

## THE PRODUCTION OF TANNIN IN ONTARIO.\*

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One of Ontario's important industries is that of tanning, and for this purpose hemlock bark is the commonest and cheapest material used. The bark is taken from the common Hemlock (*Tsuga Canadensis*) by felling and peeling it in the spring of the year, when the bark has been loosened by the growth of the cambium layer. The bark is cut into four-foot lengths and carefully piled in order that it may become properly seasoned, for if a fermentation occurs in it the tanning properties will be greatly reduced. During the winter following the bark is drawn on sleighs to the nearest siding and shipped by rail to the tannery, where it is ground to a powder and leached with the hot water of exhaust steam, the liquors coming off from these leaches being used in the tanning.

As the consumption of bark goes on, all that country contiguous to the railways becomes denuded of hemlock trees, thus each year the haul to the railways becomes greater and is an ever increasing factor in the price of bark. The stumpage value of the bark need hardly be considered, for the average settler will sell his bark for a price barely sufficient to pay him for his labor expended since he gains thereby a market for the peeled timber and a winter's work near home. But with the recent increased demand for labor and the rapid rise in wages the settler can now find much more lucrative employment elsewhere and this has forced the tanners to put in camps themselves in order to procure a sufficient quantity of bark. This places the price of tan bark at last absolutely upon a labor basis, with its value varying directly with the price of labor and the amount of work done upon it. And this being the case the time must surely come when we shall be forced by economy to separate the tanning ingredients from the bark at the source of the supply and thereby save the unnecessary expense of freighting a very large amount of non-essential materials. That the time has already arrived the following discussion will attempt to demonstrate. Let us first investigate some of the properties and sources of the materials that are generally used in tanning.

There are a number of substances found in certain woods, barks and leaves which have an astringent taste and acid reaction, and are known under the general term, "Tannin," on account of their resemblance or relationship to tannic acid. They are formed in the leaves of the plant under the conditions necessary for general assimilation, transmitted through the leaf stock and distributed through the permanent structure. The tannins formed in the various plants differ somewhat in properties and composition, but they all possess in common the property of combining with hides to form leather penetrating and reacting with the animal fibres in such a manner that hides thus treated will not be decomposed and are insoluble.

The tannins are subcrystalline solids, neither fusible nor volatile, and although fairly soluble in cold water, they are quite soluble in hot water and such solvents as alcohol, acetic ether and acetone.

They may be identified by two typical reactions.

1. With the salts of iron they give a blue, black or green color, and this reaction is the basis of most of our writing inks.

2. With a solution of gelatine they form artificial leather, the reaction being quite similar to that taking place with hides.

All of the natural tannins are strong reducing agents, absorbing oxygen readily, especially in alkaline solutions.

The tannins have quite an extensive application as mordants in the dyeing industry, for they have the property of combining with the textile fabric and giving to it an increased affinity for coloring matters.

It is quite apparent that these valuable properties will give to the tannins an extensive industrial application, and as their synthetic preparation on a commercial scale is as yet merely speculative, the vegetable kingdom remains the only source of supply and an exceedingly variable one it is. We find tanning principles in the fruit, wood, bark and leaves of a great number of plants and future investigation will doubtless reveal them in many more at present unknown. The

following incomplete list will indicate somewhat the wide diffusion of these principles:

Northern trees—Oak, chestnut, willow, sumach, elm, ash, elder, birch, cherry, poplar, hazel, pine, fir, hemlock, etc.

Other sources and products—Tea, gall nuts, gambler, divi divi, catechu, valonia, quebracho, etc.

The most important of the tropical tannin producing plants are exported to England, United States and other countries and there made into extracts which are used for tanning and other purposes.

Galls or gall nuts are excrescences formed upon the leaves and leaf stocks of a species of oak (the *Quercus Infectoria*) which grows in the Levant. They are produced from the puncture made by the female gallwasp in depositing her eggs, around which the juice of the tree exudes and dries in concentric portions. The galls are gathered before the insect has escaped from its shell, when they contain a large percentage of gallotannic acid.

Gambier is an extract prepared from the leaves of the "Uncaria Gambier," and is principally imported from Singapore.

Divi-divi is the pod of a leguminous shrub, the *Casalpinia Coriaria*, which is indigenous in South America, and from it a tannin extract is made.

Catechu or "Terra Japonica," is an extract prepared from the heart wood of the *Acacia Catechu*, which is generally imported from India.

Valonia is an extract made from the acorn cups of the *Quercus Aegilops*, which grows in Morea in China.

Quebracho is an extract made from the wood of the *Aspidosperma*, many species of which are found in tropical America.

Sumach is the name applied to a number of plants of the genus *Rhus*, which although natives of Asia, are cultivated in Sicily and other parts of Europe for the tannin which they contain. The leaves are cut from the tree just before it blooms, and after being dried are ground to a fine powder. Nearly all the Sumach we use is imported from Sicily either as powder or extract.

The willow bark is used extensively for tanning in Russia and the oak was the native tan bark of England, but in North America the hemlock, chestnut and oak have the commercial importance, both as a local and foreign supply.

The chestnut extract is prepared from both wood and bark, and is greatly valued on account of its freedom from the coloring matters common to other extracts, with which it is often used in admixture as a modifying agent.

The oak derives its tanning properties from the Quercitannic acid contained in both wood and bark, and although the bark is the prevailing source, an extract is also made from the sawdust. This tannin also occurs in the elm and produces a leather that is highly esteemed. It belongs to that class of tannins which produce a bloom upon leather during tanning.

Many other barks are rich in tannin, but are very little used, either from lack of knowledge concerning them, or that they are not found in sufficient quantity to become a marketable commodity.

As the oak and chestnut are fast becoming rare and valuable, they are scarcely to be counted on as the source of any considerable quantity of tannin in the future, and in order to maintain or increase the supply we are forced to look to other sources.

Now we have in our own Province the hemlock tree, which occurs in such enormous quantities that with proper treatment it might be and forever remain an extensive source of tannin. At present, however, the cost of hemlock tannin in Ontario is more than it should be on account of the expensive methods employed, and in consequence its consumption is limited to the local tannery and barely keeps pace with the demand for the timber, in spite of the cheap grade of lumber that the tree produces.

In the United States the annual production of solid hemlock extract is said to be considerably over ten thousand tons, but none is produced in our Province notwithstanding the enormous hemlock limits it contains and the small value of the timber, the hemlock extract we actually consume being shipped to us from Nova Scotia. Our Government has apparently endeavored to encourage its local manufacture, for hemlock is the only extract on the market upon which there is an import duty, and the export of the bark is prohibited. What more favorable conditions could be required for its manufacture, and yet the tanners say that the making of extract is unprofitable. They shudder at the enormous and expensive plant that would be required, and as they should be more familiar with the subject than any one else their decision is final. They have in mind, however, the large permanent extractive plants of the United States, which make tannin and dye wood extracts from materials gathered from all parts of the world. These plants contain huge and expensive extractors and vacuum pans, resembling those employed in sugar refining, and are of course too costly to establish in the forest.

But if we are to experience the industrial evolution of other nations we must change our methods and in this instance adopt those that were employed by the Germans under similar conditions. When they were confronted by an expensive tan bark, which was made so solely by the excessive cost of transportation, they

solved the question in the following manner: Small plants, consisting of a cheap portable power, a bark cutter or grinder and wooden extraction vats, were set up in or near the source of supply, and with these they made a fairly concentrated extract. The cost of shipping this extract to the tannery was but a fraction of the transportation cost of the bark, and the cost of extraction in the forest but slightly in excess of the grinding and leaching process that would have been eventually employed by the tanner.

The plant may be stationed for a season's run in any locality where there is a sufficient block of timber, and this is not hard to find in Ontario. After the bark is peeled it should be treated as soon as possible and consumed the same year. It may be cut into fine shavings by being fed from the end against a series of revolving knives, and as each shaving is a thin transverse section of the bark cells the tannin is extracted without difficulty. The bark may, however, be ground to a fine powder by the usual form of grinder. It is now placed in a series of ten wooden tanks, which are arranged in a circle, the bottom of each being connected by a pipe to the top of the other. Steam from the boiler is now turned into number one, and passes through each in turn, until it is drawn off from number ten as a quite concentrated extract. A number of these vats are employed, because the extraction of the tannin depends upon the laws of diffusion. Thus, in boiling water, the tannin will leave the bark and become diffused throughout the solvent until equilibrium is established. If the solution is now removed and more solvent added the tannin remaining in the bark will now become diffused, forming a weaker solution and if this process is continued all of the tannin will be finally extracted. Therefore if hot water is passed successively through ten vats, in which the bark of number two is richer than number one and number three richer than number two, etc., it is evident that the solution must become continually stronger as it passes through each in turn, and when discharge from number ten is a quite concentrated extract. When the tannin in tank number one is exhausted it is refilled and then becomes number ten.

By this process we eliminate the harmful effects of the open evaporating pan, in which the tan leach concentrated in the open air, and a large part of the tannic acid thus destroyed by oxidation. Tan liquor or extracts should never come in contact with iron pipes or tanks, for the tannic acid will corrode iron, combining with its salts with the formation of ink, and correspondingly neutralizing its tanning properties. Carbolic acid or corrosive sublimate added in minute quantities to an extract will prevent the growth of fungi and an addition of one-half centimeter of glacial acetic acid to one litre of extract is valuable as a preventative of oxidation.

If several of these portable plants are in operation the same locality and an extract for export is desired solid extract may be prepared by further concentration in a vacuum pan. This apparatus will evaporate all the moisture in the extract at a temperature below 100 degrees centigrade on account of the partial vacuum which it is kept, and as there is no access of air, tannin can not be decomposed either by hydrolysis or oxidation. A solid extract may be composed of various quantities of tannic, gallic or other organic acid coloring matters, starch, gums and any other extract ingredients soluble in hot water. Therefore the percentage by weight of tannic acid is an exceedingly variable factor, depending upon the method of extraction and the relative amount of extractive material contained in the original substance. In the liquid extract all of these inert ingredients affect the gravity of the solution, and the customary habit of pressing the strength of the extract in terms of degrees Baume is very unreliable, and often gives a false value to a worthless extract because all of the moisture might have been decomposed during extraction yet the density remain the same.

The extraction of tanning materials is not an elaborate process, but proper methods are necessary to obtain good results, and it is more than probable that failures in the past in the preparation of tannin are traceable to mistakes in this respect rather than that the business is in itself unprofitable.

The possibilities in the development of this industry appeal more to the lumbermen who own the limits than even the tanners, for it could be carried on in harmony with other lumbering operations, and other valuable products beside the hemlock, such as ash, birch, etc., could also be profitably introduced. There is no reason why our lumbermen should not supply all of the local tannin with an extract at a price less for equal tanning value than that now paid for bark, and still have a considerable amount for export. Under these conditions a large quantity of hemlock timber now inaccessible could be lumbered with a profit, as the bark would have a stumpage value and would pay the cost of seasoning the timber. Hemlock is now taken from localities where the bark has no value, and is endeavoring to float it in the green state large quantities are lost. As hemlock has also a value for pulp making, there will soon be an urgent need some method of consuming the bark in the forest, and if one such as has been suggested be employed it will pave the way to the more scientific development that accompanies the application of the principles of forestry and economy.

\*From the last Report of the Director of Forestry for Ontario.