

SCHOOLS OF FORESTRY.

Mr. David D. Thompson, of Cincinnati, who has taken much interest in all forestal subjects, gives some valuable information concerning the schools of forestry established in Europe. In order to secure the best results from the culture and care of forests, says this writer, which require a carefully planned system of regulations, with competent agents to look after their application, the European governments, with two or three exceptions, have established schools of forestry, most of which are now in a flourishing condition. The students in these schools have entered that they may thoroughly qualify themselves for the work they will have to perform, and the importance of which they appreciate. For them the salary is not the all-important question—as is usually the case with scientists.

These schools of forestry are of two kinds:—First, those designed for the study of forest sciences and collateral branches, which are called in German, *Forstakademie*; and, second, the *Allgemeine Hochschule*—colleges or polytechnic institutions in which forestry is only a department. Before entering the *Forstakademie*, students are required to have taken a course in some preparatory or other school; and in some schools to have had, in addition, a practical experience in forest planting and management under the direction of skillful forester. Practical experience in the care of forests is, in all schools, an important feature in the regular course. The rules governing admission are very strict. Either a certificate of graduation from a responsible institution or other evidence of efficiency is always required; and in the service of the state certain conditions as to age, nativity, etc., must be complied with. The object is to give such instruction as is needed in the planting and care of forests. The course of study embraces whatever will be of use for such a purpose. It includes the natural sciences, and the numerous details of administration required. Its usual result is to impress the student with the responsibilities of his work and develop a habit of close observation.

One of the oldest and best schools of forestry in Europe is at Nancy, France, and to it the department of Muerthe, of which Nancy is the capital, owes much of its rural beauty. The school is liberally supported, and is fully supplied with cabinets, museums, apparatus, and appliances of every sort. To those who prepare for state forest service instruction is free. The importance of this service may be inferred from the fact that the state forests cover an area of nearly 3,000,000 acres, with a gross revenue of nearly \$7,000,000, and a net revenue over all expenses of over \$5,000,000. The total expense for board, lodging, uniform, instruments and pocket money is between \$400 and \$500 a year. Foreign students are admitted, with a moderate special charge. The English government usually has several students at Nancy training for forest service in India.

The course of study occupies three years. Every student is required to devote 1,500 hours to study each half year. Lectures are delivered on the exploitation of forests; relation of forests to climate; natural history of different kinds of trees; management of forests; conversion of one form of forests into another; desirable qualities and defects of woods, etc. A large number of lectures of an hour and a half each, and the same amount of time allotted for preparation of the topic of the lecture, are devoted to botany and mathematics. There are also lectures and lessons in road and bridge building, in forest law, and in the German language, together with some military instructions and drill, and practice in horsemanship. During the summer session, about a month is spent in botanical and professional excursions in the Vosges, the Jura and other mountains, in which are visited forests in all stages of treatment and exploitation, and where the students are required to practice in the mensuration of wood and timber. Of all these observations and experiments each student must prepare a report.

In addition to the branches enumerated in the third year, attention is given to zoology, especially to entomology, the ravages committed by insects upon forests, the means of averting or destroying them, and of recovering a forest ravaged by them; the fixation of sand dunes, the reclamation of barren wastes, and the re-

foresting of denuded mountains; the geology and mineralogy of the mountains of France, mountain torrents, their causes and the means of preventing them; the chemistry of vegetation and all that relates to the production and assimilation of atmospherical and terrestrial elements.

In Germany are found the oldest, the best endowed, and, in some respects, the best managed schools of forestry in the world. In the latter part of the eighteenth century, occasional lectures on forest science was given in the Berlin University. As early as 1821 an academy for forest instruction was established in Berlin, but, on account of the absence of suitable forests in the neighborhood of that city, it was, in 1830, removed to Neustadt Eberswalde, where was abundance of forests, and the name changed to the High Institution for Forest Science. The course of study embraces chemistry, physics, meteorology, mineralogy, geognosy, botany, anatomy of plants, vegetable physiology and pathology, microscopy, zoology, entomology, geodesy, wood measuring, surveying, plan drawing, public economy and finance, cultivation of forests, forest improvements, forest botany, protection of forests, calculation of the value of forests and forest statistics, administration of forests, redemption of rights of usage, forest history, civil law, criminal law, jurisprudence, construction of roads, hunting and shooting.

There is connected with this school a driving house for seed, beds, and nurseries, specimens of a great variety of trees for botanical study, and a museum containing specimens of birds, insects, and animals found in forests, all neatly arranged in cases. Specimens of the branch, leaf, bark, wood, or cone of trees damaged by animals or insects, are exhibited side by side with the same parts in a healthy state, in order to teach the student to know at a glance the nature of any injury to a tree, and the animal, bird, or insect causing it. Stuffed squirrels, beavers, rats, and mice are so placed as to represent the same in nature, gnawing at the bark, grubbing at the roots, etc.; and insects are shown in the several stages of larvæ, chrysalis, caterpillar or moth, with all their ramifications in the stems or branches of trees. Besides these are specimen blocks of almost all descriptions of timber. A number of other schools of forestry have been established in Austria, Italy, Spain, Portugal, Denmark, Sweden, Finland, and Russia.

The American people ought certainly to be wise enough to profit by the sad experience of other countries, and not only regulate the necessary and put a stop to the unnecessary destruction of their forests, but imitate their example in endeavoring to restore them. This may be accomplished in almost innumerable ways, if only the people can be made to realize the necessity for it, and a desire awakened to have it done.—*Northwestern Lumberman*.

THE CATALPA.

A western paper believes that the railway tie of the future will be of this wood. The Fort Scott, Texas and Gulf railroad has planted 300 acres of young trees, and the Iron Mountain railroad 100 acres, near Charleston, Mo. On the roadbed of the latter company, ties of this wood have lain in the muddy silt of the Mississippi for 12 years, and are still in a good state of preservation. They have outlasted two sets of white oak ties, and bid fair to survive the third. Fence posts in Indiana and Illinois are now sound after having been in service 40, 50, and even 75 years. In the muddy regions about Cairo, where it is grown extensively, it is used as corner stones for the most substantial building. It is of an elastic nature, but not so soft and light as cottonwood. Dr. John A. Warder, President of the American Forestry Association, claims for the catalpa a durability and power of resistance to the influences of the elements possessed by no other wood. It is found in the Mississippi valley, and on the shores of the tributaries of the great river. It bears a large, white, highly-perfumed flower, and grows rapidly.

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THE GROWTH OF TREES.

Trees, says Elizar Wright in an eastern paper, record their own history. The stump not only tells the age, but in what years the departed grew vigorously and in what it did little more than hold its own. I not long ago, in Ohio, measured the stump of a sugar maple, recently cut, and found it thirty inches in diameter. The tree had lived 125 years. In the first sixty-three years, while it had stood in the dense forest, it had acquired but nine inches in diameter. After the forest was cut away, and it was left with only a few scattering companions, it soon assumed a superior rate of growth, which it maintained till nearly the last, so as to add twenty-one inches of diameter in sixty-two years. The rings averaged about seventeen-hundredths of an inch in thickness, whereas, in the first sixty-three years they had averaged but seven-hundredths.

In Sweden it is ascertained that a forest of mixed wood on medium soil grows about a cord of wood a year on an acre of land. If much more than a cord is removed from an acre in a year, the production is reduced. But to keep the production from diminishing, it makes all the difference in the world what trees you take away, whether you take those which are beginning to decay, or those which are in the rapid stage of growth. It is only by the best judgment in thinning out that the capital of growth can be kept whole after a forest has become well established.

If we take two trees of the same species—say an oak sapling that is four inches in diameter, and sixteen years old, and twenty feet high, and a tree that is twenty-four inches in diameter, ninety-six years old and sixty feet high—a little calculation will show us, supposing the thickness of the rings now equal, that the sapling is making 2.18 of a cubic foot of wood in a year, while the tree is making 3.924 cubic feet in a year. It will take between thirty-two and thirty-three such large trees on an acre to make a cord of wood in a year; and it will take about 590 of the saplings, of nearly four to the square rod; and it would take more than seventy to be cut to make a cord, so that in so young a forest a cord cannot be taken away without trenching on the capital. It is not, in fact, till a forest is made 100 years old that it can yield so much as a cord an acre without trenching on the capital of growth. But when it gets of that age, if the right care is taken, the average cord it yields is much more valuable than mere firewood. The larger and more perfect the sound tree the more valuable per cubic foot.

The forest I have supposed, consisting of thirty-two two-foot trees to the acre, would make only between forty and fifty cords of wood to the acre, if all cut at once. But that would be a destruction of capital which it would take nearly 100 years to restore; a capital which, if kept up by replacing every tree cut, will continue forever to yield a net profit of \$10,000 per acre yearly.

A forest, not to be ruined must be managed very much as death manages the human race. Trees must not be taken out faster than they spring up, nor all of one age or sex; only those that are ripe, sickly, and in the way. By adapting the species to the soil, even the poorest soils will yield immense returns. The rocky hills of Massachusetts, which will not grow very large oaks or walnuts, will cover themselves with enormous pines and hemlocks, if they have an opportunity. As evergreens do not, like other trees, perpetuate themselves by sprouts from the stumps, when a forest of them is slaughtered by the axe, their tender seedlings are prevented from replacing them by the sun, frost and cattle; while the harder seedling of the deciduous woods—such as birch, maple and ash, and the sprouts of such oaks and hickories as may have been mixed with the evergreens—have a better chance, and thus take the place of the rosinous woods on a soil not so well adapted to them. With a little judicious care and forethought, a wood of scrubby oak or hop-pole hickory may be converted into a glorious pinery, yielding masts for navies. But, as the individual man has, on the average, a life shorter than that of a tree, it requires the state, which does not die, to do this.

The Middlesex Fells is a tract of nearly 4,000 acres within six or seven miles of Boston, of

which more than 3,000 consist of rocky and blue-gravel hills, once covered with lofty pines and hemlocks, nearly all of which have given place to oaks and hickories, living lives of semi-starvation and devastation by frequent forest fires. There are about 140 proprietors, assessed at an aggregate sum between \$300,000 and \$300,000, and deriving an income from the fuel of a good deal less than one per cent. over the taxes. And this is taking annually more than is replaced; so that the tract, in spite of its woody green foliage in summer and rainbow tints in autumn, is growing every year more desolate.

It has been proposed that the citizens of the towns within whose territory this mostly unoccupied tract lies, and others interested in forest culture, should purchase this tract and give it to the state for the purpose of inaugurating a scientific and common-sense system of care for the trees. Should this be done, plainly, in 100 years from now the state might be enjoying from this tract alone a revenue of \$20,000 a year, while it would be a source of health and recreation quite beyond the power of money to measure.—*Northwestern Lumberman*.

WEIR MEASUREMENTS.

Within the past few years much has been said and written for and against the reliability of measurements of water flowing over weirs; this has arisen through the great diversity of results obtained by different persons, who have used the same formula for computation of data. Turbines of almost every make, tested by their builders, have seemingly given highly useful effects; while in actual use some of them have not proved economical in the use of water. This has had a tendency to discredit weir measurements, but unjustly so, as may readily be explained, for the matter is one of great simplicity, notwithstanding the complications thrown around it by those who have supposed a long array of decimals denote profundity and accuracy. Any weir under exactly the same conditions will repeat results invariably; but a formula based upon certain conditions, will not give correct results if those conditions are changed. All brooks and rivers vary much in width and depth, yet the same water flows through the narrow as well as the wide places, the velocity, of course, varying with the cross section of the stream. The velocity, however, does not cease immediately upon entering a wider or deeper part, but continues until the momentum is lost, and the general level attained; this of itself would prove the necessity of placing a weir at a considerable distance from the discharge of a higher head. The Francis formula is based upon the natural flow of the water, which for a depth of one foot over a weir is about three feet four inches per second, and it must be evident that such formula is entirely inapplicable where the velocity is four or five feet per second, as it may be if the weir is placed close to the discharge of a poor turbine, where the water leaves the wheel with half the velocity due the head; or where a cross section of pit or stream approaches the weir is but little greater than the capacity of the weir itself. It is plain that under such conditions the velocity will vary according to the useful effect of the wheel, and equally plain that no reliable correction for velocity can be applied. Had this been considered, much trouble and expense might have been saved the past twenty five years; for it is not likely any builder would have knowingly continued the manufacture of forty per cent. turbines. The cross section of a pit or stream, up stream from a weir, should be at least five times the cross section of the stream flowing over it; and for a discharge of two thousand cubic feet per minute, the weir should be fifty feet from the discharge of the turbine or opening into pit. Racks should never be used, as they obstruct and raise the water so that it passes through with renewed velocity. If there is a horizontal discharge towards the weir, check the current by zig zag breakwaters. For measuring the flow of a river the weir or dam cannot be too large; but it may be for measuring the discharge from a mill where a governor is used, as the varying discharge, caused by adding or throwing off machinery, may prevent accuracy if too much time is required for the water to find its proper level.—*James Emerson*.