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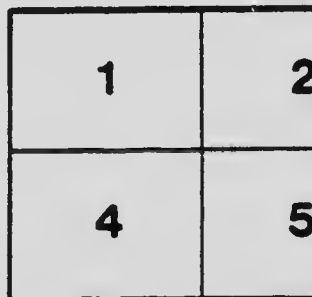
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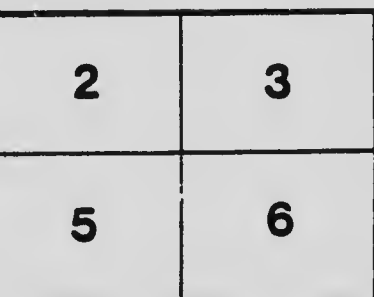
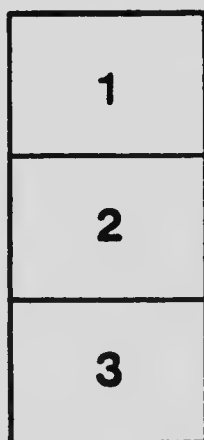
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FORESTRY BRANCH—CIRCULAR No. 8.

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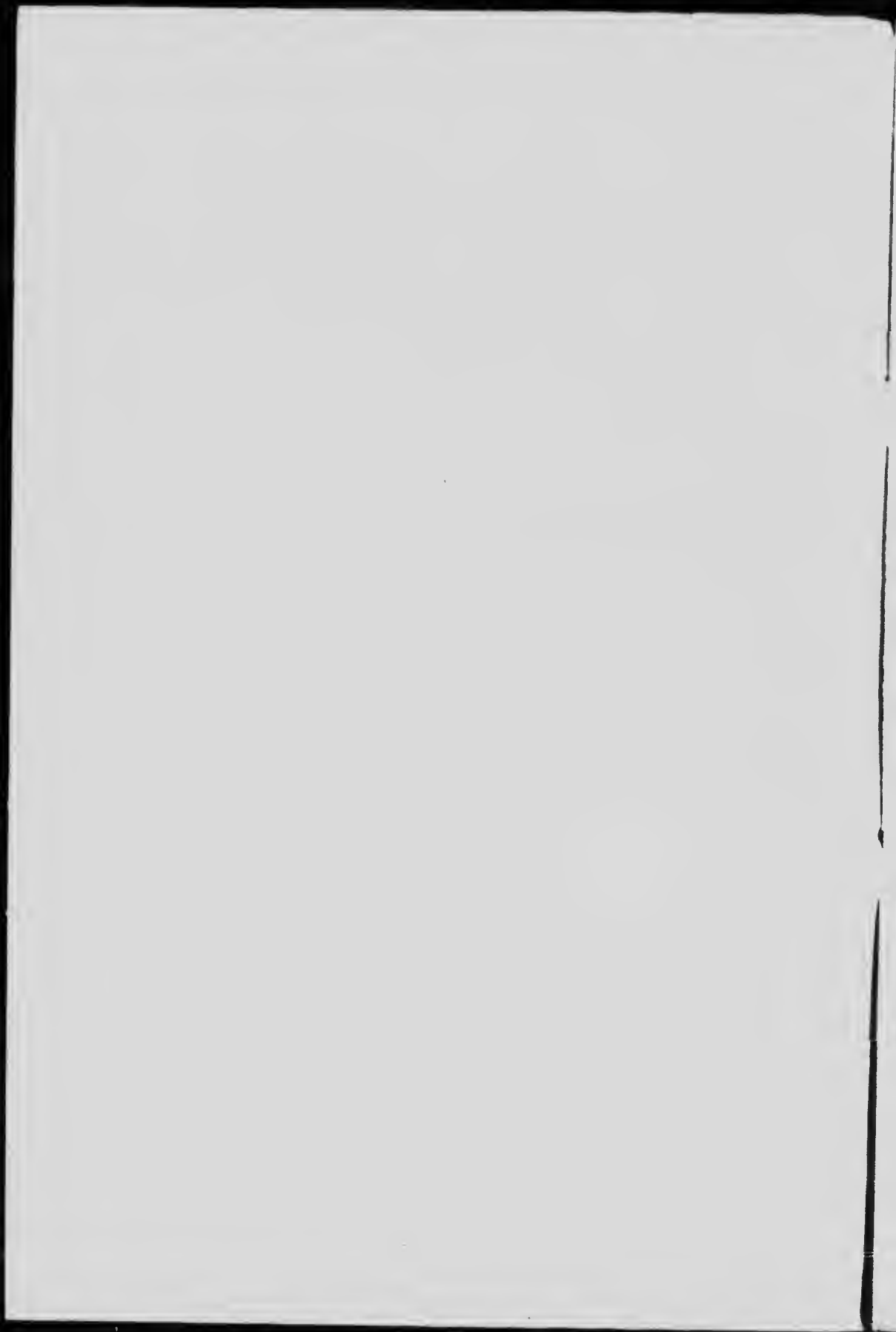
THE FOREST PRODUCTS  
LABORATORIES

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## THE FOREST PRODUCTS LABORATORIES

The prime object of forestry is to manage the forests and their products so as to reproduce them and to use them as efficiently and economically as possible. For this purpose provision is being made within the jurisdiction of the Department of the Interior for the protection of the forests from fire, for eliminating waste in lumbering operations and for educating public opinion to co-operate in these objects. To completely fulfil the objects of forestry it is necessary to go further and investigate the possibilities of conserving the forests by reducing waste in manufacture, by prolonging the life of forest products used in construction, and by developing uses for products now wasted for lack of knowledge as to how they may be employed. Forest services in older countries have felt the necessity finally of undertaking scientific investigations of such matters. Such work has been carried on in Germany, and other European countries, in the United States, and in some of the British dominions, and where it has been undertaken it has appealed strongly to those engaged in manufacturing, who have given it every assistance and even material support. A laboratory and investigation staff was established four years ago by the United States Forest Service at Madison, Wisconsin, in co-operation with the University of Wisconsin, for investigations of this nature, and the work has appealed strongly to the manufacturers, who have given it every encouragement.

### WASTES IN WOOD MANUFACTURE.

An analytical study of the modern logging camp and sawmill shows:—

1. That 25 per cent. of the volume of all trees cut is left on the ground in the form of "cull" logs, tops, and stumps. This material checks natural reproduction, increases greatly the danger of fire, and retards the clearing of the land for agricultural purposes when it is suitable for such purposes.
2. That many trees, especially of certain species, are left because it is thought they do not furnish wood suitable for the needs of commerce. Until comparatively recently in the United States red gum was considered worthless because it could not be seasoned without serious warping and checking. Tupelo gum was ignored for the same reasons. Western larch, western hemlock, and loblolly pine were not used because they were not as strong and durable as longleaf pine, and in the southern states could not be sold because it was thought they were not as good as the hardwoods of the Ohio valley. Such cases are rapidly becoming fewer in number, but even yet the forests in all parts of Canada, as well as the United States, contain splendid trees that are left to the fires and winds, ostracized from the woods of commerce, because in the stress of business competition no one has time to determine whether or not it is practicable to use them as well as the species that are better known.
3. That after the sawlogs reach the mill, fifty per cent of their volume is wasted in the form of bark, slabs, sawdust, edgings and trimmings. Some of this waste is used for fuel, but in most cases the larger part of it is destroyed in burners or thrown away.

We also discover, if the analysis is carried further, that after wood is put into service its period of usefulness is greatly diminished because it is not properly protected against organisms which destroy it, such as decay-producing fungi, insects and marine borers.



Lumbermen and owners of stumpage have grown so accustomed to regarding these wastes as necessary that they are frequently impatient with the man who calls their attention to them, and who predicts that the time will come, as it has with the steel and packing industries, when the present so-called wastes will be turned into sources of profit.

#### ECONOMIES IN UTILIZING WOOD.

Wood is a fibrous material, the fibres of which are composed of cellulose and lignin. When the fibres are separated, they are valuable for the manufacture of paper, fibre-board, and other fibrous materials. It has also been demonstrated that cellulose can be converted into fermentable sugars, from which alcohol can be made. Wood alcohol, pyrolicaceous acid, acetate of lime, artificial silk, and many other products have been manufactured from cellulose. If methods can be perfected so that these processes may be applied with profit to mill and forest wastes the economic importance of this development will be stupendous:

1. It will increase the value of forest lands to the point where it may be profitable to the Government or individual to grow lumber.
2. It will decrease greatly the cost of clearing agricultural lands.
3. It will change methods of logging, in that slash, tops, "cull" logs, etc., will be brought from the woods, thus lessening the fire risk and leaving the ground in better shape for natural reproduction.
4. Instead of a saw-mill only, there will be a group of plants in which wood will be converted not only into lumber, but into alcohol, paper, and other staples of commerce. From it in some cases would also be secured turpentine, rosin, and other valuable oils and gums.

The movement for forest conservation depends more upon the ability of science to demonstrate the potential value of wood substance now wasted than upon any other factor. If this can be done, the solution of other phases of this great problem will follow as a natural sequence. To do this, or to aid others in doing it, is the purpose of the new Forest Products Laboratories.

#### PURPOSE AND WORK OF THE LABORATORIES.

The Forest Products Laboratories are laboratories of practical research, conducted by the Forestry Branch of the Department of the Interior in co-operation with McGill University. The purpose of the laboratory is:—

1. To secure authoritative information on the characteristic mechanical and physical properties of commercial woods and products secured from them
2. To study and develop the fundamental principles underlying preservative treatment of wood, and its use for the production of fibre products.
3. To develop practical ways and means of using wood which, under present conditions, is being wasted.
4. To serve as a public bureau of information on the properties and utilization of forest products.
5. To co-operate with consumers of forest products in improving present methods of use.

The work carried on at the Forest Products Laboratories leads to a better utilization of our forest resources, viz:—

- 1st. Finding more efficient methods of manufacture of woods.
- 2nd. The elimination or utilization of the wastes of manufacturing and logging.
- 3rd. Finding use for woods not now commercially useful, from a study of their mechanical and physical properties.
- 4th. Finding better use for woods now used to make the lower-grade commodities.

5th. Looking for Canadian woods to substitute for imported woods, either in their natural state or after treatment.

6th. Studying and developing the fundamental principles underlying the treatment of wood in its use in the manufacture of fibre products—alcohol, turpentine, resin, tar, etc.

7th. Serving as a public bureau of information on the properties and utilization of forest products.

8th. Co-operating with consumers of forest products, in improving present methods of use and formulating specifications and grading rules for commercial woods, materials secured from them (such as gums, oils, resin, etc.), and materials used in the treatment of wood (creosote, zinc chloride and other preservatives).

The work of the Forest Products Laboratories will be divided into the following subdivisions:—

1st.—Timber physics.

2nd.—Tests of the mechanical properties of timber.

3rd.—Pulp and paper.

4th.—Wood preservation.

5th.—Wood distillation.

6th.—Chemistry of woods and wood products.

7th.—Pathology and agencies destructive to wood.

It is proposed to develop the work of the laboratory in units, commencing first with timber physics, timber tests and pulp and paper.

The United States Forest Service has a fully equipped laboratory at Madison, Wis., which employs eighty people and spends annually in operating expenses \$125,000. It has been organized for four years and already at least half a dozen companies with individual capitalizations up in the millions are operating, or building to operate, on the results of the investigations carried on at that laboratory. The benefits and results are striking and immediate. The fields of investigation in all the departments are very broad and in many cases only partially developed. The general purpose of the Forestry Branch Laboratories will be to adapt information and data already obtained elsewhere to Canadian materials and conditions and to further investigate problems and projects which directly affect Canadian interests.

The following summary of the kinds of work conducted at the laboratories will give a fairly comprehensive idea of its field of work.

#### PHYSICAL CHARACTERISTICS OF WOOD.

The physical properties of the woods studied will be specific gravity, shrinkage, microscopic structure, and, in the case of some species, specific heat and heat conductivity. Data secured from investigations of this class are chiefly used in correlating the results of other experiments.

A study of the physical properties and characteristics of Canadian woods is most important and fundamental to any advance that can be made in the investigation of the uses of wood. A knowledge of this is necessary for the other work of the laboratories. This department will operate in connection with the properties of Canadian woods with those of other countries, and determine accurately and completely their physical characteristics. The work will include the making of photo-micrographs of all Canadian woods and the study of the variation in properties due to variation in natural conditions. In this section will be included the important work of wood conditioning, dry-kill and air-drying problems.

#### MECHANICAL PROPERTIES.

Industries seeking new woods for their raw material must have accurate knowledge of the mechanical properties, such as strength, resistance to shock, bending, elasticity, checking, shrinkage in drying, etc. It is proposed to carry

on this work in exact accordance with the United States Forest Products Laboratory methods, so that all the Canadian species tested will be directly and accurately comparable with all the American woods. This will enable users of the laboratories to investigate intelligently the possibilities of Canadian woods. There is a keen discussion among builders as to the various merits of different woods for their various purposes. It will be the duty of this section to place all woods on a comparable basis, so that their relative merits may be equally discovered. The tests will be made on small clear specimens free from defects, on structural timbers in their manufactured forms, such as spokes, axles, etc. Tests are also made to determine the effect of methods of seasoning, preserving and fire-proofing on the mechanical properties. The general purpose of work of this character is to furnish engineers and architects with data upon which to base moduli for design and upon which to base material specifications, to permit manufacturers using wood to judge the desirability of substituting other woods for those becoming scarce, and to determine how wood can be seasoned and treated with the least injury to its strength. The actual tests will be made by breaking the specimens under examination and determining the loads which they will carry or the shocks which they will stand. The wood will be subject to bending, twisting, compression, shock and moisture, the effects of each being noted and the aggregate results determining the value of the wood for any specific purpose. The equipment used will be very similar to that by which steel is tested and which is now considered essential to all design and use of steel.

#### PULP AND PAPER INDUSTRIES.

The pulp and paper work of the laboratory comprises the study of the uses of different species and forms of wood for the production of pulp and paper products.

The chief purposes of the work are to determine the value, for the production of pulp, of woods not being used at present, and to conduct experiments for the purpose of perfecting present methods of manufacturing wood-pulp. Especial attention will be given in this work to the development of methods of manufacturing a commercial pulp from woods at present being wasted.

This is one of Canada's largest and most rapidly expanding industries. This country has trebled its production of paper in the last three years. Very few woods are used in the manufacture of paper. The United States laboratory at Madison, Wis., is adapting processes for using other commercial woods in special kinds of papers. There are in this country many species which might be found suitable for the manufacture of pulp. Last year over half Canada's pulp-wood was exported to the United States, instead of being manufactured in this country. Better methods and less waste will enable Canada to be the leading pulp and paper country in the world. No agency is so well adapted to use in the development of this industry as the Forest Products Laboratories. The Canadian Pulp and Paper Association heartily endorsed this laboratory, so that this section is assured of the unanimous support of the manufacturers whom it will benefit. The equipment provided in the estimates will be complete, and will place this laboratory on a commercial basis, so that the results obtained will be directly applicable to mill work. It will include a small-sized paper machine identical with machines used in modern mill practice, two digesters—one for sulphite pulp and one for soda pulp—computing equipment, screens and all the necessary equipment for the commercial manufacture of paper. All machines will be adjustable to make any combinations necessary for a thorough investigation of all the variables entering into paper manufacture. The paper machine itself will be capable of manufacturing all grades of paper, including wrapping, writing, news, kraft, board, etc.

It is found in the United States Laboratory that the pulp and paper section alone has justified the existence of the laboratory many times over. The

former director of the laboratory is now with a private corporation in Southern Florida erecting a large plant to manufacture long leaf pine into paper, being the result of investigations which he carried on at Madison. There is also at Cornell, Wis., a \$3,000,000 mill manufacturing steamed ground-wood board from jack pine, the result of investigations conducted on the steaming of wood by this laboratory. Canada offers enormous opportunities for such investigations to bring immediate and far-reaching results.

The special problems that this section will deal with at present are: (1) methods of making ground-wood pulp to determine whether or not commercial pulp can be made from species other than spruce; (2) the practicability of treating different woods with the sulphite and soda processes; (3) the qualities of paper which can be made from different grades of the various sulphite, soda and ground-wood fibres; and (4) the practicability of using different forms of wood waste for the manufacture of paper pulp and other fibre products. The manufacture of wood-pulp and paper is to be one of the largest industries in Canada and the problems that offer themselves are of vital interest to the country.

#### ARTIFICIAL DRYING OF WOOD.

This class of work includes the study of commercial dry-kilns and their operations; also the experimental study of different methods of drying wood. The proper seasoning of wood is a very important factor in its use and one which is at present too frequently neglected.

#### AGENCIES DESTRUCTIVE TO WOOD.

The office of Forest Pathology will be located at the laboratory for the purpose of studying wood-destroying fungi and how they are affected by various wood preservatives. The chief purpose of this work is to suggest ways and means of perfecting the preservative treatment of wood.

#### WOOD PRESERVATION.

This division of work includes all problems dealing with the impregnation of wood with preservatives, fire-proofing substances and other materials. At present its attention is largely directed to the study of preservatives and preserving processes. Wood preservation concerns principally the railways, mines and other large consumers of structural timbers, but it also is of much interest to the building trades and to municipalities interested in wood as paving material.

These problems may be broadly classified into:

- (a) Those dealing with the preservatives themselves;
- (b) Those dealing with the methods of getting the preservatives into the woods.

To study the first class of problems, this laboratory will be provided with a fungus pit, which will contain chambers thoroughly inoculated with various wood-destroying fungi.

The humidity and temperature of the pit is so regulated that conditions in it are most favorable to the growth of fungi. Wood will be treated with different preservatives and placed in the pit. The efficiency of the preservative will be determined by its ability to resist the fungi.

In addition to such laboratory experiments, timbers will be treated and placed in actual service and will be carefully inspected at periodic intervals.

The second class of problems are primarily problems of mechanical engineering, dealing with the methods of forcing the required amounts of various preservatives into the different species and forms of wood.



#### WOOD DISTILLATION.

This line of activity is directed to the study of methods of distilling wood and methods of refining and grading the products secured. Work will also be done to demonstrate the practicability of using certain of the products for different purposes, thus creating a market for them. This work bears directly on the possibility of using the enormous quantities of mill and forest waste. The work of this section naturally divides itself into:

(a) Experiments to determine what products and how much of them can be secured from different woods.

(b) The design and operation of machinery best adapted to the production of these products having the greatest value.

(c) Refining of the crude products.

#### CHEMICAL CHARACTERISTICS AND PROPERTIES OF WOOD.

This work consists of experiments to determine the quantity and quality of essential oils, tanins, gums, and other products which may be secured from different woods. It bears directly on the practicability of using certain forms of forest waste.

The work of the section of chemistry is largely supplemental to the work of the other laboratories. Its purposes are:

(a) To find uses for products at present having little or no commercial value.

(b) To secure data upon which to base commercial specifications for wood products, wood preservatives, and other products secured from or used in the treatment of wood, and to investigate chemical problems that come up in connection with the work of the other sections.

#### PUBLICATION OF RESULTS.

As perhaps the chief purpose of the Forest Products Laboratories is to serve as a public bureau of information in the field of work which it covers, when problems of general interest confront commercial organizations the Forestry Branch will co-operate with these organizations in their solution, supplying the skilled supervision of the work and retaining only the right to publish the results.

The possible value of the Forest Products Laboratories to the lumbering and wood-using industries will be readily recognized by all who are familiar with the problems confronting these industries. The actual value of the laboratories, however, depends upon its ability to obtain results capable of practical application. To secure such results to the fullest extent it must have the support and co-operation of the men who are in constant and intimate association with commercial problems. The Branch, therefore, invites such men to share with it the responsibility of making the Forest Products Laboratories play an important and useful part in reclaiming the wastes of the forests and in increasing efficiency in the commercial uses of wood.



