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Adirondack Forest Problems

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ADIRONDACK FORESTRY PROBLEMS.

The State of New York is the first and only State in the Union to have entered upon a definite policy of forest conservation, acknowledging the necessity and duty of the State to assume the protection of its most important watershed and of the forest cover thereon, and recognizing that in State ownership alone lies the assurance of its continued conservation.

Such a policy, now firmly established, presents a number of problems which are partly of an administrative, partly of a technical nature. Some of these are still partly unsolved, and the solution of others has not even been begun.

Ownership.

The main and fundamental one, the problem of ownership, has been practically settled by various acts of the Legislature, namely : in 1883, when the State determined to retain the forest lands which it then owned ; in 1885, when it placed them in the care and custody of a Forest Commission ; in 1890, when the first act authorizing the purchase of additional lands was signed by a democratic governor, with the memorandum affixed that the act was good but inadequate ; and finally in 1897, when the Legislature and a republican governor created The Forest Preserve Board, giving it authority to acquire for the State, by purchase or otherwise, control of the entire region within an outline comprising three million acres more or less, or as much thereof as might appear desirable.

The acquisition of lands has proceeded cautiously and slowly. Unfortunately, the State did not embrace the opportunity, when it existed, of acquiring these lands at a low price, and although purchases have hitherto been made in most instances at a reasonable enough figure, the delay has had three undesirable consequences, namely : first, to raise prices ; secondly, to allow a further decrease of virgin forest lands and deterioration of the same by wasteful logging ; and thirdly, to allow large tracts to be bought up by private individuals and clubs for game preserves. While at first sight the passing of lands into conservative private ownership does not appear objectionable, inasmuch as the object of the State, namely—a conservative treatment of the forest cover—may as a rule be expected from such owners, there is no absolute assurance of the continuance of such con-

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servative treatment. Besides, not only would public ownership of the whole give more satisfaction to the people at large, but in the administration of its property the State could only be benefited by a consolidation of the same and the elimination of interspersed properties. Consolidation and uniformity of administration is perhaps more desirable in forest properties than in other properties. Take alone protection against fires: a careless neighbor's neglect in preventing the many causes of conflagration puts to naught the effort of the more careful. Again, accessibility and means of transportation are of first importance, while foreign possessory rights might often hinder the development of most desirable means of transportation.

Even now the State would not make a mistake, financially or otherwise, if it were to settle the ownership question at once, and acquire without further delay the balance of what it intends finally to own.

Administrative Problems.

The next problem is that of the administration of the property. At first a forest commission of three unpaid commissioners was charged with this duty of the "care, custody, control and superintendence of the forest preserve," and the law declared that "it shall be the duty of the Commission to maintain and protect the forests now on the forest preserve, and to promote as far as practicable the further growth of forests thereon"; also, to "have charge of the public interests of the State with regard to forests and tree planting, and especially with reference to forest fires in every part of the State."

In 1893 the number of the Commissioners was increased to five, with additional powers as to acquisition and lease of lands, and especially the specific power, with certain restrictions, "to sell the standing spruce, tamarack and poplar timber, the fallen timber and the timber injured by blight or fire." Another change was made in 1895, when an amalgamation of fisheries and game interests with the forestry interests was provided and the (five) Commissioners of Fisheries, Game and Forests were installed. The realization that the forest interests are decidedly more important than the other two interests has lately led to the change of name by which "forests" are first mentioned in the title of the Commission.

Whether by the consolidation any benefit has come to the forest policy is doubtful, although it would have been advantageous if the consolidation had been more in substance than in name. It would, for instance, have been advantageous to combine the functions of protecting fish and game and protecting the forest property in the same officers; especially within the forest preserve such arrangement would be only logical.

It has been suggested that the change from a five-headed commission to a single-headed one would insure greater efficiency. Theoretically, such a single-headed administration may be commendable provided a man of unusual capacity, broad-mindedness and experience is put in the place, just as the wise and moderate tyrant or king is said to represent the most beneficent government. With our democratic principles of government, however, it would appear that wherever public policy, not single will, is to be administered, a judicious council representing varied interests would be more apt to give satisfaction, provided that it relies for executive work on expert advice and assistance and on single responsibility of its executive officers. In the end the question of the personnel of the commission, rather than the number, is the important one, and still more important, the organization under the Commission and the objects to be attained through that organization.

The first object of the administration, naturally, must be protection of the property ; and that means, with forest property, mainly against the dangers from fire. This is the first and foremost administrative problem. The only way to furnish that protection is by proper organization of the fire service, and by reducing the causes of forest fires.

Forest Fire Problems.

Forest fires in the Adirondacks are of very varying character, according to the condition of the ground on which the fire occurs. In the openings, in the slashes, in the sandy flats which used to be occupied by pines and which were burned over repeatedly after the lumberman had made the *débris*, on the rocky shores of lakes which the hunter's camp fire has wasted again and again, the fires run fiercely, fanned by the winds that have access here, burning up the young growth which is trying to establish itself. As a rule, when a fire breaks out in these wastes, it burns at least the entire area that had been burned over before, and also gradually eats into the hitherto untouched surrounding growth. In most cases, when such a fire has once gained headway it will run its course, all human efforts notwithstanding, until a rain, or a watercourse, or a swamp stops its spread ; or until it has reached the green timber, where it may be checked. These are the dangerous fires and the most difficult to cope with.

On the other hand, the fires on the covered hardwood slopes are progressing slowly ; they smoulder persistently in the soil, however, wasting the stored accumulation of vegetable mould, and causing the fall of trees without necessarily burning more than their roots. It is possible, with due vigilance and without great effort, to subdue these fires or keep them in check.

It is evident that different methods must be pursued in these different cases. The present law provides a system of firewardens whose duty it is to put out fires. This duty they may be able to perform in the last described cases; but it is almost if not entirely impracticable or impossible in the first class of cases. There are, besides, mechanical limitations to performing the duties of a firewarden over too large a territory; hence the appointment of a sufficient number of deputies, properly chosen, properly located and properly instructed, to act at least during the dangerous season, is necessary. Nor is it sufficient to have these firewardens employed only to put out fires, to go to fires when they have assumed dimensions. They should patrol their beats regularly through the dangerous season, prevent the starting of fires by their vigilance, and extinguish the small fires in their incipency. The cost of such service, if efficient, will be large and an argument against it. As long as a fully organized forestry service is absent, in which the fireguards perform other necessary duties and useful work besides their patrolling, the objection is valid.

Again, the personnel of the organization is of first moment; and even when proper persons have been chosen, only a constant inspection and oversight will keep the organization alive, its members on the alert.

A great deal could also be done by systematically subdividing the forest area, especially the dangerous slashes and openings, and gradually reducing the *débris* on the waste lands. If the State proposes to hold this property it might as well begin to improve it, to make it grow useful timber instead of weeds, and in doing so remove or reduce the danger of deteriorating these waste lands more. When such clearing and planting operations are actively begun it will be possible, and a financially sound policy, to employ also the necessary force for the protection of the young plantations. Moreover, greater care in the use of fire will be inculcated, when the true value of these waste lands, and the fact that an expenditure for their improvement has been made, forces itself upon the attention of the careless. As long as these areas are treated as worthless wastes it is natural that they are carelessly treated as such.

There is one serious drawback in existing arrangements which could readily be improved. It is the manner of paying for the service of fire fighting. At present, bills are audited and paid by the towns; the tedious delay of such payment is discouraging to the men who have to wait for the hard-earned money for many months. Authority to make the necessary outlay on the part of the Commission, for which the Board may then seek reimbursement through the town, is the ready remedy.

Technical Problems.

While these problems in the mechanics of administration are readily understood—and their solution is not difficult—the problems of technical management of the property are more difficult to solve. What is to be done with the forest owned and protected by the State? What policy is to be followed in its treatment, and what methods are to be applied?

The first legislation, instituting the Forest Commission, had in view the application of forestry methods to the management of the property; but the Commission failed to devise such technical management, and the people, as is well known, by constitutional amendment restricted the activities of the Commission by forbidding the cutting of trees on State lands, and thereby ruling out a large share of forestry work.

Knowing the history of this amendment we can assert that it was intended, not to establish a policy of non-use, and to exclude forever the application of such forestry work as requires the use of the ax, but rather to delay it until conditions should be more favorable for the employment of technical forestry management. If nothing else were to warrant this conclusion, the establishment of the New York State College of Forestry, with its experimental forest area within the limits of the proposed State Forest Preserve, must stand as an earnest that, ultimately, technical forest management is expected and intended, and not merely leaving Nature to take care of the forest cover.

There is, to be sure, no haste necessary to engage in such technical work; but even now the Commission is in position to do considerable preliminary work and prepare for the future.

There can be no question as to the first step in attacking the problem of technical management. As the physician bases his treatment on a diagnosis, so the administrator of a property must first become acquainted with its conditions. The first step, therefore, towards a technical management of the State's forest property must be a forest survey; *i. e.*, a technical description of the conditions of each parcel in such a manner that its character, conditions, and location can readily be referred to.

The Commission should know not only the acreage of the burnt lands and the virgin and the culled forest it controls, not only the location of each parcel of these, but the condition of each with regard to its possible treatment. Such a description can be satisfactorily made only by a practically educated forester, who, like the physician, diagnoses with a view to devising the remedy.

It is only when the condition of the whole or major part of the property is known that a harmonious, well-considered plan for its

technical management can be devised and followed. It is then that the silvicultural as well as the administrative problems involved become apparent.

It was mainly for the solution of silvicultural problems that the New York State College of Forestry was endowed with an area of thirty thousand acres in the Adirondacks, the tract having been so located as to exhibit the greatest variety of problems that might be met in the entire Preserve.

The silvicultural problems can be classified into at least four groups, with any number of subdivisions, according to the character of the prevailing forest conditions. They will have to deal with the treatment of (1) virgin lands, (2) culled* lands, (3) slashes or burns, and (4) swamps.

Since the virgin lands in the possession of the State represent a proportionately small area, a few hundred thousand acres, they may, like the swamps, be left without detriment to future consideration. It is, therefore, to the culled lands and the slashes, of which the major part of the State property consists, that first attention should be directed.

Making Wastes Useful.

The slashes and old burns and openings of various kinds exhibit quite a variety of conditions, and admit, therefore, the possibility of a variety of treatment. But they are all alike in this, that in their present condition they present the greatest danger from forest fires, and that in most cases they fail to grow useful material. They are not only dead capital, but a menace to the standing timber. Not only do they furnish the best chances for the starting of fires, but, once a fire is started, the winds sweeping over the open, drive the fire with such fury that human efforts to stop its progress are in vain. Usually the fire burns over the entire opening and destroys whatever effort Nature has made to recover the ground since the last fire.

In some places repeated fires have almost cleared the area of the old *débris*, and it is possible to begin at once, without preparation, the planting of valuable species. In other cases there is need of clearing the ground more or less thoroughly of *débris* in order to reduce fire danger and make the planting practicable. The degree to which the clearing must be done varies, and so does the cost.

The College has started the solution of the question of how much clearing is needful and how cheaply this preparatory work may be done, as well as how cheaply a growth of valuable tree species may be re-established.

* Lumbered lands from which the spruce or some other species have been taken.

Sometimes Nature has covered the burn with a growth of aspen or birch, and, if left alone, gradually the more valuable conifers—pine, spruce, and cedar—would establish themselves by natural process. But even here the helping hand of man may hasten the process of useful occupancy of the soil by using as much of the volunteer crop for nurse purposes as may be desirable. Lanes are opened through the aspen growth at varying distances apart, and pines and spruces are set out in the lanes where they will be benefitted by the light shade of the neighboring strips of aspen and white birch.

The species which have been chosen for this planting are entirely taken from the family of conifers. The conifers are the most useful of the trees of the temperate zone; they are required in largest quantity—the consumption in the United States standing as three to one, when compared with the hardwoods—and they promise to continue to hold their position in the market.

White pine is the king of the woods, and, with the development of the pulp industry, spruce is next to the throne; hence these two species should be specially encouraged. Moreover, the hardwoods have, in the struggle for the occupancy of the soil, various advantages which the conifers lack. They will propagate without much assistance, while the conifers, with their greater permanent and economic value, deserve, and with their natural deficiencies in propagating, require the protection and encouragement which may be artificially given to them.

Besides the native white pine, which is in every respect the most desirable species to plant, growing rapidly into useful material, the Norway spruce has been favored. This was first done with hesitation, and mainly because plant material of the native spruce was not readily attainable, while the European species could be had in large quantities and most cheaply. In addition, the European spruce grows more rapidly and produces better material.

After observing older and younger plants and seedlings of this species in their new home for two seasons, expectations have been far surpassed by the behavior of the plants. Of the six or seven species planted, the Norway spruce has shown that it is more perfectly at home than any other, and promises to grow as vigorously here as it has done elsewhere in the United States. The seeds germinate most readily—very different from white pine, which germinates slowly. The seedlings in the nursery stand the drought—the unusual one of the summer of 1899—as well as the frosts of the region, making in their second year shoots of five to seven inches; three-year-old plants set out in the slashes appear among the weeds as born to the manor.

There will be croakers who predict failure in later life, but there is no warrant for such predictions. Whatever experiences there may

have been had in this country, which might lead to such doubts, have not been had with trees planted under forest conditions, and certainly not in this region. I have no hesitation in recommending for quick results the use of this cheap and promising plant material, in combination with the white pine, with which it makes a most desirable mixed stand, the white pine growing somewhat more rapidly and needing the improving companionship of such shadier neighbor.

In addition, there has been used in larger numbers one of our native western conifers, the Douglas spruce (*Pseudotsuga taxifolia*) from Colorado, which appears also most promising from its behavior during the first season, although not as rapid as the Norway spruce. It is, unquestionably, the best material and the most adaptive species which the western mountain regions afford.

In somewhat smaller quantities, for trial, the Colorado white fir (*Abies concolor*), the European and Siberian larch, and the Scotch pine have been used; the latter, cheapest material of all, set out on a sandy knoll, has made a most promising start in spite of the dry season.

Altogether some two hundred thousand plants have been set out on burned slashes, and the opportunity for judging what is most satisfactory will soon be at hand. The Axton nursery contains half a million seedlings, and a second nursery at Wawbeek will produce double that quantity, ready for use in the woods in two or three year's time.

One of the essential requirements in this reclamation of waste lands is adequate protection against fire. As I have pointed out, the greatest fire danger lies in these very areas; hence, special precautions to reduce the danger become necessary wherever the expenditure for planting has been made. Greater vigilance and special fire-guards will be required, and in addition, mechanical means can be employed to reduce the danger. Among these are to take in hand, as far as possible, the entire burnt area at one time, clearing and burning the *débris*, so that the cleared and planted area be bounded by standing timber or by water or marshy land; subdividing the area by ditches; or, better still, by lanes sown to grass, which can be kept in proper condition and serve as bases of defense in case of fire, so that the same may be confined in area. Old snags, especially dead pines, must be downed, as they are apt to be set on fire by lightning.

The question, I suppose, is asked: "Does it pay to reforest these wastes?" The answer is, that if the State really proposes to hold, protect, and improve this forest area as a whole, it does pay unquestionably, even were we to look at it merely as a work of internal improvement. And if, as the indications are, the cost of restocking these, at present, worse than worthless areas can be kept below ten

dollars per acre on the average it can be figured out even as a profitable financial proposition. This work of reclaiming wastes is, by the way, one against which no constitutional bar exists, and which, therefore, could be taken in hand by the Forest Commission without any change of present functions, if sufficient appropriations are made.

How to Manage the Culled Lands.

The other problem, that of handling the culled lands, is one presenting much greater difficulties. While the reclaiming of the waste lands is merely one of financial capacity and of expenditures which can be more or less accurately determined, the rational treatment of the forested lands requires not only much more skill, but their improvement, if it is to be kept within practically advisable expenditures, is dependent on market conditions, over which even the State may not exercise control. To understand the problem we must state the conditions.

The Adirondack forest is one composed of a variety of species, in which the hardwoods, birch, maple, and beech preponderate, and in which the conifers, pine, spruce, and hemlock, form a variable, more or less prominent part. The culling has been of the latter, so-called softwoods, especially pine and spruce, because they were most in demand and most easily handled and transported by water. As a consequence, after the culling process, the hardwoods, preponderating before, became still stronger, and only the tolerance of shade, which is a characteristic of the spruce, has maintained it in younger individuals, besides the decrepit old ones which the logger has left; while the white pine, which cannot reproduce itself under the shade of the hardwoods, is almost extirpated, except in occasional openings.

The hardwoods, while furnishing a full and pleasing canopy of foliage which may mislead the uninstructed into the belief that he is looking upon a virgin woods, exhibit in the old specimens the decrepitude of age, dead branches and rotten heart, and many of the younger, thrifty-looking trees, upon closer investigation, also show the signs of decay as a result of the running fires which have swept over nearly every culled tract of the wild woods. This, then, is the condition: a forest of old decrepit hardwoods, deteriorating from year to year, with a tainted progeny struggling beneath, and a small though promising number of young spruces impeded in their development by the former, with occasional older trees that can be used as seed trees.

Can there be any question as to the changes which it is desirable to effect, if we apply the reasoning of rational political and financial economy? Remove the dead capital of old, hardwood timber, and

replace it by a young, thrifty crop, growing into value, in which the more desirable conifers preponderate!

The silviculturist will have to decide how best to secure this young crop, which may be done by favoring the volunteer crop of conifers, by giving a chance for seeds from left-over seed trees to find a seed-bed and favorable light conditions for development, or by planting or sowing artificially.

But before he can apply his skill, the manager must have found a way of disposing of the hardwood crop. And here lies the pivotal point of the problem, as with most of the forestry problems that are to be worked out on financial basis in the United States; namely, in the market question.

If the silviculturist is to show his skill in producing a new crop, the old must be disposed of; not only must a market first be found for the sound merchantable sawlogs, but for the much more bulky and less valuable portion of poor cord-wood which, in the Adirondack timber, may readily be set down as exceeding in bulk two or three times the raw material. Where this cannot be done, the culled lands may still eke out an income by further culling of pulp material, etc.; but it is evident that this can only be at the expense and to the detriment of the value of the property, for it means removing the most valuable species, and reducing its chance for reproduction. In such cases nothing is left but waiting for economic conditions to change, until the old hardwood crop is salable.

One of the absolutely unavoidable conditions for marketing hardwood material is accessibility to railroad transportation, either for the raw material or the manufactured. Therefore, before the State may enter upon a policy which has in view the rational use of its property from a forestry point of view, it must change the provision which prevents railroad building over State lands. I do not advocate the indiscriminate opening of the State lands to railroad construction, but merely state that rail transportation is a necessity for successful technical management of these lands.

The State College of Forestry has been successful in securing a market for the hardwood material on its tract of thirty thousand acres, by inducing manufacturers of staves and of wood alcohol to combine in establishing plants. By such combination the fullest and least wasteful use of hardwood materials at present known is secured, since all sound material to a diameter of eight inches and a length of thirty-two inches can be used for stave-wood, while the retort and fuel wood used in the manufacture of alcohol takes the material down to three inches, thus securing the fullest possible utilization of all the material in the trees which have been felled.

In the attempts to introduce more conservative methods of

lumbering, it has been usual to restrict the cut to trees above a given diameter. By such restriction, possibly, a less wasteful use of the existing supplies may be attained, but the main object of the forester's art, namely, securing a valuable aftergrowth, is not at all, or most uncertainly, attained. The College has, therefore, not allowed itself to be bound down by any such mere commercial considerations. In its contract with the manufacturer it has reserved the right to cut or to leave uncut whatever trees it is desirable to leave or to cut, the College being the arbiter as to what, in a proper forest management, is to determine this choice. Old and large trees, therefore, may be left, be it for seed trees or for other reasons, and small or young trees may be cut, if by their removal an advantage is secured from the forester's point of view. Silvicultural considerations—*i. e.*, the condition in which the forest is left with a view of securing a new, more valuable crop—alone decide this question, except so far as financial or business considerations must modify the ideals of the silviculturist.

Since, finally, this reproduction of the wood crop, like all production, is an economic problem, the silviculturist, while he has the task of securing the new crop, must also *count the cost* and secure the result by the least expensive means and methods.

Briefly, then, the problem is: How to cut and dispose of the old hardwood crop most profitably, at the same time saving the young spruce which is on the ground, and leaving enough seed trees of the various kinds forming the forest to secure a desirable new crop of a mixture in which the conifers have the preponderance.

In some places this may be more cheaply and more effectively secured by cutting the old crop without considering the existing young growth, and replant by hand. This method would be called into requisition where the forest has been culled too severely, or where, for other reasons, the conifers are absent and their reproduction is desired.

In the contract under which the College is working, due to business considerations of the market, the amount annually to be cut is necessarily determined by the requirements of the manufacturer: *i. e.*, a certain, stated amount of material must annually be delivered. To the European forester and to those who attempt to propagate European methods of forest management in this country under a system of so-called "working plans," this basis for determining the cut, the absence of yield calculations, and of propositions for a sustained-yield management, will appear strange.

It is customary in Germany, and wherever German methods are blindly followed, to determine the capital stock of wood standing in a forest, to calculate how much this stock annually increases by

growth, and then to determine from these data how much may be annually cut without impairing the wood capital ; in other words, to harvest annually only that which does or ought to grow annually, at the same time reducing or increasing the cut, if the capital is deficient or excessive. This is called "sustained-yield management."

To apply this principle—perfectly proper for the settled conditions in the artificially reproduced German woods—to our decrepit Adirondack woods would mean lack of judgment as to the conditions under which it is to be applied. Measurements and calculations upon the basis of which the cutting is to proceed, while they have the appearance of a highly scientific foundation, are for our virgin woods really most insecure. Even the Germans, after a hundred years of attempt to determine, with a measurable degree of accuracy, the contents and the rate of growth of a selection forest—*i. e.*, a forest in which old and young trees of all ages and various species are mixed—have come to the conclusion that it is impracticable, and that a guess is almost as safe as the elaborate calculations.

The fine measurements, then, in our wild woods, which are made to establish so-called "yield tables" while no doubt of scientific interest would be most unsafe to base financial calculations, investments and practical management.

Moreover, the measurers have overlooked that in our woods which are run over again and again by fires, there is about as much *decretion* as there is *accretion*, and this *decretion* by decay in the heart withdraws itself from measurement.

But it takes no fine calculations, only common observation, to ascertain that our old timber is past its prime, and has been financially ripe for harvest, *i. e.*, growing no interest, for many years. Hence the proper policy is that stated at the outset : to replace as quickly as economic conditions warrant, the old crop by a new. How fast or how slowly this may be done depends upon the conditions in each case, and cannot rationally be determined by such a general rule as the sustained-yield management imposes.

Especially for the State, with its extensive holdings and without the necessity of securing a continuous and even annual revenue from these woods, there is no need to adhere to this principle, and to waste money and energy in finding out what the future growth will be. Let the next generation count the chickens for which we have secured the opportunity of development, favoring the better breeds. No fine measuring, calculating, and predicting of future incomes is necessary to assure us that the replacement of a decrepit old stand of timber by a vigorous new crop of better kinds is the true financial policy for the State. As slowly or as fast as market conditions and other esthetic as well as economic considerations warrant, the old, unprofitable

investment of Nature should be changed into a new, live investment of art and skill, by practicing silviculture pure and simple.

Other Than Business Considerations.

There is no doubt that the majority of the people who were interested in the preservation of the Adirondack woods under State ownership never looked at the proposition as one involving business considerations; they did not conceive the woods in the hands of the State as objects of profitable exploitation, as a thing with which to do anything else but leave it alone. Some saw in the wilderness only a pleasure ground, a health-giving resort, a park to be set aside for the use of those who need and could afford the relaxation of a life in the woods. Others had conceived that the climatic effect and the influence of the forest cover on water supplies imposed the duty on the State to look to the preservation of the forest cover.

To the first proposition—namely, that the State set aside a pleasure park—that portion of the people who cannot afford to take advantage of it naturally objected; as to the latter proposition, that the water supply of the State required forest conservation, doubts regarding this relation and the need of State protection are by no means unfrequent or untenable.

But both these classes of advocates of State ownership of the woods have overlooked the fact that their objects are attainable without sacrificing the other functions which a forest is to fulfill, namely, the furnishing of wood supplies. It is not necessary to withdraw this large area of land from economic use; it is not necessary to make it an expense, a burden on the taxpayer. On the contrary, the protective function and the luxury function can be subserved as well as the economic function, by a proper system of forest management, which takes into consideration the esthetic as well as the business aspects of the property.

Forest preservation is attained in the same way as the preservation of mankind, by reproduction; by removing the old and giving a chance to the young crop. This involves the cutting of trees, to be sure; but if this is done with regard to securing a new growth of better composition, it is the rational method of forest preservation.

The forest policy of the State will only be completely and rationally rounded out when the State forests are managed for revenue as well as for the other benefits that may be derived from them under skillful foresters, such as the State College of Forestry is intended to educate.



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