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Mixed Hardwood, 25 Years Old, in the Harvard Forest

The Harvard Forest

By Albert C. Cline, Assistant Director.

THE Harvard Forest was acquired by the University in 1907, largely through the generosity of John S. Ames of the class of 1901. It is located in the town of Petersham in north-central Massachusetts, about seventy miles west of Cambridge and nine miles south of Athol. In addition to the Petersham tract, which comprises a total area of nearly 2300 acres, there are three outlying properties of small size: in Winchester, N. H., 20 acres of extremely rare primeval forest over three hundred years of age; in Hamilton, Mass., 120 acres of plantations established and given by the late Nathan Matthews, '75, one of the earliest and most extensive experiments with exotic and native conifers made in this country; and in the western part of Petersham, 45 acres of mixed "second growth" forest given by the late G. Frederick Schwarz, '95, for demonstrating adaptations of landscape architecture to forestry.

In the beginning years of forestry at Harvard (1903-1906) instruction was undergraduate in character and centered at Cambridge. A few years of classroom work were sufficient to convince those in charge of the need for a school forest where, by tutorial instruction under field conditions, the student might become intimately acquainted with the technics of forest management and develop proficiency in the methods of forest investigation. Thus the Forest was acquired to serve for students in forestry very much the same purpose as a hospital or a clinic for students in medicine. For this the area chosen in Petersham was exceptionally well adapted. Few areas of similar size anywhere in the region provided such a diversity in forest growing stock, soil, and topography. Present were stands of all ages, complex associations of species representative of both the Northern Forest and

the Central Hardwood Forest, cover types varying from temporary mixtures of short-lived weed species to lightly culled virgin timber, soils ranging from light sand and gravel to heavy clay loam and peat, and elevations differing by as much as 700 feet within a distance of two miles.

Furthermore, the peculiar economic history of the region had served to create a most interesting set of conditions. Beginning around 1730, the settlers cleared a large part of the original mixed forest for agricultural use of the land; then, in the middle of the last century, widespread farm abandonment gave rise to second growth stands, largely of white pine, on old fields and pastures; and finally the cutting of much of the second growth was followed by the establishment of an inferior "third growth," composed almost wholly of hardwoods. All of these stages were represented in the Forest. Such conditions provided unusual opportunities for fruitful instruction and research in both the biological and economic aspects of forest development and restoration.

Eight years after the acquisition of the Forest, since by then so many institutions were teaching elementary forestry, it was decided that the facilities of the Harvard Forest thereafter should be available only to advanced or graduate students who possessed a bachelor's degree from a forestry school or had received equivalent elementary training. Since that time, 1915, the Forest has been managed with three objectives in view: a model forest to demonstrate the practice of the art of forestry; a laboratory for the training of professional students; and an experiment station for research in forestry and allied fields.

The eminently successful conduct of the Forest from its beginning is due in a very large measure to the wise guidance of the late Richard T. Fisher, '98, who serv-



Logging in 70-year-old White Pine

ed continuously as its director from 1907 to 1934. To him more than to anyone else belongs credit for the development of a sound regional silviculture and a clearer understanding of the problems of the regional forest industries, as well as for steady progress towards the fulfillment of the objectives laid down in 1915.

The accomplishments of the forest as a demonstrational area are of truly great importance. From the outset it has been managed on a sustained yield basis, that is, cutting at a rate to correspond with the growth; and in this respect, as well as in the continuity of intensive silvicultural treatment, its history is longer than that of any other forest in America. Harvard is fortunate in being the first to obtain a sizeable tract of forest whereon conditions of stand merchantability, variety of species of commercial worth, and distribution of ages—from young seedlings to sawtimber trees—permitted the immediate adoption of such a plan of management and the employment of numerous instructive experimental operations in harvesting mature crops.

The Forest is divided into blocks, three in number, situated respectively northeast, northwest, and southeast of the village of Petersham, each traversed by serviceable woods roads leading to public highways. Each block is divided into compartments, which, in turn, are sub-divided into stands. With the physical plant thus organized and separated into administrative and biological units, it has been possible to accumulate a great body of classified, factual information on forest crop production. For 28 years the Forest has maintained records in the form of maps, photographs, detailed descriptions of all operations, and costs in terms of labor-hours as well as money. The number of silvicultural operations carried out annually ranges from 50 to 75, not including nursery stock production, sample plot treatments, coöperative experiments with other organizations, or work occasionally performed on the forests of others. While much information has been disseminated through bulletins and technical articles, and by word of mouth, it has not been these instruments but rather the Forest itself which, to use the words of the

late Director, "has translated the developing technique of management into realizable and convincing terms. It speaks the only language which can be understood both by the wise and simple—visible results." During the past year over 300 persons, a very large majority of them practitioners, teachers, and students of forestry, were conducted through the Forest and shown the methods and results of a great variety of treatment and experimentation. Of particular interest are the intensively cultivated stands established since 1907 under a policy of high quality production for sawtimber. It is generally considered that these young mixed stands are among the finest in the country.

Aside from what may be seen "on the ground," the cumulative results of sustained yield management are evidenced by cutting records which show, to date, the removal of nearly 8,000,000 board feet of lumber and 4,000 cords of wood. At the same time, a steady advance has been made towards the reclamation of all "waste" areas, and the attainment of a

uniform distribution of age classes—a prerequisite for sustained regularity of production. Financial returns from the Forest, however, have not measured up to early expectations, chiefly because of the great influx in recent years of lumber from regions which still contain readily exploitable bodies of virgin timber. Such a condition cannot continue longer than two or three decades; but, meanwhile, a share of the cost of managing the Forest must still be met from other sources. As regards the more distant future, greatly increased yields and improved qualities, made possible through continued care and cultivation, undoubtedly will provide sufficiently greater revenues to recompense fully for the lean years at the start.

In the training of foresters and specialists in allied fields, the Forest has rendered distinguished service. One hundred and thirty students have profited by the instruction offered; and nearly 75 per cent. of them, a comparatively large proportion, are actively engaged in some branch of forestry. Instruction has covered many sub-



Virgin Hardwood and Hemlock

jects, including silviculture, forest management, forest utilization, tree physiology, forest entomology and pathology, and, more recently, game management; and for all of them the Forest itself has been used to the fullest possible extent, both as a classroom and as a laboratory. Insofar as funds permitted, the results of research undertaken by staff and students have been published as Harvard Forest Bulletins, now numbering eighteen in all; but many manuscripts worthy of publication must perforce await the time when additional funds are available.

Viewing the situation at large, one sees

that vast changes have taken place in forestry since the Forest was acquired. Many new schools of forestry have been established, the public forests have been enormously extended, Federal forest experiment stations serve every region, and extension foresters stand ready to aid every individual woodland owner. Hundreds of trained specialists, in the field, the office, and the laboratory, are engaged in a great work of forest and soil conservation and development to meet the ever-increasing needs of the nation. Assuredly, opportunities for well-trained and trustworthy leaders in forestry grow apace.

Hormones and Plant Behavior

By Kenneth V. Thimann, Ph.D., Biological Laboratories

THERE is a marked tendency in modern biology to bring together from their long separation the two great groups of living organisms, animals and plants. While animals and plants are very different in their structure and systematics, their physiology in many instances rests on the same fundamental processes. One of the most characteristic possessions of animals is the circulatory system, which carries, in the blood, not only oxygen for the needs of the respiring tissues, but also a number of stimulating substances known as hormones, which are secreted into the blood from special glands and thus transported all over the body. The heroine of mystery story who turns white as a sheet, while her hair stands on end with fright, is reacting to a sudden discharge of adrenalin, a hormone secreted rapidly into the circulatory system.

In recent years it has become known, through the labors of plant physiologists in Europe and America, that the higher

plants show a similar correlation between their various parts by means of the movement of hormones. These substances not only control the responses to outside stimuli such as light and gravity, but they exercise a controlling influence on the process of growth in general. Plants have no circulation comparable to that of the blood, but the plant hormones are transported in a very rapid and unknown manner, and in young plants always from apex to base, never the reverse.

If oat or maize seedlings, grown in the dark, are beheaded by cutting off the uppermost $\frac{1}{2}$ mm. of the shoot, their growth, within an hour or two, comes almost to a standstill. This is because the extreme tip of the shoot is the organ which produces the growth-controlling hormone. If the tip be stuck on again, growth is resumed; the substance can therefore diffuse across the cut and cause growth of the part below. More strikingly, if the tip be stuck on one-sidedly, the part below it will grow but the other side of the shoot will not; this causes a curvature. From the extent of the curvature under constant conditions

Dr. Thimann is this year a lecturer on botany at Harvard and has been appointed Assistant Professor of Plant Physiology.