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Commonwealth of Pennsylvania Dept. of Forests and Waters.

DEPARTMENT OF FORESTRY.

PROCEEDINGS OF THE FIRST CONVENTION
OF PENNSYLVANIA FORESTERS,

HELD AT HARRISBURG, PA., MARCH 4, 5, 6, 1908.

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THE PENNSYLVANIA DEPARTMENT OF FORESTRY.

THE STATE FORESTRY RESERVATION COMMISSION.

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THE STATE FOREST ACADEMY, MONT ALTO, PA.

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John E. Avery, Class of 1906, Forester.
Ralph E. Brock, Class of 1906, Forester.
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Lewis E. Staley, Class of 1906, Forester.
B. F. Heintzleman, Class of 1907, Forester.
James E. McNeal, Class of 1907, Forester.
Paul H. Mulford, Class of 1907, Forester.
John L. Witherow, Class of 1907, Forester.

TABLE OF CONTENTS.

	Page.
"The Importance of Surveys," John E. Avery, Forester,	9
"Fertilizers for Renewing Nursery Soils," Ralph E. Brock, Forester,	11
"Broadcast Sowing vs. Drill Planting," Ralph E. Brock, Forester,	14
"Forest Protection," William L. Byers, Forester,	16
"Necessity for Advancing Improvement Work," Robert G. Conklin, Forester,	18
"A System of Forest Book-keeping," Robert G. Conklin, Forester,	24
"Forest Nurseries and Nursery Work," William H. Kraft, Forester,	27
"Dividing the Reserves," Lewis E. Staley, Forester,	29
"A Regularly Employed Labor Force," Lewis E. Staley, Forester,	32
"Improvement of the Ranger Service," B. F. Heintzleman, Forester,	34
"A System of Forest Protection," James E. McNeal, Forester,	37
"Management of Forest Lands under Present Forest Conditions," James E. McNeal, Forester,	40
"Disposal of Fire Killed Timber," Paul H. Mulford, Forester,	41
"Roads, Fire Lanes, and Trails on the Reserve," John L. Witherow, Forester,	45

Beginning with September, 1906, the first class of foresters from the State Forest Academy went into the field, and the second class followed September, 1907. For the purpose of comparing ideas and notes on their work and enabling them to have an interchange of thought, it was deemed advisable to bring them together during the early part of the following year for discussion of forestal topics and the reading of such papers on pertinent subjects as the men in the field might wish to present or hear discussed. Accordingly, on February 11th, 1908, the Commissioner of Forestry issued a call for the first convention of Pennsylvania foresters to meet at the Department in the new Capitol at Harrisburg on March 4th, 5th, and 6th, ensuing.

In the meantime, the wishes of the men were learned with respect to what subjects they wished to hear discussed, the program of exercises was prepared, and the meeting duly convened at the Department, Wednesday morning, March 4, 1908.

The Commissioner of Forestry presided at the meetings, and at intervals the other members of the State Forestry Reservation Commission, all of whom were present, were called upon to preside.

The papers presented by the young foresters are hereinafter contained and show that the men were interested in their work and desirous of learning whatever will assist them to bring better results. The discussions after the reading of each paper were participated in freely by all present.

The regular meeting of the Commission was held on Friday morning, March 6th, at which the foresters were present and saw how the business of the Department is conducted. During the sessions, at the invitation of the Governor, a visit was paid to the Executive Department where Governor Stuart in a short address welcomed the foresters and gave them some good advice with respect to their conduct both as men and officials. The Convention adjourned finally on Friday, March 6th, and the feeling of those who participated was that it was not only a successful meeting, but that much valuable instruction had been imparted which would be of permanent use to them in the forestal work of the future.

THE IMPORTANCE OF SURVEYS.

JOHN E. AVERY, *Forester.*

Surveying is the art of making such measurements as will determine the positions of points on the surface of the earth, so that a map of any portion of that surface may be drawn and its contents calculated. A survey of all forest lands or reserves of this Commonwealth is exceedingly important. Most of the State's reserve lines have not been run or retraced for years. Often the blazed trees have been cut, or have been destroyed by fire, or blown down. It takes a good surveyor with an instrument to follow them. Therefore, the lines should be run or retraced, plainly blazed, and blazes painted. Corners should be distinctly marked. The lines could be made more visible by cutting an open path and by posting notices at frequent intervals. This would show conclusively the lands of the State to all persons. The neighbor who intentionally or unintentionally gets over the line a little, and very often quite a distance, taking timber that does not belong to him, will not take the chance of crossing a well marked or well established line. Therefore, stealing of timber ceases almost immediately. There are but few cases of timber stealing on the reserves where lines have been retraced and visibly marked.

What can the wardens do, not knowing the lines? Absolutely nothing. They cannot properly patrol the land, and they are not sure of alleged trespassers being on State lands. One of the wardens reported to me several weeks ago that a party was chopping wood either on the reserve or very close to the line, but he was not sure and did not know what to do. He had asked this person where the line is and he could not show him, but said he was on his own land. In such a case, what are we to do? Finally we got a man living in the same community, one who claimed to know almost every line in the woods, to go with us. He put us on a line which had been run years ago and which he said was the State land line. Are we to rely upon the judgment of such persons, and will not work of this kind leave a loop-hole for timber thieves to plunder from the State lands? In a community like the one I have just cited every person seems to be related to every other or else they are bosom friends. What one knows all know. If they once find out that we do not know or are not sure where our lines are, they will cut without the least hesitancy and think all the while they are taking what belongs to them; for in a wooded country, and I think especially in Pike county, there are many men who do not think it a crime to go on his neighbor's tract

and relieve him of some of his timber. I know of a man who was not a native of the county being driven off his own land at the point of a gun by a timber thief. The owner knew he had land, but did not know the exact location until he had his lines run.

If the lines of the reserves were surveyed, blazed, and posted, it would not only be a benefit to the persons in charge, but also to the public and to the sportsmen. The sportsman or hunter, probably not accustomed to the distance travelled, may find himself crossing a State line, opened, blazed, and posted. He is safe to the extent that he is not trespassing on lands of an individual or lands owned by a hunting club, and is not liable to arrest and fine of ten dollars or ten days in prison for trespassing, and have his game taken away from him; but he does know that he is on a State Forest Reserve, free for all to hunt or fish, provided he complies with the rules of the Forest Reservation Commission.

If our reserves were surveyed and the boundary lines cut open, we could have the lands under a better system of patrol. The wardens could cover more of the reserve in one day than they can now in two. As most of the lines are at present they are delayed by tramping through underbrush. Again, the cut lines would serve as wagon roads for getting out timber in the future, or as fire lanes, along which back-fires could be set whenever a fire is headed toward the reserve. We would thus protect the reserve from its most deadly enemy, and save hundreds of dollars for the Commonwealth.

From a forester's point of view, he cannot make a forest working plan until he knows what he has. Here again a survey is very necessary. Not only the outside lines should be run, but township roads, railroads, creeks, bluffs, and other obstacles should be located. Lines between localities having different jurisdiction, as county and township boundaries, interior tracts, lands upon which any rights are reserved, or any individual property, should be accurately located. The forester cannot divide his reserve into compartments which should have natural boundaries, as streams, crests of ridges, swamps, and valleys, because they are permanent, until he has a topographical survey which will show the various undulations and inequalities on the reserve.

In conclusion, without a survey, the forester is continually handicapped, because

1st. The wardens are unable to do their duty for the simple reason that they are not positive as to location of lines and have to depend upon the honesty of neighbors.

2d. It is not fair to the public, as the State Forest Reserves are open for recreation purposes to the people of the Commonwealth.

3d. It is most important for a forester to have a map of his reserve. He can do scarcely anything without a map from which to make his calculations and working plans.

FERTILIZERS FOR RENEWING NURSERY SOILS.

RALPH E. BROCK, *Forester.*

In discussing the subject "The Best Method of Renewing Nursery Soil," I have endeavored to include the two methods most generally followed in best agricultural practice, that is, the one in which there is application of commercial or other fertilizers, and the other, green manuring. The latter is preferable for supplying essential plant foods, because of its cheapness, reliability, and mostly because it involves few or no experiments to determine the plant foods, or the amounts that are most needful.

But laying aside the methods of fertilizing, there is nothing that brings the soil up to "dot," so much as thorough tillage, bringing out the old adage from which we get the word manoeuvre or manure, "he who tills the soil, manures it." From this tillage or working of the soil, the texture is improved, and in heavy or clay soils its absorptive value is increased. Of course tillage alone will not suffice. Composting or fertilizing must be relied upon to aid. From this source we obtain the needed materials, nitrogen, potash, and phosphoric acid.

Supply of Nitrogen.

There are two ways of supplying this essential plant food to the soil, the one by the application of nitrates, and the other by the practice of green manures, the latter of which is preferable, especially if the soil is poor. Where the nursery is of sufficient size to keep a portion of it (one-fifth) unused, this method is very suitable. To restore this portion is to begin early in the spring, sowing Canada field pea, seeded deeply at the rate of two bushels and one-half per acre, giving the soil a top dressing of 300 pounds of acid phosphate and 120 pounds muriate of potash. This crop should be ploughed under during the latter part of June and the land sown in cow peas. Plow this under in September and then sow rye. Give the land now a top dressing of 350 pounds Thomas meal, 2,650 pounds slaked lime, and 900 pounds kainit. This method will give the area one year in good nitrogen catch crops, and will improve the texture of the soil considerably, making a loose soil more binding and retentive of moisture or a clayey soil more open, porous, and absorptive. Also, it would insure nitrogen for years to come, the soil being thoroughly inoculated and also possessing a supply of potash and phosphoric acid.

The Supply of Potash.

The most available supply of potash and the one from which the least trouble can be expected, is in the use of unleached hard wood ashes especially on a soil that is clayey and wet. I have found ashes alone a splendid fertilizer at Mont Alto. Professor Johnson suggests 30 pounds of freshly burned shell lime, 10 pounds of bone meal and 8 pounds kainit a good substitute for wood ashes. This formula is equal to 100 pounds of wood ashes. The ingredients can be bought at the rate of \$4.40 per ton; hence, it is decidedly cheaper and has no weed seed.

Phosphoric Acid.

Bone-meal containing three per cent. nitrogen and twenty per cent. phosphoric acid, and kainit containing the same amount of phosphoric acid, besides many other valuable plant essentials in small amounts, are the two best sources of phosphoric acid to be had at a reasonable price.

Formulae for mixing fertilizers and composts are as follows:

Composts.

Substitute for wood ash equal to 100 pounds, 30 pounds freshly burnt shell lime, 10 pounds bone meal, and 5 pounds kainit.

Thomas-meal, 16 per cent. citrates, 350 lbs.

Slack lime, 2,650 lbs.

Cornallite, 900 lbs.

Mix well together with fine turf, scatter over ground in late fall or winter, and work well in early spring.

Two measures of well rotted wood, two measures of well rotted horse manure, one measure of liquid manure. Keep in covered place until used. Even quantities of chip dirt and well rotted dung well mixed, to which wood ashes and lime have been added. Keep two years.

Ground bone, 300 lbs.

Bone black super phos., 300 lbs. (Fall).

Muriate of potash, 400 lbs.

Nitrate of soda, 89 lbs. (Spring).

Von Schroeder's:

Kainit, 520 lbs.

Super phosphate, 60 lbs.

Whale Guano, 320 lbs.

A good reliable fertilizer for general purposes, is:

Mixture of 30 pounds hen manure, 10 pounds sawdust, 16 pounds acid phosphate, 8 pounds kainit.

This will carry about 1.25 per cent. nitrogen, 4.5 per cent. phosphoric acid, and 2 per cent. potash, which used at the rate of two tons per acre would furnish 50 pounds nitrogen, 185 pounds phosphoric acid, and 80 pounds potash.

Substitute for Barn Manure.

Dissolve one bushel salt in enough water to slack five or six bushels lime. The best method for preparing for composting is one bushel of this lime to one load of swamp muck, though three bushels to five loads is a very good manure. Mix well.

In laying up the heap let layers of muck and lime be thin so that decomposition will be more rapid and complete. Sprinkle salt water on the lime as heat goes up.

When lime cannot be obtained, use three or four bushels of unleached ashes to one cord muck. Turn in a month or six weeks.

Home-made Guano.

Save all fowl manure from sun and rain under cover. Spread a layer of dry swamp muck and dump fowl manure on top of it. Beat into a fine powder with back of spade, add hard wood ash and plaster paris to make following proportions:

Dried muck, 4 bushels.

Fowl manure, 2 bushels.

Ashes, 1 bushel.

Plaster paris, $1\frac{1}{2}$ bushels. Mix well.

A little before planting moisten with water or liquid manure. Mix with soil when planting.

While home mixing of fertilizers is less expensive than prepared fertilizers, care must be exercised in the selection of the needed constituents for two reasons; first, when certain materials are mixed chemical changes take place in which a valuable material is lost, as when lime and barn-yard manure are mixed, ammonia is given off; and second, a change to a less available form occurs as, when lime and super phosphate are mixed, the phosphoric acid is rendered less soluble; also, when potash salts and Thomas meal are mixed the product is apt to cake and becomes hard to distribute evenly. For this reason a German expert lays down the rule that lime and sulphate of ammonia; lime and super phosphate, lime and Thomas slag; lime and barn-yard manure; lime and nitrogenous guano, should never be mixed. Nitrate of soda and Thomas meal; nitrate of soda and lime; potash salts and lime; and potash salts and Thomas meal, should never be mixed. Kainit and lime; and kainit and Thomas meal, should never be mixed unless used at once.

No seed should be sown until several weeks after fertilizers have been sown, and where kainit is to be used in mixture, that is, in connection with a highly nitrogenous product, all but the nitrogenous product should be sown the fall before. Concerning lime and nitrate of soda I add the following, especially concerning the nitrate of soda.

A tree is a slow growing plant and soluble salts, as nitrate of soda, leach away before they can be assimilated by the plant. Regarding lime, except as a mechanical ingredient in compost heaps, no conclusive results have been found, except in the case of three hard woods. Cherry, linden, and American elm appeared to be benefitted.

My experience has been that all conifers suffer from the use of lime. Even from the use of diluted Bordeaux mixture as a fungicide in the endeavor to check "damping off" the coniferous plant suffered.

BROADCAST SOWING vs. DRILL PLANTING.

RALPH E. BROCK, *Forester.*

In the raising of seedlings for commercial purposes, the idea of importance is to raise the greatest number of even sized, vigorous, and thrifty seedlings on the smallest possible area at the least expense.

Whether this can best be accomplished by sowing the seed broadcast or in drills, depends largely upon the character of the soil in the germinating beds, the moisture conditions of the locality surrounding, as influencing the amount of soil moisture in these beds, the species to be raised and the character of the location in which they are to be finally planted. Broadcast seeding is most practicable where the land has been under a system of thorough tillage for several years, in which weeds have been effectually subdued, the water table raised by successful cultivation, and where the drainage conditions are such that excessive moisture easily and quickly passes away. These conditions would most likely be found in soil that varies from a sand to a sandy loam, and where the surface water of the higher ground surrounding the nursery site is drained away from the beds naturally or artificialy. Drill planting is successful under a wider range of conditions, the four to six inch space between the drills renders weeding less difficult, permits cultivation at all times, and, in times of drought, where there is no adequate water system at hand, allows one to break the soil to facilitate capillary attraction of water from the sub-soil. Again, billets of wood may be laid between the rows of seed-

lings, in a measure, keeping down weeds, preserving moisture and lessening the quantity of leaves needed to cover the beds in the fall.

In beds that have been sown broadcast, the raising of even-sized seedlings excepting by chance is nearly impossible. The seedlings on the edges of the beds are larger, more vigorous and possess a more healthy color, than the dense masses near the centre of the beds. From broadcast sowing it is possible to secure a larger number of seedlings per bed, but the beds present an uneven appearance. The north and east ends of the bed have seedlings several times larger than those of the centre, and those on the south side are likely to be dwarfs and possess a less healthy color, though this may have been caused by exterior conditions. Where the seed had been sown in drills these conditions do not exist to such great degree.

It has been said that broadcast sowing chokes out weeds, but in this State our sowing season is in the latter part of April, after plant life has started. Even if we soak the seed, germination does not take place for three weeks. During this time the weeds have a good start, and from this time on a proportionately larger number of young seedlings are pulled out by weeding in broadcast sown beds than from those sown in drills. For this reason alone one would think that broadcast sowing would be inadvisable except in old beds where weeds have been greatly subdued. The cost of this method of sowing is so large as against drill sowing, except as above, that it would be inadvisable.

The cost of making a bed 100 feet by 4 feet averages one dollar, and the cost of the seed \$14.40, making an initial cost of \$15.40, not counting the cost of sowing and weeding. Ideally, allowing one seedling per square inch, this bed should give fifty-seven thousand six hundred seedlings, over half of which would be lost in weeding, and from damping off and other causes. In clayey soil after a heavy rain with bright sun following, the soil would bake and nothing could be done. If a drought should follow under these conditions, as it generally does, the soil could not be loosened artificially. In drill planting the baking of the soil can be remedied, and the initial cost of a bed 100 feet by 4 feet is seven dollars and forty cents. There would also be from fifteen to twenty thousand plants with a greater likelihood of surviving. For this illustration two dollars are allowed as the cost of white pine seed per pound, using one and eight-tenths pounds per hundred feet broadcast and eight-tenths of a pound in drills. Of course drill sowing will increase the bed surface needed, but not necessarily increase the cost of working the nursery. More beds could be weeded per day, the time gained could be applied to cultivation, and in the end labor would be saved, more thrifty and vigorous seedlings would be produced suitable for planting both in brush and cleared land, and be more satisfactory to the nurseryman who raises them.

FOREST PROTECTION.

WILLIAM L. BYERS, *Forester*.

In considering forest management, among the first things should be the establishment of an efficient protection from fire, insects, and atmospheric influences. The most important of these in our case is protection from fire. Any reason for an economic forest policy implies forest protection as the first step to be taken. The object of forestry would be defeated without protection. The planting and tending of forests are useless and a direct loss without protection. The management of a reserve will otherwise certainly prove a failure. It is possible to do lumbering on only a few portions of the different reserves at this time; but if these lands be protected from fire for a period of from twenty-five to forty years, we will then be able to cut a crop of timber from the greater portion of the reserves. The first protective measure should be the demarkation of the reserve boundaries. This survey should be done by competent surveyors. In this manner all disputes as to ownership of land will be settled. Without a survey some people will advance claims as owners of land, and thus have an excuse for trespass upon State forests. In the survey of land, nothing but stone corners should be made wherever possible, as they are not so easily destroyed as posts and trees.

The next step should be the making of a good system of roads, trails, and fire lanes, which should completely cover the reserve. They will furnish safe and effective places from which to fight fire, and they will also make the reserve accessible in case of fire. If it is possible, a good system of roads and trails should be made in preference to the making of fire lanes. Fire lanes should be made only where the grade is too heavy for a road and where it is necessary for one or the other to be used.

There should be an efficient force of rangers, about one for every 5,000 acres of land, and in some cases, one for 3,000 acres, and, during fire season, there should be appointed wherever it is found necessary an assistant ranger. These rangers should be trustworthy and not be appointed for political reasons. They should be required to learn their districts, all roads, trails, streams, and note any improvements that may be needed. They should patrol their districts thoroughly, and learn the needs and habits of the people who frequent their ranges. There should be a tower on every reserve, located on the highest point, from which may be had a view over most of the reserve.

During fire season there should be one man in this tower at all times. He should be provided with a good pair of field glasses, a complete map of the reserve, showing the roads and streams, and should also have telephone connection with the officer in charge of the reserve, or the nearest ranger. There should be placed on the reserve at different points, small tool houses or chests, fitted with a lock and keys, and each man employed on the reserve should have a key. These chests should contain shovels, rakes, picks, and one or two torches for use in back-firing. One of these outfits would not cost over ten dollars. They should be placed along roads, so as to be easily accessible in case of necessity.

With a private individual, forest protection is a question of profit and loss; but with the State, whose purpose in obtaining this land is to perpetuate the forest supplies and preserve the water supply of the State, it is its duty to protect, even if it does not pay. By affording protection, the land will bring the results for which it was bought. It pays to protect forested land in Germany, and there is no reason why it will not pay to do so in this country. Protection from fire would be greatly benefitted by having the law of June 12, 1907, P. L. 527, apply to all timber lands.

In case of attacks by insects, one way in which they may be stopped is by introducing into the forest insectivorous birds. Trap trees may also be resorted to. It is seldom that insects will attack healthy trees. Therefore, having a healthy stand of trees, is, in most cases, a protection against insects. Against atmospheric influences, a change of species will in some cases stop wind-falls. The attention of campers should be called to the loss that results from forest fires, often caused by carelessness. It is necessary to educate the people so that they will be more careful with the use of fire in the forest. The slashing of cut-over lands should be burned at a season of the year when there is no danger from fire being communicated to surrounding forests. In the planting of old fields, it would be well to leave an open strip around the planting area, to be kept free of all inflammable material as a protection to the young seedlings from fire. Seedling transplants should be carefully watched for any attack by insects. From November, 1903, until March, 1908, or a period of 52 months, the cost of protecting the Bedford county reserve, consisting of about 9,000 acres, outside of the regular ranger's salary, was \$374.48, \$7.20 per month, or \$0.0096 per acre per year. This includes the opening of fire lanes, the repair of a road a distance of three miles, and the employing of an assistant ranger during several of the fire seasons, and a surveyor for a few days.

NECESSITY FOR ADVANCING IMPROVEMENT WORK.

 ROBERT G. CONKLIN, *Forester*.

The lands which the State owns are commonly called forest lands, but this is a comprehensive term. These lands may be divided, according to the character of growth, into six types, as follows:

Type A. *Mature Growth Areas*. Lands on which there is a growth to maturity, which will only depreciate in value by being allowed to stand.

Type B. *Normally Stocked Areas*. These are the lands which contain an average stock of young growth, being neither greatly over-stocked nor greatly under-stocked. This does not mean that they contain a normal growing stock.

Type C. *Over-stocked Areas*. These are the lands on which there is a good young growth of various species, but which stands too thick for proper growth. There may be a few cases of lands which are over-stocked with old growth, but they are few.

Type D. *Under-stocked Areas*. These are the lands on which there are not sufficient trees to form a forest canopy to protect the soil. On these areas there is very often considerable young growth of little value.

Type E. *Barrens*. These are not lands entirely without growth, as the name might indicate, but are lands which contain nothing more valuable than scrub-oak or fire-cherry. Hundreds of acres of this type of land are to be found in all parts of the State, and Pike county has a large area.

Type F. *Open Fields*. This, perhaps, needs no explanation, as they are just what their name implies. They are found on almost all of the reserves, but not in large areas.

This classification is not intended to be taken as a standard, but is intended merely as a rough classification for the purpose of this paper.

To give here a lengthy picture of the conditions existing in many parts of the State where fire has followed the lumber man, and only the stumps are left, is not necessary. We have all seen them and know what they are. Likewise we are familiar with the other types of land as given above, so a picture of them is not necessary.

We are given the work of making something of these lands. What we make out of them depends on the success we have in keeping out fires, and the improvement work put upon them.

This improvement work is mainly directed toward the correction of bad conditions, as stated in the types above, and may be said to consist of three operations, improvement cuttings, thinnings, and plantation work.

There is a distinction to be made between improvement cuttings and thinnings.

An improvement cutting is the first cutting made on a new area, with the purpose of bringing the growing stock as near the normal as possible, by removing dead, dying, and valueless species. *A thinning* is one of the cuttings made at regular intervals during a rotation, to reduce the growing stock to the normal. This distinction is used by the Federal Forest Service, and has been sanctioned by various authorities.

While our systems of protection embrace all of the lands we own, our improvement work is directed mainly towards the lands of types C and F, the over-stocked areas, and the open fields. In one case, on the Mont Alto Division of the South Mountain reserve, a tract which came under type A has been improved, but this is the only one of that class.

All of our lands demand more or less immediate attention, and I shall attempt to show why this attention should be given them; that is, show the necessity for advancing improvement work on the reserves.

First, we will consider it from the point of silvicultural reason. This reason applies more closely to lands of the over-stocked type than to any of the others. On these areas we find conditions which are the very reverse of good. The trees are crowded together, their boles are thin and spindly, and their crowns small and sparse.

Every quality of soil has a definite amount of nourishment available for plant use, and no more. Consequently when an area contains more trees than the soil contains nourishment to sustain, we find the conditions stated above. And this is what we find on lands of type C. There is insufficient nourishment for the stock, consequently the trees are retarded in their development and what growth there is, is generally of an inferior quality. These conditions are opposed to the best silvicultural development standards, and the longer they are allowed to remain so, the worse they will become. Now, go in there, remove the smaller and less valuable trees, and make available for the remaining stock the food which the removed trees used, and also the space for the spreading of their crowns. The remaining stock will advance rapidly, their crowns will spread out, and the diameter and height increment will increase. If enough trees are removed, the boles of the small spindly trees will increase more rapidly in diameter. If carrying out this improvement work means the advantages here

stated, does not neglect of the work mean a corresponding loss? Every year the work is omitted means a year lost to the trees' development, and in the aggregate this is a great loss.

On the Mont Alto division of the South Mountain reserve, on the point of Pine Mountain, along the public road to the Consumptive Camp, there was made in the year 1904, an improvement cutting, covering a number of acres. The worthless and stunted trees were removed, cut into cord wood, and sold. Here we can see, in one phase, the silvicultural value of the work. Before this work was done there were a few white pine seedlings growing here. Their tops were of a sickly yellowish color, and the seedlings were not making their best growth. Since the cutting was made there is the greatest difference to be seen in these seedlings. Their tops are of a deep rich green, and they are growing very fast. And in addition, there are great numbers of all kinds of young seedlings coming on. These will soon fill the blanks left by the removal of the worthless and dead trees. To obtain the best returns and development on all these lands, they must be managed so as to bring the growing stock as near normal as may be done, and as soon as possible.

The economic and financial side of this question is somewhat closely allied with the silvicultural side, for on the attainment of the best silvicultural development depends the highest financial return. While the carrying on of this work now does not mean large financial return at the present time, there are economic reasons why it should be done at once.

One thing is sure: The carrying on of this work at present does not mean any increase in the cost of the work, but may mean a somewhat lower rate. The cutting and removal of small soft saplings is certainly cheaper than the removal of the larger harder poles, not only in the cutting but in the handling. Does not forest economy demand that work of this kind be done when it can be done with the least cost?

And then there is another phase. The removal of the stunted, diseased, and dying valueless trees means there is so much more nourishment available for the remaining trees. As stated above, this produces higher development both as to wood quality and quantity. Better development means greater financial return.

Take an area capable of producing two cords per acre per annum under the over-stocked conditions. The improvement of these lands will mean an increase of perhaps one cord per acre per year bringing the total up to three cords per acre per year. At the common rate for cord wood this means an increase in value of \$2.00 per acre per year. Should this work be put off for 10 years, it would mean a loss of 10 cords per acre at a value of about \$20.00 in the value of the woods. Will it not be better, financially, to do this work now when the cost is the lowest, and secure this increase in value?

Another economic reason for doing this work now is to prevent loss by reason of waste in the woods. This applies to two classes of lands, those on which there is no stock of any value or of very small value, and those on which there is a great quantity of timber, the removal of which is a help, both by benefitting the remainder and by a financial return.

Take those referred to first, which includes the open fields and the barrens. In the open fields and barrens we have a dead investment, *i. e.*, one which calls for expense, protection and taxes, but which produces no return. This is wasteful, but it cannot be remedied at once. In three counties, Adams, Franklin, and Huntingdon, we have taken steps to put these lands into the paying class. White pine and other seedlings have been planted on the open fields.

And again in the open fields we have another source of waste. On these places we encounter two great soil enemies, leaching and erosion. Rains beat down on the soil and what goes into the ground takes with it some of the soil fertility while that which runs off carries away the soil bodily. Trees are natural soil fixers and hence they are the things to use here.

So for every year these lands, the open fields and barrens, are left in their present state there is a loss through lack of return and payment of expenses, through loss of soil and soil fertility.

On hundreds of acres of State land, the ground is occupied by a mixture of valuable and valueless species. By the removal of the latter so much greater area will be available for the use of the former. On the Mont Alto Division on the top of the mountain, along the public road to the Sanatorium, there was a stand in which oaks of no value and aspen occupied much of the area. Under the direction of the forester, during the fall of 1904, these were removed, and now a good growth of oaks and chestnut is occupying the ground and filling the blanks.

As for the second mentioned lands, where the logs and tops are strewn around and dead and dying standing trees occupy the ground, the question has three phases. First, unless this stuff is utilized immediately it will be impossible to derive from it any revenue, for it will become rotten and worm eaten. Second, this stuff is occupying ground which should be supporting good young growth. Third, areas like this are fire traps. Fire starts easily here and once started burns fiercely, destroying everything in its path.

So improving areas like this will do three things; produce a definite financial return, give the young growth a chance, and destroy fire traps. On the Mont Alto division, Pondtown tract, there were 40 or 50 acres of dead poles. It had been a growth of oak and chestnut of 4 to 10 inches in diameter, but fire killed it all. This stuff was

cut by the people of the vicinity, and hauled away. The Department received \$0.50 per cord on the stump. Here the young sprouts are again taking hold and making a good start.

On lands of type A, where we have the mature and over-mature stuff, the question of the immediate advancement of this work hinges on the fact that these lands have ceased to increase in value by reason of any wood increment; but are either at a standstill or are going back. Just as soon as stock ceases to increase in value it is ripe for cutting, and where it has started to go back or depreciate in value it should be cut at once. Why not reap the crop while it will give us the highest returns, and give the second growth the advantage of that much start?

Again we have to go to the Mont Alto division for an example of this phase. On the Guilford tract near Pondtown there was a mature stand of oak and chestnut. Under the supervision of a forester this was cut off. It yielded the State about \$1,400.00 clear profit. And here the sprouts are already starting, although this was cut over only during the spring and summer of 1907.

On the Caledonia division of the same reserve there are several stands which are about ready for cutting, and should be cut within the next few years. But so long as a stand is not really going back, it will perhaps be better to expend all our efforts upon those areas which are in greater need of improvement.

The financial side has this to be said in its favor, that by deriving a return from the lands we will be meeting the popular demand for some visible sign of what this business will amount to.

There is still another phase to this subject, which, while it may not appeal very strongly to the forester, has a decided hold on the minds of the people. This is the aesthetic value of the forests. One of the popular ideas of forestry is that we are working toward the creation and maintenance of forests as parks and outing places for the people. As we are to a greater or less extent working for the interests of the people, we should recognize this public demand so far as is compatible with the best interests of the forest.

When we come to look at the two extremes of forest land, and scrub oak barrens of Pike county or the stripped hillsides of Tioga county on one hand; and the cathedral pines of Mont Alto or the hard-wood grove on the road between Caledonia and the Sanatorium on the other, we will all agree that there is a great deal of good in the idea of developing the aesthetic beauty of the forests. There is a necessity at this time to get the work before the public. We must show that we are doing something real. Where will we find anything so likely to attract attention as the fact that an agency has been at work removing some of the eye-sores which exist along the public roads? A well regulated forest, without a tangle of old logs and

greenbriars littering the floor, means more to the people than all the explanation about silvicultural development and economic use of the soil, and they will appreciate any effort we may make along this line.

Almost all of the operations so far carried out have been along the routes of public travel. Here the people see and appreciate the fact that something is being done. So with the necessity of getting the public's attention. Since the people will appreciate the development of natural beauty, do you not think this another reason for the advancement of improvement work?

And now will this work pay? There is an idea somewhat prevalent among the people that the real object of improvement work is the immediate return to be derived from the sale of material. That this idea is erroneous we all know. The real value of improvement work lies in the increased value of the remaining stock. In many cases improvement work can be made to pay for itself and in some cases to yield a profit. But where the need for advancing the work is great, it would be better to do it at a small immediate loss than to neglect it and lose the increase in value of the stock. As for plantation work it will more than pay for itself in the future.

Most of the states are taking up work in forestry, Pennsylvania perhaps in the lead. She has gone into it deeper and more business like than any of the others. There is still a lot of criticism and abuse by people who do not know anything of the subject.

On our work will depend the disarming of these critics and their change to friendliness. As before stated, most of the criticism is on the ground that there is nothing of any value resulting from the work. By advancing improvement work as rapidly as possible and showing by actual results that there is something being done, we will make and hold them friends.

While we all concede that improvement work is a necessity, we must not forget the need for another phase of the work, perhaps as important. I refer to protection. All improvement will count for nothing if we are to have it destroyed by fire. Every year thousands of acres are burned over. What will it benefit us if our work is to be obliterated within a year or two? While paying, therefore, all possible attention to the work of improving the lands, let us see that lands and work are properly protected.

A SYSTEM OF FOREST BOOK-KEEPING.

ROBERT G. CONKLIN, *Forester*.

In working out a system of book-keeping for a reserve, there is one thought to be kept constantly before you, simplicity. Where a forester has to do his own book-keeping, a complicated system will increase his work two-fold. Book-keeping will generally be done in the evenings after the day's reserve work is over, and a complicated system will needlessly increase his labors.

The conditions under which we must work are, perhaps, unlike any others where book-keeping is done. Each reserve is like a department in a big manufacturing concern, and yet different; for while a department of manufacturing has only one operation to deal with, here we have as many different operations as there are compartments or cutting areas in the reservation.

All our expenses are returned to a central office, and paid by moneys from there. Likewise all receipts go into the same office, but are paid from there into a different fund.

To work out a system of book-keeping which will be simple, yet applicable to the conditions under which we must work, will take time and experience. I am not an expert accountant, nor have I had an extensive experience in book-keeping. Consequently I do not set up any recommendations I may make as the best, but simply as recommendations.

In modern business practice, the card index system is rapidly taking an important part. Business forms of various kinds simplify matters, and system plays an important part.

On the Mont Alto division, there is in use a system of book-keeping which combines the use of books, blank forms, and cards under a somewhat elaborate system. This system of book-keeping is good and I thoroughly approve it, as it is clear and practical. There the conditions differ very much from the conditions on the reserves generally, for there are school accounts and reserve accounts which intermingle somewhat. But it is too complicated and elaborate for use on a reserve where conditions are simpler and the forester has to do his own book-keeping.

At Mont Alto they use the day-book, cash book, and ledger; a card index system, and a system of time-sheets and reports. The system of time-sheets and reports is good, and as it is, perhaps, as simple

and effective as could be devised, it will be suitable for use on all reserves; but as for the books and cards, I believe them too cumbersome and require too much work to be valuable on reserves.

At the Asaph Nursery I tried to devise a system, which, while simple, would fill all requirements. Of course, here conditions were much different from those found on a reserve, for we had only one operation to take care of. Other operations such as surveys and road work, were simply charged to the Department. Here only two books were used in connection with the system of time sheets, a journal and a ledger. In the journal everything was charged as used, except labor, which was entered only at the end of each week or the last day of the month. In the ledger the work was divided into such accounts as operation, protection, grounds and buildings, equipment, etc. The real stock account was headed "Pennsylvania Department of Forestry," and all goods and checks received were credited to this account. All expenditures made for outside reserve work, but paid from the nursery, were debited to this account. At the end of the season the inventories of equipment, protection, and seedlings, were debited to this account and the account balanced. This system is faulty without a doubt, but having had no previous experience and needing it immediately it was the best that could be evolved at the time.

When I submitted this question for the Convention I had not expected to be assigned it as a subject, but had expected to get some information from the Department as to their wishes in this matter. So far as I know there has never been any statement made to the foresters as to how they wanted the accounts kept. Are we to keep a simple record of expenses and receipts, and allow the profits and losses to be determined for each reserve as a whole, or by compartments, at the Department? Or are we to keep a more elaborate system of accounts so that we can determine at a glance whether the operations on each compartment, or on the reserve as a whole, are being carried on at a profit or a loss? So far, I have been going on the supposition that the second case is the one under which we are working.

There is one thing which should be kept in mind though, and that is that all operations, expenses, and receipts, for each compartment should be kept separate. Whether this will mean simply a separate account in the ledger or a separate ledger for each compartment, depends on the viewpoint. Suppose we use one ledger. In this ledger each compartment or operation should have a separate account, and different accounts such as pole wood, lumber, shingle wood, etc., should be kept.

The use of a loose leaf ledger will, perhaps, be better than this for at the end of each year the leaves of the various compartments could be separated and filed, each under its own head.

By keeping these separate accounts or books, each compartment will be made a separate investment.

But this is, perhaps, too elaborate, for it will require that each compartment have its own rangers; that the forester and his assistant will have to keep record of their time so as to charge it to the compartments they have worked on; and that will mean perhaps too many accounts.*

I believe the best way would be to have someone whose business it is to solve such problems work out a simple but comprehensive system of book-keeping for reserve use.

I do have a few recommendations to make:

First: Let the system be as simple and comprehensive as possible. Nothing causes so much trouble and worry as mistakes in book-keeping, due to ignorance of the system used.

Second: Use wherever possible blank forms which indicate clearly what is required.

Third: Keep the accounts of each range or compartment separate, so that a glance will suffice to show whether the operations have been carried on at a loss or gain.

Fourth: Keep separate accounts, if possible, for the various classes of products.

Fifth: Keep a general account which will show the status of the business of the entire reserve at once.

There is still another point which I wish to place before this convention, and that is the value of an accurate and minute record of the daily progress of the work on each reserve. The use of a separate record book for each compartment would very likely be much better, but perhaps it would entail too much work. The best way may be to use what may be called a Year Book. Each book would be divided into the same number of parts as there are compartments in the reserve and the complete record of the operations on the compartments entered in the part of the book allotted to it. By the use of a separate leaf book waste in paper could be eliminated, and the sheets used could be removed from the cover at the end of the year and filed under their proper head. This would not only be cheap but would reduce bulkiness in the record.

But whatever is done, one thing must be remembered: A full and complete record of all transactions both in book-keeping and records, should be kept on each reserve. The sooner a practical system is worked out and put into use, the better it will be for all parties and interests concerned.

*At present the conditions on each reserve differ from those on every other. With the instruction in forest book-keeping received at the Academy, each forester is expected to keep the best accounts under the circumstances, determining for himself largely what are his needs. After work on new reserves has been reduced to a system, uniform accounts will be required.

FOREST NURSERIES AND NURSERY WORK.

W. H. KRAFT, *Forester*.

The ever increasing demand for desirable timber trees brings to our mind the mission of Forest Nurseries, which is to supply seedlings of the most desirable species, in large quantities, at a nominal cost, to be used in reforesting waste and burned over lands.

These forest nurseries are being established by individuals, railroad, and lumber companies, state and national governments, for their own use, and professional nurseymen for the sale of desirable seedlings of the timber species for forest planting. This method is used to overcome the uncertain and slow natural regeneration of our most desirable species of timber trees.

The forest nurseries I will deal with mostly are the ones now established and operated under the direction of the Pennsylvania Forest Reservation Commission.

These nurseries, of which there are three principal ones at the present time are so situated in different parts of the State, that seedlings from them may be supplied to the different reserves without long or expensive shipment.

The one situated at Mont Alto, Franklin county, was established in the spring of 1902, and with which most of you are familiar from our forestry reports. One is situate at Greenwood, Huntingdon county, established in the fall of 1906. The other is situate near Asaph, Tioga county, established in the spring of 1907. Of the nursery at Greenwood, of which I now have charge, I wish to state as follows:

This nursery contains about two and one-half acres, is situate on a northwest slope in an old field, which was under cultivation for farm crops until the nursery was established thereon. The site is an ideal one for the raising of coniferous seedlings. The soil is of a shaly character and is protected on the west by a strip of woodland, which breaks the force of the prevailing westerly winds.

In the fall of 1906, Forester W. L. Byers, had this site plowed, manured, and cleared of stones. He also prepared the soil and planted in nursery rows two feet apart, one and one-half bushels of white oak acorns, one-quarter bushel of pignut hickory, one pound of black locust, which he gathered in the locality nearby. He also prepared twenty nine seed beds 4 x 70 feet, for the planting of white pine seed the following spring. In the spring of 1907, I was placed in charge of this nursery, but owing to the unfavorable weather and a late season I was unable to advance the work begun the fall before,

until the last week in April. With what help that could be procured at that time, the seed beds were prepared and there were planted 75 lbs. of white pine in drills six inches apart, sowing a few beds broadcast as an experiment only; 5 lbs. Scotch pine, 5 lbs. European larch, 10 lbs. white ash, 3 lbs. cucumber, 40 lbs. shellbark hickory, 40 lbs. bitternut hickory, all sowed in drills six inches apart.

The seed beds are raised about four inches above the path, are 4 x 70 feet, and run east and west giving them the benefit of the shifting light throughout the day. All the seeds above mentioned were procured by the Commissioner from professional seedsmen, and were sent me too late to make test for germination. Owing to the ground remaining cold and damp until in June, the germination of all the seeds was retarded, none making any appearance until late in June and in July. The conifers showed almost a perfect germination, also the white ash. The cucumber was evidently worthless, as none of it germinated. The hickories were so badly ravished by the pine squirrels that very few were left to germinate. At the present time I am unable to give the exact number of seedlings in the nursery as no inventory was taken in the fall of 1907 owing to insufficient help. Taking an inventory in the fall requires another in the spring to account for loss by severe winter or heavy spring frosts. With proper appliances, such as screens to shade the beds, and an available water supply in case of drought for watering beds and seedlings, I think this nursery when fairly started will produce from five to eight hundred thousand seedlings a year. This will depend largely on the age of the seedling to be used in the planting operations, as more two year old seedlings can be procured than those transplanted. The age at which the seedlings may be used will depend largely on the location of the plantation; two year old seedlings being satisfactory for plantations in old fields and ground which are easily prepared for planting; but where there is a heavy growth of brush or briars, four year old transplants are more advisable. The additional cost of these transplants will be about \$2.50 per thousand.

Other work done at Greenwood in connection with the nursery was the making of a black walnut plantation in an old field containing about four and one-half acres. This was planted in the fall of 1906 by Forester Byers, about 30 bushels of walnuts being used and planted four by four feet. The nuts were greatly destroyed by the squirrels during the winter. What seed germinated made a thrifty growth, in the fall of 1907 ranging from six to twelve inches in height. The blanks were filled in in the fall of 1907 with nuts, nineteen bushels being used for the purpose.

The year 1907 having been a fairly good white pine seed year, one hundred and fourteen bushels of white pine cones were gathered by

boys of this locality, for which I paid thirty cents per bushel. While these cones when dried did not turn out as large a quantity of seed per bushel as some foresters estimate, from 114 bushels of cones I cleaned 77 lbs. of seed, ready for planting, averaging one pound of seed to not quite every bushel and a half of cones. Counting total cost of building screens on which to dry the cones, trays to catch the seed, and cost of cones, the price per pound was about \$0.59. Allowing that these screens and trays will last five years instead of one, the cost would be reduced nearly one third.

The crop of other desirable seeds in this region, excepting walnuts, was a total failure in the year 1907.

The cost of labor in our nurseries and upon reserves could be reduced considerably, I think, if the question of hiring labor could be better adjusted than at present. Men are now employed only during the busy season of the year. This is unsatisfactory, as a man acquainted with the character of the work will do considerably more than one who is not. Therefore, steady, industrious men, who are quick to learn the work, are unwilling to be employed at a low wage for a few months only in the year. When men can obtain work at a higher wage even if it require their being away from home a great part of the time, they will seek such work. On account of the increased cost of living a man is unable to provide for a family on an average of eight months' work a year with 16 to 18 days per month, working only 145 to 150 days per year out of a possible 300 working days. Many of these men could be retained by giving them every possible day's work the weather permits. This could be done in opening necessary fire lanes, repairing roads, making improvement cuttings, and doing other work. Thus by employing a regular force, considerable more work could be done on the reserve with a smaller force than in the present way, and it would keep desirable labor in and about the reserve.

DIVIDING THE RESERVES.

LEWIS E. STALEY, *Forester.*

The subject of dividing the reserves into ranges, blocks, compartments, and sub-compartments is, without doubt, one which requires much forethought and a careful study of actual conditions found in the forest. Not alone must we be well acquainted with present conditions, but past conditions should be known in so far as they are

of value in the future management of the area to be treated. If the reserves were to be divided into their several divisions at short intervals, say every five or ten years, the subject would be quite different; but since when once divided they are divided for all time excepting for small changes, we should have nothing short of a complete past and present record. A division of the forest depends largely upon the kind of management to which the reserve will be subjected: that is, do the conditions of the forest require an intensive management, or are they such that warrant only an extensive management?

These conditions can only be actually known by a complete survey. Until recently, the boundaries of lands owned by the Commonwealth were not well located. The method of this complete survey depends largely on the value of the forest as represented by the returns. Generally speaking, all main lines such as boundaries, all public roads, all streams, meadows, farms, and anything else that may be of a permanent nature should be surveyed and accurately marked. As these data, so procured, will form all skeleton maps for future management of the entire area, they should be carried out in the minutest detail and to the greatest degree of accuracy. Nothing should be left undone that might be of value in determining what lines to follow for the future.

Considering conditions as we have them on the reserves today, each reserve may be well divided under the following general heads, viz:

- 1st. Ranges,
- 2nd. Ranges into Blocks,
- 3rd. Blocks into Compartments,
- 4th. Compartments into sub-compartments.

By a range is understood such an area as may be conveniently covered by one man called a ranger. In the division of a reserve of twenty thousand acres or more there are two conditions which must be considered: The situation and the intensity of management.

In the case of scattered blocks, or in hilly country such as we have to deal with, the ranges may comprise a smaller area than if the blocks are consolidated or situate on level ground. In forests which yield a small return, as is the case with ours at present, the ranges may be large. Where the returns are large it pays to make the ranges small in order to facilitate a more intense management of the area. The boundaries of ranges should in all cases conform to some very conspicuous topographical features. If for some reason no well defined ridge can be had, some permanent fixture as a public road may be well suited to mark the boundary. In rare instances either of these may make the range too small or too large. Then the only method would be to designate the boundary by an opened line. It

might happen that this line between the ranges may be well located for a fire lane and under these conditions would serve for both boundary line and fire protection.

Each range may again be divided into smaller divisions called blocks. These may or may not be of value other than reducing the area into workable sizes. If it should be convenient to divide the range into blocks by natural boundaries, very good; if not, it may be no detriment to the range. On large ranges this division into blocks may aid in designating any particular part of the range.

Again blocks are divided into compartments. Compartments are sometimes called the silvicultural unit because they form the unit of work. The whole of this division is effected by using in addition to the outer boundary lines, interior natural lines, as creeks and smaller water courses; or some geographic unit, as a basin formed by two hills, the entire flat on top of a hill, or, in some cases, from the top of a hill to a ravine.

The boundaries of compartments may be made to coincide with the conditions of growth. For instance, a compartment may be composed of a pure stand of pine, of chestnut, or of some other species. Age conditions and, in some cases, public roads may conveniently form compartment boundaries; but it is best to have some geographical feature form boundaries when convenient. This will do away with the possibility of the lines ever being changed,—something that must be guarded against.

The size of the compartments as well as of other divisions depends on the intensity of management, the extent of danger from fire, and the size of the former division.

When there is necessity for dividing compartments these divisions are known as sub-compartments. Such sub-divisions should be avoided as much as possible because of the additional expense incurred in their management. When a compartment is composed of an area of large trees and an area of small trees each area may be called a sub-compartment, but as soon as there areas can be thrown together without much distinction of age classes it should be worked as one compartment.

Among the advantages to be gained by dividing the reserves are the following:

Each ranger knows exactly the area which he is to cover or patrol.

In case of operations a record can be kept and the exact location designated.

The best management can be effected by striving toward the ideal forest, and this is most easily accomplished by a systematic division of the forest into workable units.

A REGULARLY EMPLOYED LABOR FORCE.

LEWIS E. STALEY, *Forester.*

The necessity of a regular force of laborers is becoming more apparent as forestry advances. Not alone in forestry has this necessity manifested itself, but in all business operations one of the first things to be considered is men,—a regular force of laborers—men that can be depended upon at all times.

How can good results be accomplished if the men that are doing the work are careless and unconcerned? If good results are to be accomplished in forestry as in any other business, the men must be more or less trained for the work they are to do. They must have practice, and this can only be obtained by having them employed regularly.

Some one may make the statement that men are plentiful, that men can be picked up at any time. Of course to a very great extent this is true at present, but is it not also true that such men as are available at any time of the year, are in many cases men that cannot be depended upon? You have them one day and the next day they are gone. They have some excuse, your work does not suit them, or perhaps the wages are too little.

Why does the State train its own foresters? It is simply because the Commission has found it to be the most advantageous way in which to fit men for the work. Men who are trained along certain lines can undoubtedly work to better advantage than those who may be picked up at any time. The same rule may be applied to laborers. They may not be so well adapted to the work in the beginning, but in most cases, woodsmen, in particular, can in short time do the work as it must be done.

A very good example of a regularly employed force of laborers is the section gang of a railroad. These companies have a certain amount of work which must be done just as the forester has on each reserve. Could not these railroad companies depend on picking up men as the occasion demanded? Is it not true that the "section" labor is almost at an end as soon as the rough weather sets in, and yet the majority of the gang are retained the entire year? There is something at all times to employ them if it is only to make a surplus of handles for their tools. The retaining of these men, in my opinion, is simply because the railroad companies have found it to be to their

advantage to stick closely to their experienced workmen. The companies have so distributed their labor over the entire year that men are needed at all times.

The same idea with reference to distributing labor over the entire year could be used to advantage in forestry. While it is true there is certain forestry work, such as nursery work and fire patrol, which requires prompt action, there is a great deal of labor of other kinds which can be distributed over the greater part of the year just as it must be done when laborers cannot be had.

In forestry nearly every kind of labor must be done with the greatest care. Ordinary laborers in many cases are not capable of accomplishing the best results. For instance, take a man into the forest to do improvement work who has never swung an axe more than to split wood on his own wood pile; while he may be one of the best of workmen, he knows nothing about handling an axe, nothing about felling trees, cannot cut stumps as they should be cut, and in general knows little about the woods and the requirements of the work. But he is willing and always ready to do what is asked of him in his way of working. This man will soon realize how improvement work must be done, and in a short time can do fairly well. If men of this kind could be employed regularly, they undoubtedly would work to better advantage than if picked up at leisure.

Not alone in improvement work would a regularly employed force of laborers be a great advantage, but on reserves where nurseries have been established they could be available for the rush season of the year. In the early spring when nursery work must be pushed, when most planting must be done, and, as a rule when men are scarce, these regular men could be used to great advantage. By experience they would soon learn how nursery work must be done and in case of the absence of the forester in charge they could go ahead and cause no delay which so often is the case where the forester has charge of work other than that of the nursery.

Again in the spring and fall fire seasons there is always necessity for placing extra fire wardens on most of the reserves. The ranger in most cases has to patrol at least from five to seven thousand acres of mountainous country which, of course, is entirely too great. He may be in one region and fire be burning in another for several hours before he discovers it. Instead of taking some laborer not suited to the position, as in many cases the forester is compelled to do, one of these regular men could be available for each range at any time; and in case of rain or damp weather there is always plenty of other work for them, such as opening roads, fire lanes, repainting boundary lines, and numerous other small jobs that otherwise must be done.

The salary of these men would necessarily vary according to the standard of the locality. In localities where lumbering is carried on

and where manufacturing establishments are near at hand a larger salary would be required. Under conditions as we have them on the Mont Alto reserve, \$30.00 per month would be a reasonable salary to begin, with the chance of a raise as proficiency in the work is reached. These men would soon realize the importance of the work and once being interested they would undoubtedly work to the advantage of the State.

Next, the value of these men could hardly be estimated in case of fire. While this may not be true on the Mont Alto reserve where the Academy students are ready in a few minutes to respond to any fire call, yet on reserves other than this one, and where men are scarce, truly great results could be accomplished with these regular men. They would be ready at any time and cause no delay in getting to the fire, something that may aid in checking disastrous fires.

As a summary, where nurseries have been established on the reserves, the regularly employed force of men could greatly aid in getting the work through. After the rush season of nursery work they could be used to advantage in improvement cutting, thinnings, opening fire lanes and trails, and in any surveying that might be done; and last but not least they would be at all times ready for fire service which, in case of scarcity of men, would alone more than repay the salaries paid them by the State.

IMPROVEMENT OF THE RANGER SERVICE.

B. FRANK HEINTZLEMAN, *Forester*.

As the State forest reserves are placed in charge of foresters the more intense system under which they are managed demands that some improvements be made in the ranger service to aid in putting the system into effect. The ranger has an important part to perform in the management of the State reserves.

The first thing to discuss when considering improvements along this line is the duties of rangers. When a forester has charge of a large reserve, 20,000 or 25,000 acres, upon which much work has to be done, it is not possible for him to look after the details. He should plan and direct how it is to be done. The ranger should then be able to take charge of what does not require direct supervision of the forester, and carry it forward according to orders. Such work includes improvement cuttings, building roads, cutting fire lanes, burning brush, and the like.

For all work to be done on the respective ranges, they should under direction of the forester, employ the help needed and keep the time sheets. They should have the right to dispose of fire-killed timber in the way prescribed by the forester. Some rangers, especially those on reserves which are not yet supplied with foresters, seem to think that patrolling is the one thing required of them; that if a certain amount of time is spent riding or walking over the reserve they have done their full duty. Instead of patrolling being their whole duty it should be but a small part of it. The other part should consist in keeping roads in a passable condition, in opening the trails where necessary to make any part of the reserve accessible, in keeping springs well cleaned and paths opened leading to them, and in doing any other work directed by the Department.

The rangers should traverse that part of the reserve boundary along their ranges, at least once a month. Under the present method used by some rangers, of patrolling only the roads nearest the lines, adjoining owners might cut over them for a long while and the rangers not be aware of it. Rangers should be encouraged to operate small nurseries in connection with their work and should be supplied with the necessary material for planting and instructions concerning the raising of seedlings. There are many half days when a ranger would otherwise be doing nothing that his time might profitably be spent in a nursery. The seedlings raised could be used to plant the many small blanks found in almost all forests.

All rangers should give their entire time to work on the reserves, and should not be engaged in an additional occupation, as farming or lumbering. No one can farm and care for a large area of forest land at the same time. He will either have to slight one or the other, and in most cases it will be the forest. Foresters should try to get their rangers interested in the work. Until the men are interested it will always be somewhat retarded and of a poor quality. Probably one of the best ways to arouse interest is for the forester to explain to them his plans of work for the coming month or the coming year. Explain why such work is necessary and ask their views concerning the manner of performing it. State to them the financial results of past operations. Men like to know what returns their labor is yielding.

The placing of rangers in charge of men employed on the reserves should help stimulate interest, for a man is always interested in a piece of work if he knows he is the one held responsible for the manner in which it is done. Copies of all reports, bulletins and circulars issued by the Department should be forwarded to them, so that they can gain a clear idea of exactly what the State is doing and wishes to do on its reserves.

At the present time some men hold positions as forest rangers who who are scarcely able to read and write. As long as the duties of

rangers include only patrolling and watching, these men do very well; but as the reserves are now beginning to be managed more intensely, a ranger should be a man of at least sufficient intelligence to be able to make reports on work done, to keep the time of laborers, and conduct the sale of wood.

Again, some of the present rangers are too old to be of much service to the Department. These men were often appointed when the land was purchased, no doubt because of their familiarity with the lines of the tracts. In this, it is true, they are often superior to younger men, but as the boundaries of the reserves are now being carefully located by surveys and men are being put in charge of the reserves who know how to determine the position of a line when the question arises, the need of their services in this direction is diminishing yearly. Because of their age they do not spend the amount of time on the reserves that they should, and they are not able to perform well severe labor, which often has to be done under trying conditions, such as fighting fire. Therefore, if the maximum age of men appointed was about 45 years, and then only those considered who are physically able to do hard labor, the reserves would show the result of the change in a short time. When a ranger is to be appointed, other conditions being equal, a man should be chosen who lives nearest to the reserve. One living three or four miles from his reserve cannot give good service with this distance to traverse to reach his work. If dwelling houses found on the reserves are to be used as houses for rangers and their families, they should be kept in repair. If it is necessary to erect buildings for this purpose, comfortable cabins should be built as the kind of men we like to occupy them is not the kind that is satisfied with anything.

All rangers should be sworn forest officers. When a man is under oath to see that the law is obeyed there is no inclination to leave wrongs unrighted. The ranger service might be greatly improved by the payment of a salary of about \$45 per month, every man receiving the same amount. Very efficient men could be secured at such a salary. Even at the present salaries which as a rule are lower, some very capable men who are often making a great deal more than the rangers, figuring on a per day basis, inquire as to the prospects of getting a position, being attracted by the regular all-the-year-round employment. Much good might be accomplished by having the rangers make out their reports according to a regular system, showing the kind of work at which they were employed each day of the month, and the number of hours per day. The latter would prevent men from spending two or three hours on the reserve and recording it as the work of a full day. They should be allowed to be absent from the reserve a definite number of days per month. If they wish to be absent more days than the required number, the permission of the forester or of the Department ought first to be obtained.

A SYSTEM OF FOREST PROTECTION.

JAMES E. McNEAL, *Forester*.

Considering the short time which Forestry has been practiced in this State, and the condition of our land at present, the primary and most essential thing with which we have to deal is the protection of forests from damaging agencies.

Dr. J. T. Rothrock, in an article printed in the 1897 Report of the Division of Forestry, has written,—

“The one central point among existing conditions is that there is no use in attempting to save what forests we have, or to restore them upon ground from which they have been removed, until a reasonable protection against fire is assured. Neither the State nor the individual can hope for success until a thorough, radical change has been effected.”

Fire protection, together with protection from other damaging agencies, precedes all benefits which we can receive, either directly or indirectly from our forests, and should be dealt with accordingly. We should not only fight the danger after it has made its appearance, but should take measures for the prevention of all dangers to the forests. These dangers are numerous, and may, in a way, be divided into three classes:

1. Dangers from human agencies.
2. Dangers from organic agencies.
3. Dangers from inorganic agencies.

Under the first class, or dangers from human agencies, fire is certainly the greatest and most dreaded. Its source may be in so small a thing as a match, carelessly thrown aside by a smoker, but whose damage may be almost beyond computation, depending upon the condition of the weather, the efficiency of a protective system, or the nearness of a rain.

In calculating the amount of damage done by fire to forest land, usually only the destruction of good trees is taken into consideration, but indirectly the forest expectation value is seriously affected and the productive capacity of the soil lessened. Through the agency of fire the drain on our forests has been almost beyond belief, and although there have been large areas cut over, the amount of land burned over, in many places greatly exceeds it. This may be illustrated by a case in Oregon, where, during the past fifty years, there have been nearly 1,000,000 acres more land burned over than cut over.

Another case in which fire has done inestimable damage, occurred in New Brunswick in 1825, when there occurred what is known as the Miramichi fire, which, in nine hours, destroyed a belt of forest eighty miles long and twenty-five miles wide. More than 2,500,000 acres were burned over and nearly every living thing was swept from its path, 160 persons and nearly 1,000 head of stock perished. A number of towns were destroyed and 590 buildings burned.

Fires of this type are seemingly of the past, greatly due to laws and regulations governing the burning of brush, the awakening of the people to the importance and necessity of our forests, and the good work of Federal and State authorities. In our own State, statistics show a marked decrease in loss from forest fires. In 1902 the loss was \$620,573, in 1903 it was \$241,240, in 1904, \$135,873, and in 1905 it was reduced to \$63,951, which is less than 1-9 of the loss four years before. It does not follow, however, that the loss will decrease annually, and until there is a good system of protection established, we may look for very heavy losses.

The loss due to trespass is comparatively small and may be guarded against, to a great extent, by having good ranger service, by making all boundary lines conspicuous, and by placing warning notices through the tract.

Protection from organic agencies, i. e., from insect and fungus attacks, is very difficult and entails much study and experiment. The loss by reason of this agency is not nearly so great as that by reason of fire, but we must guard against it, nevertheless. This may be accomplished to some extent, by removing all breeding places, as dead or dying trees, and slashings.

Under dangers from inorganic origin we have "wind-falls" which, although they do not occur frequently, are often accompanied by very heavy losses. On September 30th, 1896, a destructive "wind-fall" occurred in Sullivan, Wyoming, and Luzerne counties, and although there is no exact estimate of the damage done, it is probable that not less than 200,000,000 feet were destroyed, covering an area of from 10,000 to 15,000 acres. This danger may be partly overcome by using proper methods of cutting, which should always be done under direction of a forester.

In establishing an effective system of forest protection it is necessary to do away with the cause of destruction. One of the most essential things is good fire and trespass laws. Penalties should be so severe that malicious people will be afraid to violate these laws, and careless people will be more careful.

It should be the duty of rangers, from the point of forest protection, to patrol the woods in order to guard against fire and trespassers, and to keep all fire lanes, or roads and trails used as fire lanes, free from

inflammable material. They should have some knowledge of harmful insects and fungi, in order that attacks may be promptly reported to the proper authority and effective measures taken to check them.

During fire seasons, there should be men employed to patrol the woods, if there are not enough rangers to do it properly. There should be one man to not more than 5,000 acres. "Look-out" stations, with telephone connection when possible, should be built on points commanding a good view of the surrounding country. There should be a man stationed at each of these stations while there is danger of fire. With the aid of field glasses he would locate fires as nearly as possible, and report them so that men might be sent out promptly. If a system of telephone lines were established, one can readily see that help could be had soon after the fire started and in many cases could be controlled, with little damage. A system of telephone lines has been successfully operated in the state of Maine, and in 1904 reports from one telephone are said to have saved many thousands of dollars.

All lumbering contracts should obligate the careful burning of slashing, whether on state land or private land adjoining other forest land. Although lumbermen do not meet such demands favorably, on account of the expense, experiments show a very small cost. In pine regions the slash has been piled and burned at the rate of less than 25 cents per M. B. F. logs scaled, and in some cases it has been as low as 15 cents. In California experiments have been made in which the slashing was burned as the lumbermen left it, by burning small areas at a time, in a way that the fire can be controlled at all times. This has been done successfully and at a small cost.

Many advantages are derived from the burning of slashing, among which are clear ground for better reproduction, destruction of so-called "fire-traps," breeding places for insects and fungi, and easier means of travel through the woods.

There should be on all large tracts, a network of roads and trails in order to confine fires to areas as small as possible. When cutting fire lanes it is advisable to cut them in places where there are likely to be permanent roads in the future, which will be used as fire lanes. All fire lanes should be kept free from inflammable material and should be opened up annually, soon after the growth stops and before the fall fire season begins. When there are railroads through forest land there should be a strip burned on either side of the tracks and kept free from inflammable material during the time there is danger from fire.

Protection from trespass through ignorance may be established by cutting a clean and distinct path along all boundary lines. This path should be made conspicuous by marking line trees with a special blaze and posting warning notices. Warning notices should also be

placed along frequently traveled roads and paths through the interior of the tract. All corners should be solidly built of stone which will not be greatly affected by the elements. In order that corners will be conspicuous they should be built of material which is not found in the immediate vicinity.

Although an effective system of forest protection will be expensive and will run into a good sized sum of money, it is better to establish it as soon as possible than to have losses, every year, that will in a comparatively short time exceed the cost of an adequate system of protection for many years. This may be illustrated by a case in the Adirondack Mountains where, in 1903, fires involving a loss of \$3,500 entailed an additional expense of \$175,000 for fire fighting alone. If this amount had been used in carrying out a system of protection during the dangerous months the great loss would have been averted, and protection afforded for many years.

MANAGEMENT OF FOREST LANDS UNDER PRESENT FOREST CONDITIONS.

JAMES E. McNEAL, *Forester.*

Under various circumstances a forest may yield its best return in wood, bark, or other forest products, in money, or interest on the capital which it represents, but whichever of these ways of using a forest is chosen in any given case, the fundamental idea of forestry is that of making the forest yield the best service possible at present and in such a way that its usefulness in the future will not be diminished, but rather increased. A forest well managed under practical methods will yield a return in at least one of the ways just mentioned; but before it will be in condition to render the best service, there are four things which a forest must have.

These are,—

1. Protection, especially against fire and thieves; for without such protection no investment is secure and the most skillful management is of little effect.
2. A strong and abundant reproduction. Without this a forest will speedily die out.
3. A regular supply of mature trees to be cut.
4. The proper amount of growing space for each tree, in order that all trees may grow to the best advantage.

The first requirement in the management of any property is that its condition be known and recorded. Hence, in placing a tract of forest land under management a survey is necessary. The object of such a survey is to have maps showing,

1. Outside boundaries.
2. Roads, rivers, railroads, and other means of transportation.
3. Lines between different localities having different laws, or which come under different jurisdiction, as county and township lines. Interior tracts of forest land, and land upon which any rights are reserved.
4. Contour lines and configuration.
5. Differences of soil. Whether agricultural, forest, or unproductive.
6. Fire lanes.
7. Cleared land within the tract.
8. Types of forest.
9. Any special land marks which may be noted.

In connection with these maps there should be a general description of forest, climatic, and surrounding conditions, of possible dangers, of market and labor conditions, and of means of transportation.

After this work has been done and one knows the condition of the forest, a division may be made into lots and aggregation of lots into ranges. In Pennsylvania, where most of the State forest land is in mountainous districts, division lines should follow the configuration of the soil. Difference of soil or character of growth within lots gives rise to sublots.

A valuation survey should then be made, ascertaining amounts of standing timber, rate of growth on various sites, and determining capability of production and future yield in material and money.

All these preparations should be made before a plan of management is determined. After one knows what can be expected from the forest, general plans should be made for all time, and special plans for a period of from ten to twenty years. The length of rotation should be determined and amounts to be cut should be designated, stating lots to be cut, with view of obtaining favorable distribution of age classes. Thinnings should be made, and methods determined to be used in felling and culture.

DISPOSAL OF FIRE-KILLED TIMBER.

PAUL H. MULFORD, *Forester.*

A fire running through a forest often assumes proportions that cause great damage to the roots of trees, burning the humus and ground floor, often burning the roots themselves, thus leaving the

trees with few supports to withstand heavy winds. They are blown down and become a prey to fires which pass over that land again. Or the fire may burn away the bark of a tree, girdling it and leaving it standing a prey to injurious insects which are thus invited to and fostered in starting a breeding colony in these dying trees. Finally, finding no living tissue to feed upon, these insects go at once to the broken branch, or scarred trunk of a living tree, and proceed to start their work of destruction.

These two types of fire-killed trees we have to deal with largely on the reserves in this State. A method to dispose of them must be found. Standing or lying, they are a detriment to young growth, both by crowding and because of fire menace.

In the work of the U. S. Forest Service, it has been proved by many strength tests that fire-killed timber, for instance white pine, or fir, (Cir. No. 113, U. S. F. S.) is about twice as strong as green white fir; and that it is 9-10 as strong as kilndried timber where it has received the same treatment.

So there should be no hesitation in offering fire-killed timber as second-class lumber, and also as timber ready for preservative process. As the moisture has evaporated, there is no watery sap to act as a mechanical barrier to the entrance of the preservative. Green or unseasoned timber must be piled for several weeks before it is in proper condition for treatment, else it has to be subjected to several processes to season it artificially. Artificial seasoning is expensive and is liable to reduce the strength of the timber; therefore, sound fire-killed timber is really more valuable for preservative purposes than green. The dead timber being perfectly seasoned is more easily handled and cheaper to ship. Making the larger material salable for mining timbers, railroad ties, telephone poles, dimension stuff, and posts, which have a ready sale in our State, results in a double economy, the prevention of waste, and the saving of more valuable material for better uses.

The principal defect of fire-killed timber is check. This appears soon after the death of the tree, and apparently does not increase later. To prevent decay on the surface, fire-killed timber should be barked soon after it is killed. If the bark has been left on, the sapwood will be found somewhat decayed. Most of the conifers, and some hardwoods, will last a long time, if not lying flat on the ground.

In the west, especially in Colorado, where the mines of one city alone, Leadville, (Cir. No. 113, U. S. F. S) use each month 350 M.ft. B. M. of fire-killed timber for mine props, fire-killed timber is decidedly preferred to green timber because it is perfectly seasoned and light. In Denver, fire-killed timber has been used for a number of years for boxes and crates with excellent results, being odorless and not liable to shrink or warp.

Pennsylvania with its many mines and factories using great quantities of mine timber, boxes, pails, and baskets, in their operation, should be impressed with the value of this class of material, and thus create a market for large quantities of fire-killed timber.

On a part of the Stone Reserve, an area of about $3\frac{1}{2}$ acres, lie 25 M. ft. B. M. of fallen timber killed by fire. It stood for about two years only to be wind swept, and having no root system to hold it, fell. This is in a place six to eight miles from a railroad, and accessible only by a very poor trail road. One man made an offer to pay \$1.00 per M. feet for all logs sawed mill measure, 50 cents per M. for shingles, 50 cents per M. for lath, and 30 cents per M. for fence posts. This prospective buyer says "that by taking all fire-killed and down timber, there is still left a good profit at these rates." Another, a boss logger, not wishing to make a bid says "\$12.00 per M. can be safely paid for all the better stuff, and fire wood or charcoal be made of the inferior material."

Confining this subject to our own State, we must first realize that each reserve because of its geographical and geological position would be governed by its own peculiar conditions. The money consideration in the disposal of fire-killed timber in one case could hardly be used as an example for every other. However, having in mind the idea of advanced forestry, and the thought that fire-killed timber is a great detriment to growing trees, seedlings, and necessary undergrowth, as well as to the cause of forestry, its removal is warranted at an expense equal to its revenue. Personally, I believe that its removal is warranted at a cost in excess of its return value. Such a deficit is to be regarded a good investment on account of the improved conditions obtained in the then cleared and growing forest.

Again, with a careful system thoroughly thought out for each reserve and operated under good management, there will eventually be a return of revenue far above the expense, and plus this, give a clean forest, a practical object lesson in applied forestry, an opportunity to train unskilled labor, as well as create a force of local workers, breed a friendly instead of a hostile feeling to the cause of forestry, and last, but far from least, leave a general result that "He who runs may read."

Each reserve, with an idea of profit from fire-killed timber, must first cater to the need of its local market, and then create a market for the remainder of the product, the idea being to make the former bear the expense, and from the latter, the fragments, receive the clear gain or profits of the operation.

At my station, the Stone Reserve in Tioga county, from personal observation and information received from loggers, lumbermen, and local residents, it is believed the amount of fire-killed fallen timber warrants the erection of a model plant for the manufacture of lumber,

boxwood, paving blocks, crate wood, lath, shingles, baled shavings and sawdust, poles, fence posts, stakes, fire logs, cordwood, wood distillation, charcoal, wood ashes for lye and compost, acid wood butts, and pulp wood. All of these could be marketed in a local or foreign market at a profit on the total production.

Having three streams of sufficient volume to generate electrical power to operate such a plant, also to supply power to operate a pumping and watering system for the five acre nursery of the reserve, the installation of such a system would not be amiss.

Certain kinds of fire-killed timber can be disposed of to local buyers, as in the cases already mentioned, and some cordwood could be sold to those making their homes nearby, and at no cost of labor or material to the Department; but such sales will be slowly made, and the period to exhaust the thousands of cords of stove wood and the many thousands board feet of lumber in log form will be long, after which the real cleaning up must be done by the State. Until this is done the reserve is open to fire, being practically without trails or fire lanes, at the present time. With a plant as mentioned, or any other of value, and an organized working force fully equipped, the question of the disposal of local fire-killed timber will be quickly solved, leaving a benefit in wages, a better sentiment toward forestry, and a lasting benefit in the impression of its advantages.

Thus briefly are outlined my ideas of the very important question of the "Disposal of Fire-Killed Timber," on the Stone Reserve, a matter on which I have had too little time to go into minute detail. After careful consideration it is believed each acre of State land having such timber, can be successfully handled, leaving to the State a money profit and an improved acreage for reforestation. Of the opportunity afforded by the danger of fire-killed timber to improve the ranger service, its relation to the question of roads, fire lanes, and trails, and a regularly employed labor force, cannot be entered upon at this time. That fire-killed timber has a bearing on all these matters is well understood by those who have given the subject consideration.

Finally, with a sales division of the Forestry Department organized to study and ascertain the needs of every portion of this State or nearby states, many or all of these products and by-products of the reserves could be disposed of to advantage with permanent benefit to the Department of Forestry.

ROADS, FIRELANES, AND TRAILS ON THE RESERVES.

JOHN L. WITHEROW, *Forester*.

Of all the branches of forestry, one that certainly deserves and requires our attention at present, is a system of forest roads, firelanes, and trails. Without these, forestry would be theoretical only.

A few reasons why:

1. They make reserves accessible and the removal of products possible.
2. They aid in the suppression of forest fires and insect depredations.
3. They may be made comparatively permanent.

A reserve road system should be laid out only after a careful study of the topography and market conditions of the reserve. It should not be built all at one time but rather developed gradually, and always fast enough to meet the demands of the increasing intensity of management.

An ideal road would be one which is perfectly level longitudinally, solid, smooth, and without curves, but we can only conceive of that just as we can an "Ideal Forest." In proportion to the number of these qualities that are lacking, so much less useful is that road.

The roads of a reserve should always be divided into two classes, main roads and minor roads.

Main roads should lead to the interior of the reserve and should be at least 16 feet wide, have a grade of five per cent. of less, and be made of stone.

Minor roads need not be so well built. They will connect main roads and also reach out from them into short valleys.

The old roads that we find on the reserve today were made for the purpose of removing forest products. On many of them travel was only one way, the empty wagons reaching the top by some other road much longer and less steep. On such roads the grade is so great that today they may be more properly called trails. They were laid out and built by men who knew little or nothing of engineering, but simply began and continued their work until their desired point was reached. Many of these roads are the best the locality would afford. Others should not be followed in our road building.

In all cases the route for a road should be surveyed in order to accomplish the best results from a given sum of money. Time spent on the survey must always mean both time and money saved on the construction of the road.

Not until a road is reduced to a five per cent. grade can it be called a good road, on account of the extra time and energy required for moving a load on it, and the great expense for maintenance.

It is the opinion of most men of authority, that the road that avoids the grade and is ten times longer, is the better road.

In laying out a road the survey should not be depended upon as the only guide. By every road the largest area possible should be made accessible.

Side drainage is as necessary, if not more so, on forest roads, as it is on roads running through cleared country, owing to the retentive nature of most forest soil. When building or repairing roads the camp should be moved as often as necessary to keep with the work. A working force of less than four men is unprofitable.

In our road building operations in Fulton county last year, we wanted a fair road up through a narrow valley seven miles long to serve both as a road and firelane in case of fire.

There was a road for three miles that was built over a hundred years ago for hauling out charcoal. We used it most of the distance except where grades could be avoided or the road straightened. A space seven feet wide was cut clear of everything on both sides for four miles. After this had been done, it was gone over, all rocks above the ground were removed, water turned off and holes filled up. This was done for \$18.00 per mile for labor. After it was completed we could drive from one end to the other in fifty-five minutes.

There are perhaps no other branches of forestry, unless it be protection or survey, on which money spent at present, would give as quick returns or equal results as on forest roads, provided they are built in the proper places, and not at too great an expense.

To open up good roads from the interior of a reserve out to settled country, and where they are not needed, would be wasting money, beside being a temptation to trespass. After roads have been built it is comparatively easy to calculate the money saved by considering the difference in cost of marketing forest products, or it may be represented by an increased stumpage value. At present we are taking out about 500 railroad ties in Perry county at a profit of at least twenty-three cents on each. Had it not been for a road running to market, the timber probably would have rotted on the ground, the distance being so great as to prevent the building of a road at present.

No forest road should ever be made less than eight feet wide. A narrower road will admit of only one track and a narrow space at each side for the water to collect.

The transverse slope of a narrow road should be one-half inch to a foot. On a wide road of, say twenty feet, this may be increased for if water has to run a distance of ten feet with a fall of five inches

it will run to the sides of the road very slowly. Steepness is the worst quality a road can have, as all other bad ones may result from it.

Water breaks are necessary on hills to turn off water. The should be made straight across the road, rather than diagonally, for when so made they are liable to break the couplings of heavy wagons.

It has been found by experience that stone roads built of three layers of stone of different sizes, prove most durable. The road bed should be level, solid, and free from roots and decayed wood. The largest stones are laid or thrown on it. On these a thin layer of smaller stones is put to fill up low places and to make it solid. The last layer should be fine dust and stones from a stone crusher. It should be of stones that contain cement such as lime stones. Such a road as this may be sprinkled and rolled or left for a year to settle before using.

A few facts worth remembering when building roads.

1. It is cheaper, quicker, and easier to remove large rocks by explosives than by hand.

2. Plenty of all kinds of tools, kept in good condition, lessens the cost of labor.

3. The laborers should never be left without instructions where to work. They will always find the wrong road.

4. A lazy man on the working crew is dear at any price.

5. Be boss yourself unless your advisors are more experienced.

All public roads on a reserve should be in charge of the Department of Forestry. The location of many of these will often be such that they should be main reserve roads. They cannot be so if township officers have the authority to repair them in any way they see fit.

Not until the annual two cent road tax is taken off forest reserves, and all the roads on the reserves built and maintained by the Department will it be satisfactory, to our side at least.

Firelanes.

Firelanes will serve only for the suppression of fires and diseases, and as boundaries of forest divisions.

They will likely always be necessary in Pennsylvania. The problems that interest us most are their cost, location, and width.

The expense of cutting firelanes will, in some cases, be reduced by the sale of the trees cut. Where old roads can be cut out and used for firelanes, the cost will be from \$10.00 to \$20.00 per mile. When made separate from roads they take up a large area from which no revenues can be had, and require frequent cleaning with money produced by the forest.

The width of firelanes will depend upon the species and its height through which the lane is cut, also the density of the stand and number of roads nearby. Their width in Pennsylvania will probably range from 10 to 25 feet.

Before laying out or cutting a system of firelanes on a reserve the general direction of winds should be noted, as the opening caused by some lanes may produce windfalls with certain species if the edge of the forest is directly exposed to the strong winds of the locality.

Sharp curves in narrow lanes will allow fire to cross. They should be avoided if possible.

For several years after being made they will have a tendency to grow shut. This they will lose as soon as the strength of the roots is exhausted. Firelanes should be of as uniform widths as possible and brush cut in the lane should not be piled up along the edges or pushed in between bushes, but should be thrown back over the brush, where it will decay sooner and not be blown back into the lane by every strong wind.

The entire boundary of all reserves should be a firelane of sufficient width to prevent fires from crossing. Reserve boundaries are often on the summit of mountains where growth is not dense or soil valuable for tree growth. These will allow lanes to be wider than elsewhere without any great loss of the working area of the reserve.

Most forest roads should also serve as a firelane by being cleared of all growth on each side, as far back as is necessary to make the whole opening of the proper width for a lane.

There are many reasons why firelanes should be made in connection with roads.

1. The expense for making and cleaning is less.
2. Floor space is saved allowing a larger working area which results in a higher normal yield.
3. The number of lanes that must be cut through the forest apart from roads will be fewer.
4. Travel will keep the road free from inflammable material.

Trails.

Trails may be necessary in many places on the reserve.

They should connect roads, or roads and streams, or may run from the nearest roads to fire towers. They take up little space and can be made and kept up at a small expense.

The loss that may be prevented by time saved on one trip over them in case of fire may be more than the original cost of such a trail.

They should be made sufficiently good to allow a horse to be led or ride quickly either way, or for water to be carried by a pack-saddle horse if they are in use on the reserve.

The only expense for maintenance will be for keeping off water.

Where a trail has been cut out in the middle by water, it usually retards travel so much that it is easier through the woods than on the trail. Their width and grade will vary as to their usefulness.

The necessity for roads, firelanes, and trails is so great that if they are neglected, Pennsylvania will fail to receive early revenues from her forests.

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