinone) is characteristic of rhubarb, aloes, senna, and cascara. These substances, from their properties, may be found at any time in admixture. The Bornträger[18] reaction is the most convenient means of testing for this class of drugs. The well washed benzol extract of a few Cc. of the acidulated sample is made alkaline. In the presence of emodin a deep red color will appear in the water layer.

Cascara extract will give this test in greater dilution than any other common emodin-bearing drug while senna may fail to respond easily to the test. It must always be remembered that phenolphthalein may also be present. It may be removed by the method of Warren.[19] There is a difference between the colors given by emodin alone and by phenolphthalein alone, in alkaline solution, that is easily distinguished by the eye. The emodin color is a deep red and more like methyl orange in acid solution, while the color from phenolphthalein is a deep pink. In admixture the color is quite distinct from either individual colors, when observed through thin sections of solution. Moreover, the phenolphthalein color fades when the solution is made strongly alkaline and allowed to stand for some time.

Phenolphthalein may also be detected in the presence of emodin by the following procedure: By a careful adjustment of the reaction of the solutions the Bornträger reaction may be modified in such a way as to give a separation of emodin from phenolphthalein. Extract 2 to 3 Cc. of the acidulated cascara extract with 25 Cc. benzol. Wash the benzol several times with water in a separating funnel and make alkaline with a dilute soda solution of known concentration and note approximately the amount used. Both phenolphthalein and emodin will now pass into the water layer. Neutralize this soda solution with dilute sulphuric acid of corresponding strength until two or three drops would suffice to destroy all the red color, shaking well during this operation. Wash the benzol again two or three times with water. The benzol will now contain no appreciable amount of emodin but if phenolphthalein was present some will still remain in the benzol layer, and will now give a pinkish red color to a further alkaline wash of the benzol; in the presence of phenolphthalein this akaline wash will remain practically colorless. Differences between the solubility of phenolphthalein and emodin under these conditions coupled with the fact that emodin would seem to be a stronger acid than phenolphthalein probably accounts for this reasonably close separation. This method lends itself to fairly rapid work.

In attempting to carry out a Bornträger test for emodin, the operator must always have in mind the possibility that alkalies have been used to debitter any given extract. Many extracts of cascara will give a distinct red emodin test on simple dilution with water. Extracts which have been treated with alkalies and which yield a high ash are frequently so strongly basic that relatively quite large

amounts of acid must be added before a positive Bornträger reaction may be obtained.

All color reactions, when alkaline salts are used as a basis and where the formation of rings of different shades was depended upon to indicate the presence of emodin-bearing drugs other than cascara, were found to be untrustworthy. When the ether extract of any of the emodin-bearing drugs is poured into a solution of an alkaline salt a reddish ring will be formed at the junction of the two layers. This is really a miniature Bornträger reaction. The colors produced in these tests depend more on the concentration of emodin and chrysophanic acid in the ether layer than on any other single factor. The depth of color produced by equivalent amounts of ether extract of cascara, aloes, rhubarb and senna with solutions of borax, sodium hydrate, ammonium hydrate, sodium carbonate, sodium silicate, or any solution of salts alkaline by hydrolysis, were found to range from strong to weak in the order in which the drugs are named. The ether extract of a cascara never failed to give a decided red ring with these alkaline solutions and that of senna with equal regularity gave a much fainter red ring. It is to be noted that a ring such as was given by senna could be obtained by the action of a very dilute ether extract of cascara on these alkaline solutions. The ether extract of a pure infusion of rhubarb will give a blue color when brought in contact with a solution of ferrous sulphate.[20] This may be due to the presence of tannic acid. When one tries to follow this reaction in the presence of 50% cascara extract the detection of the rhubarb becomes almost impossible for the reason that, although cascara does not give the same coloration as rhubarb, it does give a color change sufficiently dense to obscure the rhubarb reaction. It is quite safe to say that small percentages of emodin-bearing drugs are much more likely to be missed than they are to be positively identified when present in unknown admixture in cascara. Senna is more commonly used in admixture with cascara than any of the others and is most difficult to detect. The ether extract of senna is said to impart a yellow to brownish coloration to ammonium thiocyanate or ammonium molybdate solutions.[21] We were unable to obtain either reaction and in each case observed no color change. The absolute detection of aloes has been better worked out than that of any of the other emodin-bearing drugs. Mossler[22] claims the ability to detect 0.2 Gm. of aloes in 5 Gm. of rhubarb or cascara. The fluorescence test[23] for aloes using borax solution with the ether extract, is certainly not sufficiently delicate to be of any value as a test for aloes in the presence of much cascara. Most of the samples of aromatic cascara and a large percentage of the trade preparations which we examined yielded a relatively faint test for emodin indicating a very low content of cascara extractive. It is worthy of note also that these same samples gave us unusually low manganese numbers.

MANGANESE NUMBER.

It has been pointed out in a previous article by us[24] that the bark of *Rhamnus purshiana* contains a relatively large quantity of manganese which is soluble by the method of percolation. The general usefulness of this determination depends on the fact that the manganese content of this bark is greatly in excess of that of other laxative drugs. It is exceeded by *Rhamnus frangula*, but this bark, by reason of its higher cost and the fact that it is imported is not likely to be used to replace

cascara sagrada. In liquid extracts then where cascara is the only drug extractive present a determination of the manganese content of the ash becomes a quantitative measure of the amount of cascara extractive present. Before trusting such data it is necessary to show that the manganese content of cascara is fairly uniform, or at least to define its limits. On an air-dry basis it has been found that the lower limit is around 0.0093% and the upper limit 0.015%. For the purpose of this work where the manganese is used as a standard the lower limit is the more important and it is safe to say that the greater part of the bark on the market will reach this standard. It is also necessary to show that the methods of percolation extracts this manganese in a uniform manner. It has been shown that for a definite method of percolation the manganese is extracted in proportion to its total amount in the bark.[25] For a certain bark it was found that the B. P. method of extracting gave 0.0023% manganese extracted and the U. S. P. gave 0.0028% maganese.

This was due to the fact that in our application of the latter method we used so much water and washed so often that the unusually high value of 30% was obtained for the solids extracted. It is thus possible to establish the minimum amount of manganese that should be present provided genuine cascara bark has been used and no dilution of the extract has taken place. For a liquid extract one Cc. is the equivalent of one Gm. of the bark. The percentage of manganese W/V in the extract is in direct proportion to the amount of cascara solids present. Therefore this percent is a direct measure of the bark equivalent of the extract. With this as a basis we have developed a manganese number for these extracts. We have defined this to be the percent of manganese W/V × 100,000. Our lower limit then would come at 230 for samples prepared from air-dry bark. The amount of manganese will be proportional to the solids extracted; that is, the percent of manganese in the total solids of genuine extracts of cascara should be an approximate constant. Considering all our results where extraction may not have been uniform, we may say that this number varies from 0.01 to 0.02 for all samples found genuine. If the number falls below this limit it is evident that the solids of this extract are not all cascara solids. This manganese test is of particular value in distinguishing *Rhamnus purshiana* and *Rhamnus californica*. The latter contains only about one-third the manganese of the former and yields an extract with a manganese number of about 80. Whether or not some of the extracts examined which show low manganese numbers have been prepared from this bark is a matter of inference. The manganese content of licorice root[26] and its extract is sufficiently low not to interfere with the application of this method to aromatic extracts. The presence of no other common laxative drugs destroys to any extent the value of this manganese number. If, on the other hand, these drugs displace cascara, the manganese content will be very much lowered. It is safe to say when considering aromatic extracts that their manganese content varies directly with their cascara content. The method of estimation is that given elsewhere by us,[27] except that in the case of liquids, 10 Cc. were taken as a sample, being the equivalent of 10 Gm. of the bark when properly prepared. From the ash of this amount the manganese was determined by the ammonium persulphate method with silver salt as catalyzer. 76 samples are tabulated as follows:

TABLE VII.

Class (1).		Class (2).	
Range of manganese.	No. of samples.	Range of manganese.	No. of samples.
0 to 50	8	0 to 100	0
50 to 100	2	100 to 150	6
100 to 150	1	150 to 200	6
150 to 200	5	200 to 250	7
200 to 250	1	250 to 300	10
250 to 450	2	300 to 350	6
450 to 600	2	350 to 400	3
600 to 700	2	400 to 500	13
	—	500 to 600	1
	23	700 to 800	1
			—
			53

In conclusion, our thanks are due to Dr. J. M. Francis, of the Parke, Davis Co., Detroit, Mich., who kindly supplied us with genuine samples of these barks and practical information of value.

SUMMARY.

(1) Complete data relative to the analysis of 76 samples of extracts of cascara has been given.

(2) It has been shown that methods of percolation are not sufficiently detailed in various pharmacopoeias to allow general uniformity in trade preparations.

(3) A fairly rapid and reasonably conclusive test for the presence of phenolphthalein in emodin-bearing drugs is proposed.

(4) The introduction of a Manganese Number for cascara extract is proposed as a method for determining the amount of cascara extractive present, and as a basis of judgment on the nature of the extract.

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THE LABORATORIES OF THE
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THE RECOGNITION AT SIGHT OF POISONOUS AND MEDICINAL PROPERTIES IN UNKNOWN PLANTS.*

BY H. H. RUSBY, M.D.

The following paper is based on three simple facts:

1. There are certain groups of plants whose members are so uniform in medicinal or poisonous properties, or both, that the mere recognition of a plant as belonging to one of them is sufficient to indicate its general medicinal usefulness or its dangerous nature.

2. Associated with these physiological relationships are genetic relationships which are clearly indicated by the structural characteristics.

3. These structural characteristics are so manifest that the physician or pharmacist who possesses a fair practical knowledge of structural botany can at once recognize them, and thus be enabled, in cases of emergency, to utilize the plant medicinally or to avoid it if poisonous, in the absence of other knowledge concerning it.

Centuries ago, before the relationships among plants were understood, and when there was a complete absence of knowledge concerning the nature of medicinal action, mankind believed in divine revelation regarding medicinal treatment, which was supposed to be afforded only to the priesthood, who based thereon their claims to service as physicians. Later, a belief developed that this revelation had been made to all mankind, through the impression upon each medicinal plant of some visible sign of the nature of its medicinal action. This idea persists to some extent to the present day. One of my earliest recollections was that of being taken out by a neighbor, descendant of an old family of Dutch settlers, who explained to me the theory of signatures. "You will find," said he, "if you hunt close enough, that every plant has a sign somewhere that shows what part of the body it is good for." We pharmacists see this belief perpetuated in the common names of many of our drugs, as the blood root, the liver leaf, Solomon's seal, golden seal, lungwort moss, snake root and Devil's bit.

There have been various other so-called methods by which one was supposed to be able to judge the physiological properties of plants. A quarter of a century ago, a story went the rounds of the public press to the effect that the peculiar lurid-purple color that we observe upon the stem of the castor-oil plant, the pokeberry and the angelica, was always indicative of medicinal or poisonous properties, or both. I remember another to the effect that finely divided leaves, as seen

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* A lecture, illustrated by lantern slides, before the Chicago Convention, A. Ph. A., 1918. Contributed to Scientific Section.