in the limit of tolerance; in all other samples both the total and acid-insoluble ash exceeded the limits of tolerance, namely 10 percent for total ash, and 1 percent for acid-insoluble ash. As was expected from other general experience, the amount of both total and acid-insoluble ash was found to be higher in the leaves than in the stems. While the explanation for the high acid-insoluble ash may be found in the fact that the samples examined were grown on sandy soil, the samples were too few to justify general conclusions.

CONCLUSIONS.

The amount of volatile oil (volatile ether extract) found in sage leaves was considerably higher—about three times that found in the stems—being in the ratio of 1.63–0.60, 1.26–0.49, 1.18–0.48, 1.06–0.29, 0.92–0.24, respectively.

The herbaceous parts of the axis located close to or representing the tops of the plant, as might be expected, yielded more volatile ether extract than the woody basal portion of the axis, the amounts being about 0.9 percent and 0.2 percent, respectively.

The chemical findings are supported by the following botanical data: The glands and glandular hairs containing the volatile oil are to be found only in the epidermis of leaves, petioles and herbaceous stems. They are most abundant on the leaves, either upper or under side, and completely absent on woody stems, where the epidermis has been replaced by cork and woody tissue.

Since the stems are low in volatile oil, and hence, in spice value, a limitation of their amount is justified.

The leaves generally contain more ash than the stems. With regard to the total and acid-insoluble ash, determinations made on 5 samples indicate a tendency in domestic sages of high total and especially acid-insoluble ash, a tendency observed by growers of domestic sage.

PHARMACOGNOSY LABORATORY,
BUREAU OF CHEMISTRY.

HEMLOCK BARK (*Tsuga canadensis*) FOR PHARMACEUTICAL PURPOSES.*

BY H. D. GARR AND GEORGE E. ÉWE.

Hemlock bark finds its greatest use in the tanning industry, but considerable is employed in Pharmacy. Its use in the tanning industry is dependent upon its tannin content. In pharmacy the tannin content is also the most important consideration but, in addition, the oleoresin and volatile oil contents are frequently of importance.

For the purposes of tanning, the whole bark is usually employed, and it is not considered necessary to remove the outer cork layers. But in pharmacy the rossed bark is to be preferred since the outer cork layers are deficient in tannin, practically devoid of volatile oil, and carry excessive color and extractive matters which are non-essential to the purposes of pharmacy.

Kraemer states in "Scientific and Applied Pharmacognosy" that only the

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* Read before Philadelphia Branch, A. Ph. A., May meeting, 1920.

inner bark of *Tsuga canadensis* is used medicinally while the whole bark is employed in the tanning industry.

"The National Standard Dispensatory" states that the entire bark of *Tsuga canadensis* is used for tanning purposes but that in pharmacy the rough outer layer is usually removed.

Because of the preponderating use of hemlock bark for tanning purposes, most of it is collected in a whole condition. Some of this whole bark finds its way into the stocks of crude drug dealers and, as a consequence, the whole bark is invariably offered to the pharmaceutical trade.

The purpose of this communication, therefore, is to present evidence of the superiority of the rossed over the whole bark, for pharmaceutical purposes; to suggest the use of only the rossed bark in Pharmacy; to suggest that crude drug dealers permit only the rossed bark to occupy a place in their stock, or in lieu thereof, to submit only rossed bark to pharmacists.

FORMS IN WHICH HEMLOCK BARK APPEARS IN THE DRUG MARKET.

Hemlock bark appears in the drug market in the whole bark condition and also in the rossed bark condition. The whole bark is in the same condition in which it was gathered from the tree. It consists of the outer cork layers, inner cortex and phloem region. The rossed or inner bark consists of the inner cortex and phloem region of the whole bark.

COMPARISONS OF RATIO OF WHOLE BARK TO ROSSED BARK.

The outer bark, which consists mainly of several layers of cork cells intermingled with dead cortex tissue containing some dead tannin and resin cells, was separated from four lots of whole bark from different sources; the two separated portions of the barks were then weighed.

Lot No.	Percent of outer bark.	Percent of inner bark.
1	71.00	29.00
2	54.71	45.29
3	49.20	50.80
4	46.46	53.54
Average	55.34	44.66

The results for ratio of whole bark to rossed bark will naturally vary in proportion to the thoroughness exercised in removing the outer bark. From the above results, it can be estimated that one-half of whole hemlock bark will be "lost" to the pharmaceutical trade by the process of rossing. This does not mean that the outer bark is "lost" entirely to the dealer in the bark since there is no doubt that it will find a sale as a tanning material of lower grade than the whole bark.

COMPARISONS OF EXTRACTIVE CONTENT OF WHOLE AND ROSSED BARK.

In determining the extractive content, two menstrua were employed, namely, hot water and 32 percent alcohol. Hot water was employed for the reason that it is exclusively used in the tanning industry and its use has been established by that industry as the most economical solvent for the tannin of the bark. In pharmacy, however, the oleoresin and volatile oil are of consequence, in addition

to the tannin, and for this reason, an alcoholic menstruum was also employed. An alcoholic menstruum of 32 percent strength was chosen for the reason that it has long been employed in pharmacy in connection with this drug and much of the clinical data on hemlock bark has been collected by the use of a fluid extract made with an alcoholic menstruum of this strength.

Lot No.	Portions of bark.	Hot water-soluble extractive. Percent.	32% Alcohol-soluble extractive. Percent.
	Whole bark	11.88	18.29
1	Outer bark	11.27	18.20
	Inner bark	13.37	18.52
	Whole bark	12.57	20.56
2	Outer bark	12.54	21.36
	Inner bark	12.60	19.60
	Whole bark	13.09	...
3	Outer bark	12.75	...
	Inner bark	13.62	...
	Whole bark	11.27	18.72
4	Outer bark	10.29	18.80
	Inner bark	12.12	18.68

It will be noted that in general there is no preference, quantitatively, between the extractive matters of the outer and inner bark but, as proven later in this communication, qualitative preference is on the side of the extractive matters of the inner bark since they are higher in tannin, oleoresin and volatile oil content and lower in the non-essential coloring and extractive matters.

RATIO OF TANNIN CONTENT OF OUTER AND INNER BARKS.

In determining the ratio of tannin content of the outer and inner barks the hot water extract was employed, since its use has been established in the tanning industry as a satisfactory solvent for the tannin of hemlock bark.

Preference was also given to the hot water extract for the reason that it contained less of the coloring matters of the drug than the alcoholic extract, and coloring matters are a source of error in the estimation of the ratio of tannin content.

No actual determinations of the tannin were made; the ratio of tannin content being determined by treating definite quantities of the diluted aqueous extract with ferric chloride to bring out the color, comparing the colors quantitatively by means of a Duboscq colorimeter and correcting the reading of the colorimeter for the initial variations in color of the original extracts. Ferrous salts were not efficient in bringing out the color.

Lot No.	Ratio of tannin content. Outer bark.	Inner bark.
1	1	1.30
2	1	1.45
3	1	2.01
4	1	1.21
Average	1	1.49

Therefore, it can be stated that on the average, the tannin content is about 50 percent greater in the inner than in the outer bark.

Micro-chemical tests also confirmed the above conclusion. The micro-

chemical tests were made by staining transverse sections of the inner and outer barks with ferric chloride and examining the stained sections under the microscope.

RATIO OF COLORING MATTER CONTENT OF OUTER AND INNER BARK.

The most striking difference in the appearance of the water-soluble and 32 percent alcohol-soluble extracts of the outer and inner bark is the color. This difference is more striking in the case of the 32 percent alcohol-soluble extracts since alcohol is a better solvent of the coloring matters than water and, as a consequence, the alcoholic extracts are proportionately more highly colored. The following table will illustrate the ratio of coloring matters of outer and inner bark extracted by hot water and by 32 percent alcohol:

Lot No.	Ratio of coloring matter content. Outer bark.		Inner bark.	
1.....	Hot water	2.1	Hot water	1
	32% alcohol	4.0	32% alcohol	1
2.....	Hot water	1.8	Hot water	1
	32% alcohol	3.3	32% alcohol	1
3.....	Hot water	2.0	Hot water	1
	32% alcohol	..	32% alcohol	..
4.....	Hot water	1.7	Hot water	1
	32% alcohol	3.0	32% alcohol	1

Therefore, the outer bark contains, on the average, twice (actually 1.9 times) as much hot water-soluble coloring matter as the inner bark and $3^1/_2$ times (actually 3.4 times) as much 32 percent alcohol-soluble coloring matter.

Knowledge of the proportion of coloring matter in the whole and rossed barks is of importance in explaining to the trade the variation in color of finished products in the event of adoption of the use of rossed bark in place of the whole bark.

The ratio of coloring matter content of the alcohol and water extracts from the same drug was not determined but in every case the alcoholic extracts possessed many times the amount of coloring matter possessed by the water extracts.

The nature of the coloring was not ascertained. It is brownish red in color. Under the microscope the coloring matter was found to be lodged mainly in the cork cells of the outer bark.

LOCATION OF OLEORESIN AND VOLATILE OIL IN HEMLOCK BARK.

No exact quantitative chemical comparative determinations of the oleoresin and volatile oil contents of the outer and inner barks were made for the reason that microscopic examination showed a tremendously greater content of these constituents in the inner bark. Therefore, the inner bark is to be preferred for this reason in addition to its greater tannin content.

MICROSCOPIC STRUCTURE OF HEMLOCK BARK (*Tsuga canadensis*).

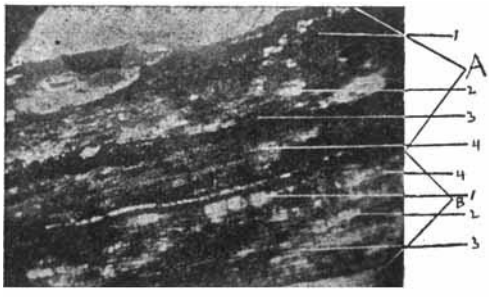
Through the kind permission of H. W. Youngken, professor of Botany and Pharmacognosy at the Philadelphia College of Pharmacy, and with the able assistance of Benjamin H. Hoffstein, Ph.C., instructor of Botany and Pharmacognosy at the same institution, several photomicrographs of the transverse and

radial longitudinal sections of the bark were prepared and are herewith reproduced:

PHARMACEUTICAL USES OF HEMLOCK BARK.

The main pharmaceutical purposes of hemlock bark are for the manufacture of fluid and solid extracts, the manufacture of volatile oil and the aromatization of local antiseptics.

HEMLOCK BARK.
Tsuga canadensis.

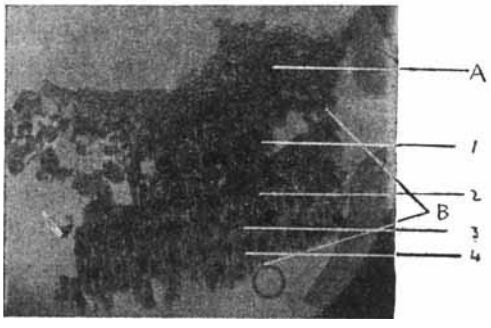


Magnified × 12 (approximately)
RADIAL LONGITUDINAL SECTION.

A.—Outer Bark
1. Cork Cells, Rich in Coloring Matter.
2. Stone Cells.
3. Secondary Cork Formation.
4. Dead Phloem Tissue.

B.—Inner Bark.
1. Groups of Stone Cells.
2. Groups of Stone Cells.
3. Phloem Tissue Rich in Tannin and Resin-like Substances.
4. Resin Cell.

HEMLOCK BARK.
Tsuga canadensis.



Magnified × 12 (approximately).

TRANSVERSE SECTION.

A.—Cork Cells of Outer Bark.

B.—Inner Bark
1. Groups of Stone Cells.
2. Phloem Tissue, Rich in Tannin and Resin-like Substances.
3. Medullary Ray Cells, One Cell in Width.
4. Same as Three.

HEMLOCK BARK.
Tsuga canadensis.

Magnified × 30 (approximately).
INNER BARK, RADIAL LONGITUDINAL SECTION, ENLARGED.
1.—Groups of Stone Cells.
2.—Phloem Tissue
3.—Medullary Ray Cells.

For the manufacture of fluid and solid extracts only the rossed bark should be used. For the manufacture of volatile oil the point to be decided is comparison of the cost of handling the extra inert material represented by the outer bark with the cost of rossing the bark.

In the aromatization of local antiseptics the rossed bark is preferable, although an equivalent amount of the whole bark may be used. It might be well to explain that by "aromatization of local antiseptics" is meant the steam distillation of hemlock bark to obtain an aqueous, colorless distillate saturated with the aromatic oily constituents of the bark, which is preferred by some as a basis for the manufacture of local antiseptics of the "Liquor Antiseptic Compound" type.

COMPARATIVE PRICES OF WHOLE AND ROSSED BARK.

Both whole and rossed bark are among the cheapest of crude drugs with which the pharmacist has to deal. At the present date the whole bark wholesales for 4 to 5 cents per pound while the rossed bark sells for from $4^1/_2$ to $5^1/_2$ cents per pound in the same quantities.

The adoption of the use of rossed bark, therefore, imposes but a negligible extra burden upon pharmacists who, heretofore, employed only the whole bark, because of the very slight increased cost of the rossed bark. Upon a tannin and oleoresin content basis the advantage in price is by far in favor of the rossed bark.

TENTATIVE STANDARDS FOR HEMLOCK BARK FOR MEDICINAL PURPOSES.

The chief purpose of these tentative standards is propaganda for the use of only the rossed bark in pharmacy.

HEMLOCK BARK.

The inner bark of *Tsuga canadensis* (L.) Carr. Family: Pinaceae.

Hemlock bark comes in flattened pieces varying in size and thickness. The outer surface is cinnamon-brown or blackish brown, and longitudinally wrinkled. The inner surface is yellowish brown to cinnamon-brown, finely striate, and with numerous small crystals. The fracture is short in the outer portion, but more or less fibrous in the inner portion. The odor is faint or nearly absent and the taste is markedly astringent.

In transverse section, the bark shows a few concentric layers of cork alternating with intervening layers of old phloem whose cells are colored a deep red. Within these are old phloem cells whose continuity is interrupted by rather regular and frequent concentric rings of cells containing prisms of calcium oxalate. Scattered throughout, are frequent groups of sclerenchyma or single cells (stone cells), thick-walled, with characteristic striae.

Medullary rays frequent, one cell in width and containing starch grains.

SUMMARY.

Hemlock bark (*Tsuga canadensis*) in the rossed condition is to be preferred for use in pharmacy.

Authorities are cited supporting the above assertion.

Comparisons of ratio of whole bark to rossed bark; comparisons of extractive contents (by hot water and 32 percent alcohol) of whole and rossed bark; the ratio of tannin content of outer and inner bark; the ratio of coloring matter contents of outer and inner bark and the location of oleoresin and volatile oil in the bark are given and discussed with the result that the assertion made in the first paragraph of this summary is supported.

Much of the bark being offered to pharmacists is in the whole condition.

It is suggested that crude drug dealers permit only the rossed bark to occupy a place in their stock, or in lieu thereof, to submit only rossed bark to pharmacists.

The forms in which the drug appears in the market are described briefly.

The microscopic structure of hemlock bark is illustrated by reproductions of micro-photographs.

The chief pharmaceutical uses of the bark are described and selection of the bark for particular purposes is discussed.

Comparative prices of whole and rossed bark are given. It is suggested that the very slight increased cost of the bark in the rossed condition imposes but a negligible burden upon those who heretofore have employed only the whole bark.

Tentative standards for hemlock bark for pharmaceutical purposes are suggested.

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THE PROPHYLACTIC AND THERAPEUTIC VALUE OF VACCINES.*

BY G. W. McCOY.[1]

In discussing the prophylactic value of vaccines I take it for granted that there is no need to take time to consider smallpox vaccine and antirabic vaccine. These two agents, to which indeed alone the name "vaccine" ought to be restricted, are on so well established a basis as to put them beyond the stage where it is necessary to advance evidence to prove their worth.

Coming to killed bacterial suspensions to which the names "bacterial vaccines" or "bacterins" are applied and discussing first the prophylactic uses of the preparations we must first consider the scientific basis for them. It has long been known that a mild attack of certain infectious diseases would prevent the development later of severe attacks of the same disease. It was but a step from this to the prevention of the disease by the injection of the bacteria which are responsible for the infection. The killed germs are generally employed though there are some examples of the use of living cultures.

As a basis of vaccination of this sort we must know first what is really the cause of the disease and then know whether the causative organism is capable of inducing a change in the condition of the animal body that will prevent the securing of a foothold by the invading germs or at least render the invasion relatively harmless. There are some organisms which are known to cause disease, yet the preparation of a vaccine from them will fail to protect against infection. A good example of this is tuberculosis; we have known the cause of tuberculosis for about 40 years and it is an organism that is relatively easily cultivated, but no one has yet been able to devise any effective preventive vaccine though the subject has enlisted the efforts of the best minds engaged in the study of immunity.

What, then, are the diseases we can effectively vaccinate against? The number is regrettably small; the best example, and at the same time the one on which the evidence is most satisfactory, is typhoid fever. I will not burden you with figures, but will simply state that, based on apparently trustworthy data,

* Read before Scientific Section, A. Ph. A., City of Washington meeting, 1920. This and two other papers are part of a symposium. The titles of the other papers are: "Biological Assay—Its Scope and Limitations" by H. C. Hamilton and "Vaccines and Immune Serums—Have they Come to Stay?" by F. E. Stewart.

[1] Director, Hygienic Laboratory, Washington, D. C.