that not only 5 cents but even 50 cents per M. feet could profitably have been devoted to the suppression of fire.

Changes on Cut-Over Lands.—The condition and character of the aftergrowth on cut-over lands is quite variable, since changes occur in the plant cover as well as in soil conditions according to original condition and subsequent treatment. These conditions and changes have a bearing on the question of the future of these lands, whether they be left alone or be restocked with timber, so that it appears desirable to give a description at least of the more frequent types.

Sand Pinery Lands.—1. When a clean dense stand of mature pine timber is cut, and the fire gets into the slashing late the following summer after all the limbs and tops on the ground have had a chance to dry, the ground is fairly cleared by the fire, the bulk of the tops are burned, a “stump prairie” remains. On the poor sandy soil whose small humus cover has been thus destroyed, there comes first a crop of fire weeds, then aspen and sweet fern, with other weeds, and some grass and isolated bushy scrub oaks (often some willows) cover the ground sparsely. As soon as enough dry leaves and other material have accumulated the fire recurs and the small aspen and other growth are killed. By this time the ground is much reduced in fertility, aspen is slower to return and the ground is largely taken by weeds and grass. A few repetitions of fire change the ground sufficiently to prevent the further growth of aspen for years and there are many areas where this tree has given up all effort to restock the land.

This seems to be the common form of slashing in heavy pine. Such areas furnish little foliage for live stock, they are naturally poor, and this condition is much aggravated by repeated fires and exposure to wind and sun. To an attempt at restocking with timber they offer no obstacle, save their poverty, which would soon be changed by growing timber.

If the fire is not repeated in such a slashing the aspen forms dense thickets in which pine, birch, and maple gradually find suitable conditions for their growth. For years the detrimental
effect of the fire is visible in the stunted growth of the young trees; aspen, which in the original forest grow often several feet a year in height, remain short runts and it is not until ten and more years of rest from fire have permitted the accumulated litter to improve the soil, that a more vigorous growth becomes apparent. Tracts of this kind occur in every county, but they form only a small percentage of the total area of cut-over lands; they are troublesome to clear after the thickets once have attained considerable height and they furnish no good pasture. To continue them as woodlands they require merely protection from fire, and for their improvement pine should be supplied either as seed or plants wherever it is wanting.

2. Where the old stand of pine was broken, and a considerable mixture of small pine and hardwoods existed, there remains after the first fire a large amount of scorched and charred standing, dead and dying material. In this, as in the following form of cut-over piney lands, young growth readily succeeds provided fires are not repeated. But this happy accident does not generally occur; the great quantity of dead material, most of which does not fall during any one year, keeps the ground furnished for several years with débris and thus invites the return of fires, which continue to come until the ground is largely cleared. The area now resembles the case first considered; it is a stump prairie, though usually not as clean. Here, too, the return of tree growth is very slow and often discouraged altogether for years.

3. Where groves of sapling pine have been culled of their larger timber and are then fired, the greater part of the remaining growth is injured and much of it is killed. These injured groves are generally of little promise in themselves; their growth is hampered, their scorched butts doomed to decay; but they are valuable in so far as they readily restock the ground with young timber, providing this is not killed by fire. If fire occur, which is the more common case, the entire grove is either gradually burned and killed, or if the fire gets in during a very dry season.
and attains considerable proportions, the entire grove is changed at once into a tangle of scorched and charred poles, which require for their improvement either a great amount of labor and expense or else the starting of more fires to first get rid of the débris. Where fire runs through slashings (in large timber) too early in the season when the ground is still wet, and also where no fire occurs for several years after logging, so that the leaves have become litter, and the small twigs are decayed, then the slashings, even of wasteful operations where large amounts of heavy tops and much dead and down material exists, are often not burned clean and the ground is strewn with scorched logs and tops, and many cases exist where settlers are logging today on old slashings of this kind although not a living pine occurs.

It is but natural that these several forms grade into each other, and that nearly every slashing, especially during the first few years, markedly changes its complexion. In general the bare land form predominates in all pinery areas and occupies today probably about 70 per cent. of the cut-over lands.

**Loam and Clay Lands.—**4. A greater admixture of hardwoods, due to the presence of a larger amount of clay in the soil, materially affects the condition of the cut-over land. If pine was predominant and the hardwoods scant, as on the red clays about Lake Superior and on the poorer gravelly loam, the removal of the heavy stand of pine commonly involves almost a total destruction of the hardwoods just as in the case of the regular pinery; the ground is soon cleared by a repetition of fires, the aspen ceases to return. Unlike the sands, however, these loam lands soon produce a fair amount of grass and the land is converted into pasture.

5. Where the hardwood is heavier, and especially where hemlock enters into the composition of the forest, the dead timber remains standing for years. A forest of dead trees and often 400–800 cords of timber per acre may be seen after repeated and often severe fires have swept over the ground. Such areas are not rare; the fires of 1894 created quite a number. They are
undesirable pasture lands, difficult to clear and still largely too good to be restocked with timber, which in such places would require considerable labor and expense.

6. Where the heavy hardwoods and hemlock predominated and the pine was a mere scattered admixture, the ground and litter are usually damp, and fires run only during exceptionally dry seasons (as in 1894). The removal of the pine from these areas is not followed by fire; the lands are left densely timbered, so that they hardly seem to deserve the appellation of cut-over lands. Nevertheless, even in these forests fires have run, never far, to be sure, but still strips five miles and more in length are seen, where the fire has left a dense, heavy cover of dead and dying, scorched and charred trees of all kinds. Fortunately these tracts are not very numerous; their only hope lies in clearing them for farm purposes, for which nearly all of this heavier land is eminently well suited.

Restocking.—What may be done to restock the land will vary from place to place, according as the land is well under way to reclothe itself, or is a bare waste, or is a tangle of débris or covered with worthless thickets of fire damaged woods. This work may be done at once or by piecemeal, it may be done thoroughly or roughly, it may assist nature to a small or large degree. Where scattered saplings and defective trees have been left in logging and have survived the fires, these trees continue to seed the ground, around each of them a little crop of seedlings springs up after good seed years (every 3 to 5 years), and, if protected, these grow and in about 20 years, by the time the mother trees are gone, bear seed themselves and then really the process of restocking begins. Thus much valuable time is lost and the ground remains exposed too long to wind and sun and is thereby reduced in its fertility.

In many districts seed trees are wanting; repeated fires have killed both mother tree and seedlings, and nature must be assisted if anything is to be accomplished in reasonable time. In most sandy pinery lands where the fires have made a clean sweep, the work does not require much preparation, and a very cheap
beginning can be made by planting a much smaller number (say, 500 per acre) than is really needed to make a satisfactory stand. These plants, together with the poplar, birch, and other brush, would soon make a cover for the ground, the young pine would rapidly be growing into marketable wood and at the age of twenty years and less would begin to shed abundance of seed so that before the first trees are ready to cut every foot of ground would be covered by a promising pine thicket.

Fire may have to be resorted to as a cheap and rapid means of clearing the ground where it is covered with large quantities of dead and fallen timber, and especially where dense thickets of fire-killed brushwood offer serious obstacles to any sylvicultural processes. The outlay for all work of this kind need be made but once; the forest once established will be permanent and by judicious logging and adequate protection against fire will renew itself indefinitely.

Of equal and perhaps greater importance than the choice of proper methods will be the selection of the proper kinds to plant. Among the native growth the pines are preferable to the hardwoods, and the white pine is foremost here as in every other respect. Nevertheless, red (Norway) pine and even jack pine will prove of great value and may often have to be resorted to. The value of these pines lies in part in their frugality, since they are perfectly satisfied with poor soils, really unfit for farming. They are still more valuable in their gregarious habit, thriving in great numbers together and thus facilitating exploitation, and in their capacity of developing a large number of trees on a small area. These powers, together with the great length of their trunk, causes them to produce large yields, and, finally, the character of their wood ensures for their product an almost unlimited market at all times.

The white pine will thrive on 90 per cent. of all sandy areas of Wisconsin and on all loam and clay lands, grows fast and in very dense stands, is useful for pulp at 30 years, for box boards at 50 and makes lumber at 80 to 100 years. According to the experience in Massachusetts and New Hampshire, groves 60-
years old cut over 30 M. feet shook boards per acre, and furnish trees 12 to 20 inches in diameter and over 70 feet in height. These New England groves, which have largely sprung up on old abandoned farmlands and are generally without any particular management, are reported to furnish in the aggregate from 30 to 50 million feet per year.

Red (Norway) pine is even more frugal than white pine and there is no sandy area in northern Wisconsin which this tree can not cover with an abundant growth of fine timber. The jack pine is the most frugal tree of all and though of small stature and short-lived in Wisconsin, will prove a valuable aid in connection with the other pines and especially as nurse tree on the poorest sands.

To encourage the hardwoods will not be necessary except in some localities. Wherever abundant now they are growing well and are likely to be continued in the wood lot of the farmer on all clay and loam soils. It may safely be predicted that the hardwoods in the better hardwood counties will be abundant for many years. The hardwoods do not thrive on most of the land here considered "forest land," they refuse to grow on the sands, yield light and cut wastefully. They furnish a product, which however valuable intrinsically, will for a long time have to be contented with a limited and exacting market.

To those who are frightened at the mere idea of planting forests and who scorn European methods as impracticable in this country, the example of Saxony may be of interest. In that country the most intensive kind of forestry is carried on, so that an area of 400,000 acres (about 2-3 as large as Lincoln county) brings the state a net income of nearly 2 million dollars, and furnishes regularly to its consumers about 20 million cubic feet of wood per year, so that pulp mills and saw mills have long become permanent institutions.

The forests in this state are largely planted with nursery stock, yet the sylvicultural work of planting, sowing, etc., all told, amounts, on an average for the entire woods, to 10 cents per
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acre a year. This sum is only 6 per cent. of the total forest expenses, which include all logging operations.

We cannot here consider whether all these efforts will pay as long as the land is held by private owners whose fortunes are only of today and whose heirs will prefer to parcel the land out to inexperienced settlers. The experience abroad and also in this country indicates that the state must undertake at least the most difficult and unprofitable parts of the work, and that the greatest good to the greatest number lies in state ownership of forests. New York waited a long time to see private owners manage rationally in its woods, but has found itself compelled at last to buy the land and to establish a forest organization to keep its mountains from being converted into desert brushlands and its streams from being alternately dry branches and mud torrents. A similar undertaking in Wisconsin would, at present, be greatly facilitated by the present conditions of ownership. The land is still held in large bodies and by men actively engaged in a business quite distinct from speculation and dealing in real estate, and therefore a transfer could in most cases very easily be effected and at prices (25 to 50 cents per acre) which would seem to guarantee financial success to forestry even in the backwoods of Wisconsin.

RÉSUMÉ.

Briefly stated, the present conditions are as follows:

The State of Wisconsin, with a population of about 2 million, a taxable property of about 600 million dollars, has a home consumption of over 600 million feet B. M. of lumber, besides enormous quantities of other wood material, which, if imported would cost the State over 25 million dollars. Of its northern half, a land surface of over 18 million acres, only 7 per cent. is cultivated, the rest forming one continuous body of forest and wasteland. From this area there have been cut during the last 60 years more than 85 billion feet B. M. of pine lumber alone, and the annual cut during the past ten years exceeded 3 billion feet on the average per year.
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The industries exploiting this resource represented in 1890 one-sixth of the total taxable property in the State, paid to over 55,000 men the sum of over 15 million dollars in wages, and the value of their products was equal to more than one-third the entire output of agriculture. Of an original stand of about 130 billion feet of pine, about 17 billion feet are left, besides about 12 billion feet of hemlock and 16 billion feet of hardwoods. The annual growth, which at present amounts to about 900 million feet and of which only 250 million is marketable pine and over 500 million feet hardwoods, is largely balanced by natural decay of the old, over-ripe timber. In almost every town of this region logging has been carried on and over 8 million of the 17 million acres are "cut-over" lands, largely burned over and waste. The wooded area proper is steadily being reduced by logging and to a smaller extent by clearing.

At present nothing is done either to protect or restock the denuded cut-over lands of which fully 80 per cent. are now unproductive wasteland and probably will remain so for a long time. This policy causes a continuous and ever growing loss to the commonwealth, which at present amounts to about 800 million feet per year of useful and much needed material, besides gradually but surely driving from the State the industries which have been most conspicuous in its development, depriving a cold country of a valuable factor in its climatic conditions and affecting detrimentally the character of the main drainage channels of the State.

To remedy this matter and stop the great loss, it will be necessary to adopt active measures both to protect and restock. Both these processes are adaptive and may be done with a variable degree of thoroughness and consequent outlay.