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*The Application of Scientific and Practical
Arboriculture to Canada.*

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Synopsis of a Paper read before the British Association for the Advancement
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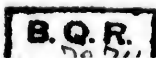


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The Application of Scientific and Practical Arboriculture to Canada.

Paper by Prof. Brown of the Ontario Agricultural College.

Is there any country whatever that has made an eminent agricultural history and does not now complain of want of trees?

Advanced nations are not discussing the worth or worthlessness of trees in their rural economy; they are considering how best to secure the fullness of the value thereof in all their bearings. In doing this much serious consideration is necessary. It would be very unwise for any country to rush into extensive tree planting without a clear idea as to how the work should be begun, carried out and maintained. It is my purpose briefly in this paper to show what Canada can do in the scientific and practical application of arboriculture, and before handling the subject as a forester, allow me to submit some general views.

Canadian forestry will have no place in all its scientific and practical value until one of two things be accomplished: One is the conviction on the part of her farmers of the necessity of conserving and replanting, therefore, their education up to these; and the other is the power by Government to resume parts of the country for conserving and replanting. Both will be difficult. The former would be the slower but eventually the most thorough because of self-interest; the latter would be more immediate and possibly less efficient, practically, though scientifically better applied. No large number of various interests could be so well

arranged as by a company, and therefore Government, as a company, will have to become foresters in all the many details of the profession.

Much of our indifference in this subject arises from the common idea that the planter cannot himself personally hope to receive all the benefits from the conservation of the present trees, and particularly from replanting. American returns, to the American, must be smart, strong, and undoubted; the idea of permanency in the long after years does not concern us so much as now. In Europe it takes a shape that may never be realized here, because of one thing—that one thing is large proprietary, the possessing within one man's power all the area and class of soil suitable to profitable production on a large scale, so that even that one man can employ officers and men in such number as make profits certain. Cultivated Canada meantime is so sub-divided as to preclude all idea of sufficient massing of woods to receive equal results with Europe,—but the day may come, and meantime progress must be made otherwise.

I believe it is the experience of the world, that more difficulty, in various forms, is found in reclothing with trees where trees grew before, than it is to plant, not replant, a country for the first time. There is not only the practical fact of succession of cropping in its scientific

and natural bearings, as similarly realized for example in the products of the field, but the more serious one of the indifference of those who cut the first crop. Most of us think of trees as means of shelter, under several forms. We like shelter for buildings, shade for ourselves, shelter and shade for animals in the field, and shelter for farm crops. These alone would make up a large value in any district where required, and would justify all the cost and subsequent attendance. Yet we have another aspect of the question that takes an equally strong place in our regard: *Climate* is not alone a matter of great outside causes, but one intimately related to local influences, among which trees are pre-eminent. We have no time to show how temperature, rainfall, moisture, and evaporation are directly influenced by a small or large surface of trees, and how, therefore, water is largely in the hands of trees for local distribution. This second duty of forestry as a science and practice would even seem to swallow up the previous question, and is consequently inducement alone to its prosecution on our part. Were neither of these sufficient, however, to convince, the third great reason for tree cultivation will surely convert even the most American amongst us. It is no matter of doubt, under average conditions, in any country, that tree culture is more profitable as a crop than its own agriculture, year by year. This position is not open to question, but clear and marked in all experience where age has given time for proof. The area of trees in Canada is not an unknown thing in the older districts, and it is not true that it is poorer wooded in comparison with other countries. The United States can show twenty-five, and Canada nearly fifty per cent. of the cultivated districts as still under trees. This is possibly larger than any other continent, if we except the northern part of Europe, where agriculture is necessarily a discount, and where forest is practically untouched. The cause of our discontent then is not want of forest per nation but its regular distribution to subserve all the needs of the nation.

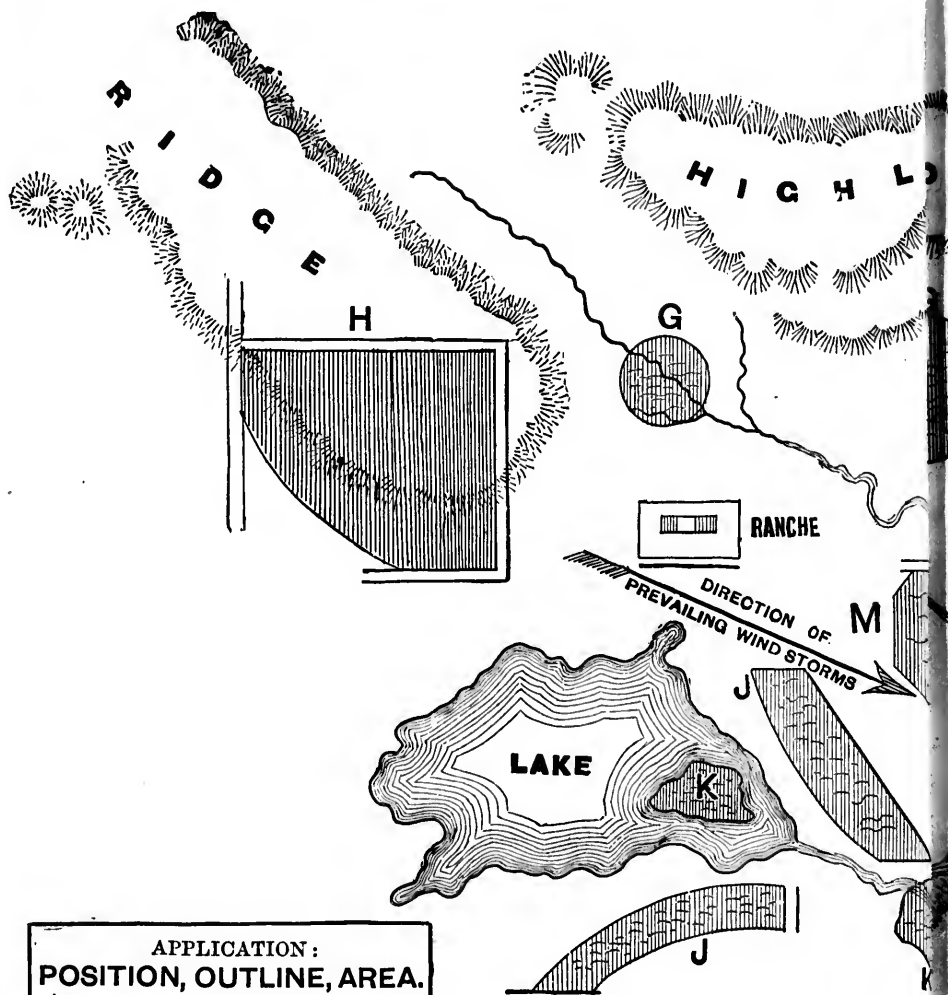
The existing condition of our forests is the very first consideration in this enquiry. Outside of the lumbering interest, which of itself is simply a taking without system, there is no enclosing, preserving, caretaking, or conser-

ving in any sense except the right of individual ownership, some of whom do act the forester, but nationally there is nothing recognized. The average "bush" of North America is a beautiful sight and yet a sad one. The artist must revel in its variety of form and foliage, but the fighting for place, the smothering and rotting for want of light and air can only be estimated by those who are scientifically and practically foresters. I do not mean that our forests in every case should be managed similarly to those in Europe, because much of our best timber requires very different conditions, but similar principles ought to guide our management.

There are really no figures to give as to the extent of Canadian forest, either as to gross area or special kinds of timber. The small map recently issued by Dr. Bell, of our geological survey, gives a good idea of the northern limits of the principal trees, but, of course, it cannot help in either of the particulars named. As the country, with the exception of prairie, was originally all forest and as we have cleared about 25,000,000 of acres for agricultural purposes, it may be said that the whole country is still under trees with these exceptions. What the extent is to a million acres nobody knows, nor do a million acres one way or the other affect our subject.

We have four distinct fields of operation in the future of Canadian forestry: 1st. The untimbered lands such as prairie. 2nd. The older cleared portions. 3rd. The recent forest settlements, and 4th the untouched forest. Each of these will require different methods as to conserving, clearing and replanting, although all will be subject to one grand system of operations. To submit details now would be unnecessary when the object is to impress principles.

But yet another aspect of the question is the requisite proportions of tree surface to that under farm crops. What should it be? This is just one of the things that we do not know and that we are not likely ever to know as a point for general practical guidance. When I had the honor of addressing the British Science Association, at Dundee, in 1867, and at Norwich, in 1868, upon the claims of arboriculture as a science they knew little upon this point in a



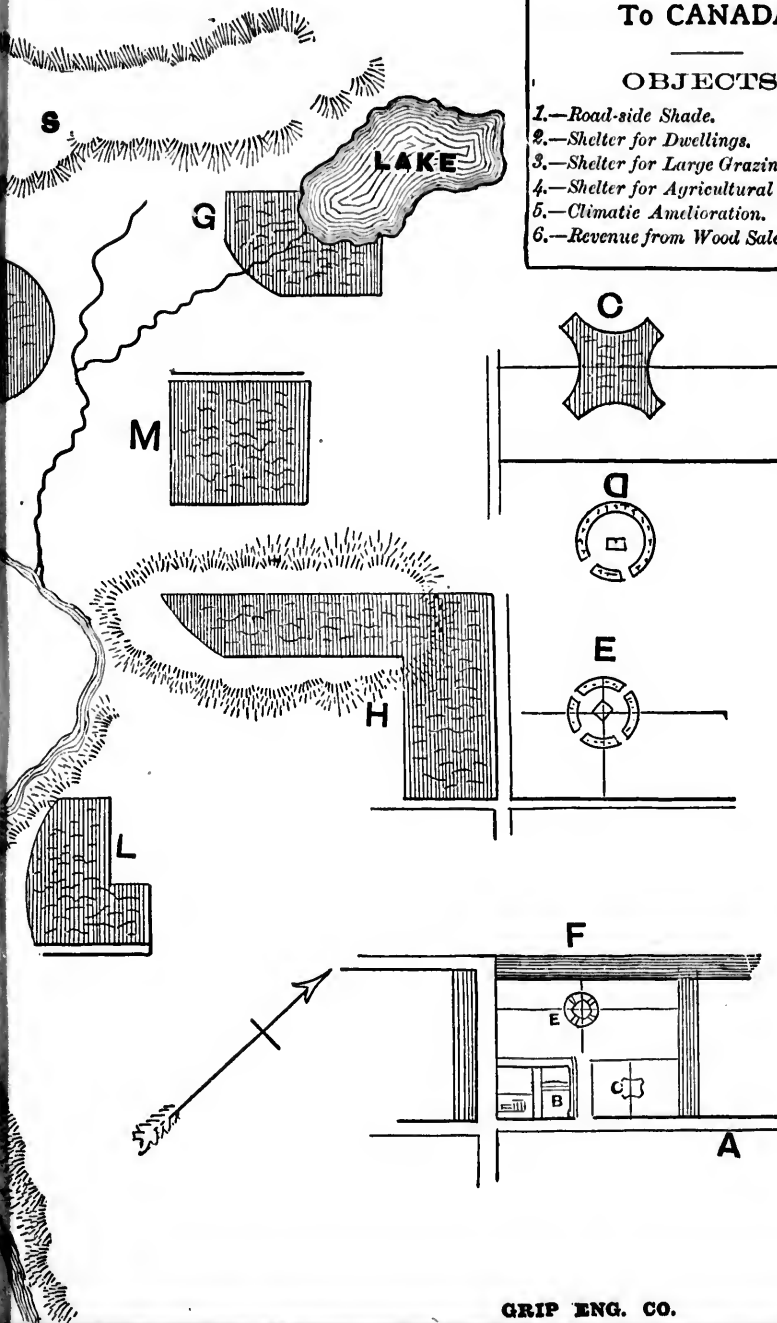
**APPLICATION:
POSITION, OUTLINE, AREA.**

- A.—Road Side Shade.*
- B.—Shelter for Dwellings.*
- C.—Shelter for Animals—Two Fields.*
- D.—Shelter for Open Grazings.*
- E.—Shelter and Water to Four Fields.*
- F.—Shelter for Farm Crops.*
- G.—Head Water Plantations.*
- H.—Great Wind Breaks.*
- J.—Lesser Wind Breaks.*
- K.—Sub wind breaks.*
- L.—Conjoint Wind Break and Climatic Plantation.*
- M.—Great Climatic Plantation.*

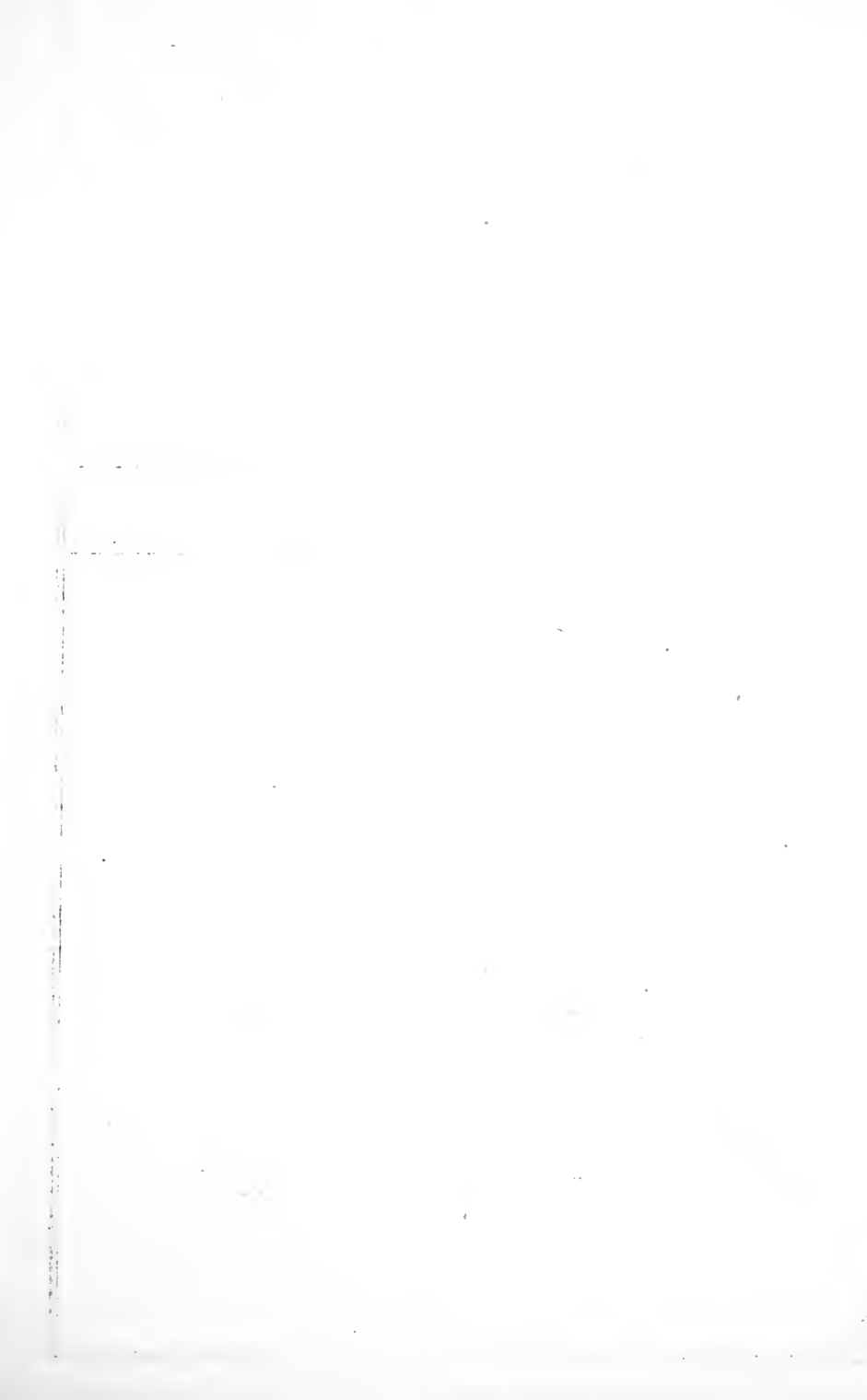
**THE APPLICATION
OF
Scientific and Practical Arboriculture
To CANADA.**

OBJECTS ;

- 1.—Road-side Shade.
- 2.—Shelter for Dwellings.
- 3.—Shelter for Large Grazings.
- 4.—Shelter for Agricultural Crops
- 5.—Climatic Amelioration.
- 6.—Revenue from Wood Sales.



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country possessing greater physical distinctions than Canada. The conditions are so various as affected by climate, altitude, latitude, aspect, soil, sea or lake neighborhood and vegetation, that no possible number of observations in any length of time could say how much for one district or so much for another. However, men do come to realize through science and practice—practice especially—that a farm or district needs the protection in certain places, and thus a country could easily be reclothed to the extent required for such shelter, if not for regulation of climate and other considerations, to which we will soon refer. The point then of immediate shelter is within everybody's knowledge, and needs no scientific guidance, and I may here say no governmental spurring. But the greater field of climate as an unknown one practically in this relation, is more a national problem, and still very much a scientific inquiry, and what it will have to say in regard to the proportion of trees to farm crops no one can tell. Of course if men disregard everything but the direct profits from trees as a crop upon land, another century may actually find some countries going back to the days of too many leaves and too little arable. Viewing trees in all their relations I am of opinion that upon an average of conditions in Canada, one-fourth of the surface should be covered by them, and as this is just one-half of what we have at present all over the forest districts, there rests the apparent inconsistency of wanting to conserve and replant all the while that we possess double what is required. This brings out the fact that it is the *irregular distribution* of tree surface in our case which gives trouble,—that some parts have more than required, and others have been overcleared.

As the subject grows upon our attention, we are next concerned with what parts of the country should be conserved or replanted, and in this part of the study it is obvious that our views cannot be confined to single farms or even special sections. Referring as we must to the great overruling influences, as previously indicated, we have to deal with geographical features that may embrace thousands of acres that have to be subserved with one or more massing of trees. Just where to conserve or replant, how much on the spot or spots, so as to gather and dispense all the virtues that trees are known to possess, is the great problem of the

future. To say that we should only replant our less valuable soils is nonsense, though apparently sensible enough from an agricultural standpoint; that high lands should be conserved or reseeded as against lower parts is largely true, though not generally applicable, and that conserving and replanting must go hand in hand and take place anywhere as found best through experience, is correct in every sense.

Following this view of the subject there is naturally that of suitability of certain kinds of trees for special purposes. We have soils and climates wherewith to do almost anything in tree life from the pine of the far north, which luxuriates in an apparently bare rock cleft, to the walnut of the south, that must send its caroty root several feet into a rich soil. The preparation of the soil, methods of planting, including fencing, draining, knowledge of enemies and friends in nature, and all the management throughout, in order to attain the highest results are not for our time on this occasion.

In connection with this branch of the subject, however, allow me to present to the Association some copies of a list of trees which I use in teaching at our College, and classified similarly to those in Loudon's work.

And now for the more special purpose of these notes,—and in order to place myself properly with the Association, it is fair, as a matter of business, to note that what I am advancing is founded on British experience, beginning in 1854 and ending 1870, during which time I had the immediate control of the formation, the planting, and subsequent management of something like twenty one millions of trees, principally on the Seafeld estates, in Banff and Invernesshire, and the Invercauld estates in Aberdeenshire.

In order to succeed anywhere there must be put in operation, upon a system, such a combination of the scientific and practical knowledge that at present exists as shall most likely bring about the fullest realization of tree value. That system is universal in its application, however small or large the scale, or however varied the conditions. Whether we pull down or rebuild, or make entirely new, the system will apply, and as it is by entirely new work that any system is best exhibited I will ask you to go with me to the Prairie. The subject then is almost

an entirely treeless one, with an undulating, but generally uniform level surface, an occasional ridge, a lake, a river, cutting deep through the unshaded land, and bounded on the northwest by high lands as I have outlined on the map. Here, men need never hope to gather wealth of agriculture in all its branches without the help of trees. I think there exists nowhere in the world an example of *universal farming reliability* unattended by trees. I see no great future for Manitoba and our Northwest unless extensive systematic forestry precedes. The sooner our Government realizes this the better. All methods of farming, railway and water communication, minerals, natural grazing, or any other form of good things will never "make" a country without trees. We are not theorising in this. *A peopled agricultural country is an impossibility without trees.*

In our treeless region, therefore, experience has made us acquainted with a variety of wants that can be subserved by trees, and science points to more. Together then they make up a bill that may be thus summarised :

1. Roadside shade.
2. Shelter for dwellings.
3. Shelter for cultivated farm crops.
4. Shelter for open natural grazings.
5. Shelter for enclosed grazings.
6. Head water conservation.
7. Wind breaks.
8. Climatic amelioration.

Either of these would of course serve more purposes than that implied by its name, but a full illustration of the system requires a form for each.

Now this map professes to show all these : from the single shade tree up to the great climatic plantation, the area or district embraced and the size of each of the classes would be subject to requirements, from one acre to as much as 1,000 acres each ; the system or principle is not affected by size, but, position and form, or outline, are prime factors.

Size would be regulated by the particular physical features of the district and the object in view ; form by prevailing winds as well as the particular object and partly by physical features.

In our prairie example on the map we have a farm of 160 acres made up as follows :

Timber	30	acres
Cultivated	125	"
Orchard, garden, buildings, roads ..	5	"
Total	160	"

The fields and roads lie northwest and southeast, and therefore also northeast and southeast. By preference the buildings are situated on the southern angle of the farm at a junction of a concession and a side road. In the first place the roads are lined with shade trees, which serve as shade to animals in some of the fields as well. Then the dwelling house and orchard while open to the southeast, south, and southwest, are shaded by ornamental standards and lined on the north and northwest by trees. This tree line may be called the 2nd sub-wind break of the farm. The barns with two small fields or paddocks, are also open to the south and protected from the colder winds by a narrow belt of timber in positions similar to the others. The six other fields are, in the first instance, sheltered by a broad belt all around from the east, via north, to the west, capable of breaking and mellowing the whole farm for cropping. But, for live stock, under such circumstances, and with twenty acre fields it is necessary to provide other shade and shelter. This is best supplied by what I have proved in actual practice both in Scotland and Canada. I know of no better form and position of a shade and shelter clump of trees than that illustrated in Fig. C., and the position of which is also shown in our farm example. It serves two fields, and from whatever direction the wind comes, or the sunshines, the animals can find a retreat in either field. You cannot shoot a straight line across this clump and not find a safe corner.

Then, in the adaptation of one form of shelter to four fields (Fig E) is neat and serviceable, and when supplied with water in the centre is a very valuable acquisition to pastures. In the case of extensive open grazings, the circular belt (Fig. D) is also best for various reasons. It resists and breaks wind storms better than other outlines ; it is less liable to damage by cattle or wind, is more compact and affords more outside shelter. There should be two passages not far apart and facing south as much as possible ; one passage is not enough with a large number of cattle going and coming, and

provision is necessary for a stack of hay in the centre.

These are what may be called the purely agricultural divisions of arboriculture, and are definite and practical enough, upon which little difference of opinion is likely to arise. In what remains of my subject there may be not only difference of opinion in regard to details, but considerable difficulty in satisfying that anything more is needed than what has already been sketched. It will be said: As each farm has its proper amount of shade, shelter, fuel supply, and even wood revenue otherwise, what more does the country require?

I have not seen in any work on rural economy that it is as much the duty of nations to administer their arboriculture as their laws of health. Then while everyone acknowledges that without the proper measure of trees there cannot exist the proper health, political economy, science, agriculture and all society, is equally interested in this question, and as I have already indicated its national aspect, it is only necessary to point out how more than the immediate farmer's work is required.

Over a great plain, such as our prairie, where storms rage unchecked, where rains come and go irregularly and uneconomized in any form, and where sunshine is unmellowed, it is necessary to establish agents for the purpose of subserving these and other climatic purposes. Assuming that all the country were planted to the extent already shown for immediate farm use, there exists nothing in particular spots,—no plantations exactly placed to conserve head water streams, no great and small wind breaks, and no great climatic plantations,—the agents respectively.

On the map these are shown in position, proper outline and extent. *Position* is regulated by elevation and neighborhood of other physical conditions, such as water surface, and high land; *outline* is regulated by direction of prevailing winds, conformation of surface, and partly by public roads, while the *extent* is directed by the indefinitely known influence that a certain body of trees possesses on climate; climate being understood as distribution of rainfall, evaporation, natural drainage, and temperature.

I am aware that we cannot reason on this from any clear or precise experience, and are driven to draw conclusions from actual facts, and there seems to be no doubt that it requires a certain massing and kinds of trees to ameliorate climate, narrow strips and clumps being insufficient, or incapable of doing so.

Head water plantations, as implied in the name, must surround, or be in the immediate neighborhood of, sources of streams, and have an outline to nurse them, with area consistent to the importance of the source. The circular form is good and applicable to the two springs at G., or it may be oval as illustrated at the mouth of the valley, and would also take the position and area of that at the small lake.

Great wind breaks being meant to fend the smaller plantations as well as particular districts, have to be carefully outlined, of very considerable extent, and must command an exact position. In the example of H. on the ridge, which is designed to break the storms from the adjoining ranch, several points are noticeable: The land occupied by the plantation is within one block, or range of roads, and therefore does not encroach; it occupies also part of a ridge that generally is less valuable for agricultural purposes, it is formed to cut or feather the storms that prevail in the district—south west by west—a point in forestry of very great importance indeed; it is massive or in sufficient body to resist and break, and it is so situated main force of the storms. It may be remarked that it would be better to extend the plantation eastward upon the point of the ridge, this I have avoided in order to make the example more difficult.

The other great wind break is of a different form, while serving a similar purpose. It parallels with the public roads, makes no awkward corners for cultivation of adjoining land, faces prevailing winds with the exception of southeast end, and will protect a large area of country.

Lesser wind breaks, as at J., are placed where, either by the form of the country on the prevailing wind side, or where a larger break is difficult to establish. The example on the east of the large lake exhibits both. Position here is very important and it will be observed that outline and area are arranged to receive the

stakes across the lake, break them, and yet yield them.

Sub wind breaks are easily arranged and can take various forms and sizes to suit conditions as at K.

Another kind of plantation, as already referred to, is that which I call climatic,—the objects of which have been explained. Their position in a country among others is not so easily reasoned, either scientifically or practically. Area is obviously of more consequence than form, because it requires a great field of leaves to do what leaves are said to do in climatic amelioration. M. with eight sides, and the other with four, are designed as concentrated masses adapted to Canada, and of course in their case, more than other plantations, the cost of establishment would be less per acre, and would also better meet the item of revenue. L. is an example of a conjoint-wind break and climatic plantation.

Canadian forestry, whatever its future, will never realize all it should unless hand in hand with science.

ESTIMATE OF FINANCIAL POSITION OF A MIXED PLANTATION OF 100 ACRES IN CANADA,

(Manitoba and the Northwest particularly.)

REVENUE.

1st Thinning when 15 years old, 3,000 poles, 20 ft long at 3c.....	\$ 90
2nd Thinning at 18 years; 8,000 trees, at 5c.....	400
3rd Thinning at 25 years; 15,000 trees, 12 inches diameter at base, 40 feet, at 30c.....	4,500
4th Thinning at 35 years; 25,000 trees, 20 inches diameter; 50 feet, at 50c.....	12,500

5th Thinning, at 40 years; 30,000 trees; 22 inches diameter.....	22,500
6th Thinning, at 45 years; 21,000 trees, 25 inches diameter, at \$1.00.....	21,000
7th Thinning at 50 years; 18,000 trees, at \$1.10.....	19,000
Gross Revenue.....	\$ 80,000
10,000 trees felled, leaving 20,000 trees, or 200 per acre as permanent crop.	

EXPENDITURE.

1,000 rods of fence, at 75 cents.....	\$ 750
Drainage of portions.....	250
150,000 trees, 1 year seedling, 1 year transplanted, at 1 c.....	1,500
Planting same.....	575
Freight on trees.....	150
Original cost.....	\$ 3,225
Per acre.—\$32.	
Replanting failures for three years, 5,000 trees	100
General attendance, up-keep of fence, &c., for 15 years.....	800
Gross cost.....	\$ 3,025
Per acre until revenue begins—\$36.	
Cost of thinning and hauling to roads.....	\$ 13,100
General superintendence and incidentals for 35 years.....	3,500
Gross expenditure.....	\$ 20,225
Balance being clear revenue.....	\$ 60,565
	\$ 80,790

No allowance is made for interest on outlay and rent of land, on the one hand, nor for interest on revenue, and value of grazing for 25 years, on the other hand. Neither is credit given for climatic amelioration, not for value of permanent crop.



