THE RESEARCH PROGRAM OF THE APPALACHIAN FOREST EXPERIMENT STATION

By E. H. FROTHINGHAM

Among papers devoted almost wholly to explicit results of research, such as appear on the program of this meeting, one like the present, which is merely an announcement of research in progress or planned, might appear somewhat out of place. Yet the accession of any new investigative organization ought to be of interest to scientists in all fields. The work of the Appalachian Forest Experiment Station will touch at so many points the investigations of various members of this Academy that a knowledge of the purpose and outlook of the new station should be of mutual benefit. Very little can be conveyed in a short discussion. The aim of this paper is therefore merely to sketch the high points of the work of the station and its background of forest research, with the hope of establishing a helpful contact with the members of the Academy.

Although forest research has long held a recognized and established position in Europe, it is still young in this country. It was only fifteen years ago that the hopelessness of attempting forest raising in America without well established principles, based upon American conditions, caused the establishment by the U. S. Forest Service of its first forest experiment station. Six of these are now in existence in widely separated parts of the country and, as evidence of the growing recognition of such institutions, two more are to be installed in July. The stations are so located, with respect to the principal forest regions, that each has before it a distinct group of vegetational and environmental conditions, usually very different from those of the other stations. Yet there is a similarity in the problems encountered which allows of a general classification.

The Appalachian Forest Experiment Station was established in 1921, with headquarters at Asheville, North Carolina. It has perhaps the most varied and complicated field for investigation of any of the forest experiment stations. Its territory extends south from Pennsylvania to northern Georgia and Alabama, and embraces from east

to west, six major topographic units: the Coastal Plain, the Piedmont Plateau, the Southern Appalachian Mountains, the Appalachian Valley, and the Cumberland and Alleghany highlands. This region of about 185,000 square miles is bigger than the combined area of Pennsylvania, Delaware, New Jersey, New York, and New England. With a range of 6,700 feet in altitude and 6 degrees of latitude, and a correspondingly great climatic variation, there is an extreme diversity of forest types and vegetation in general. The pine flats and overflow lands of the Coastal Plain present problems very different from those of the subalpine spruce forests of western North Carolina. Between these two extremes there lies the whole of the great Appalachian hardwood region with its multiplicity of forest types and conditions. The administrative difficulty of carrying on studies efficiently in this great region, and with a technical staff of only four members, has led to a policy of widespread coöperation and the concentration of the work as far as possible at definite regional centers.

Before entering upon a discussion of the work of the station a few words may be in order as to the general nature and object of forest research.

Forestry, being a use of land to produce timber crops, is a branch of agriculture. Like agriculture, it is an art and a science, resting upon other sciences—biology, geology, physics, chemistry, and mathematics—for most of its basic data. As a special branch of agriculture, as yet new and little tried in this country, it makes unique demands upon scientific research. The essential differences between forestry and other uses of the soil consist chiefly in the long time needed to mature forests as compared with other crops, the variety of products obtainable during the period in which the principal crop is maturing, as well as at the time of the harvest, and the possibility of improving the yield and reproducing the crop naturally by partial cuttings.

The best management of forest lands for timber and other incidental uses is predicated upon a thorough knowledge of a great variety of conditions and processes. It is difficult to place these in order of their relative importance because in different places each may be of major importance. As a basic groundwork an intimate knowledge of the life histories, characteristics, and requirements of the various tree species is necessary. This has special reference to their reproductive adaptations, soil and moisture requirements, rate of growth, endurance of shade, and susceptibility to injuries of vari-

ous sorts. The physical conditions, climatic and edaphic, which affect the rate of growth and the composition of the forest, must be determined. The characteristic ecological associations and societies (forest types) must be ascertained, and the causative factors identified. A knowledge of such matters as these is the foundation upon which true forest research ought to rest. Unfortunately this is still a scarcely touched field requiring protracted investigation, and in the meantime insistent demands must be met for information which can be used at once in forest management. This explains the fact that there are two phases of the more purely biological part of forest research now being carried on at the forest experiment stations, one having to do with the discovery and classification of facts and causes, the other with results based upon somewhat empirical assumptions or only partially understood antecedents. Research of the latter class is warranted, first, by the great number of interacting factors and the long periods of time that will be involved in their analysis; and second, by the possibility of securing many reliable and directly useful results without an appeal to underlying causes. This is particularly true of work in forest measurements, planting, thinnings, and growth studies, and it is much less true of studies of the succession of forests after cutting.

The field of forest research at the Forest Service experiment stations is divided into seven comprehensive groups. At the Appalachian Station work is now being done under five of these, each represented by one or more of the twelve active projects. The program ahead of the station can be best described by taking up these seven groups one by one. They will be given in the order which nearest approaches the logical sequence of the development of research, although as previously stated, other considerations make it impossible or even undesirable to conform to this sequence in the chronological order of investigations.

Forest type studies. The unit in forest management is the stand, rather than the species. The classification of forest societies (types) and physical environments (sites) therefore forms the basis for all other investigative work. In the Southern Appalachians the large number of species and the variety of habitats make this a particularly difficult matter. Very few efforts have been made to secure a logical and practicable classification,* and the matter is now in the hands of

* A comprehensive classification has been offered by W. W. Ashe. See *Journal of the Elisha Mitchell Scientific Society* **37**: 183-198. 1922.

a committee of the Southern Appalachian section of the Society of American Foresters. A preliminary study of forest sites has been made by the Forest Service, and a scheme for measuring the qualities of sites by the height growth of dominant trees of certain Appalachian hardwood species has been devised.

Forest succession and the factors responsible for forest types are subjects of interest to both the ecologist and the forester. An understanding of them is essential to the best management of the forest and coöperation with ecologists in the study of these factors will be welcomed by the Appalachian Station.

Tree studies. The object of silviculture is to produce stands of rapid-growing and intrinsically valuable species. This requires knowledge of the life habits, reproductive capacities, rate of growth, soil and moisture requirements, susceptibility to and protection from injuries, and other characteristics of a great number of tree species. The vast field thus presented for work at the station has barely been entered. Studies of yellow poplar (*Liriodendron tulipifera*) and southern white cedar (*Chamaecyparis thyoides*) are now being made.

Forest protection. Under this heading are included investigations of sources of damage to the forest, such as fire, insects, live stock, fungi, and weather. Fire is of course the most important source of loss, and two projects are now being undertaken, one to determine the nature and amount of damage under different conditions, the other to discover an effective means of forecasting periods of special fire hazard. Promising results in both studies are being secured. A study of the amount and importance of grazing damage in reproducing stands is also being made. Fungi and insects have not yet been dealt with, but coöperative work on these will undoubtedly form a part of the station's future activities.

Forest influences. The relation of forests and other vegetative cover to the run-off of streams, to erosion, to the climate of the region in which they are located, and the effect of forest cover and attendant organisms upon the physical condition of the soil are subjects upon which no work has yet been done by the station. Within a short time studies of the more practical phases will likely be called for, such as the effects of the removal of forest cover upon erosion and the silting up of reservoirs. The study of less immediately applicable phases will probably have to be postponed indefinitely.

Reforestration. In the Biltmore estate plantations at Biltmore, North Carolina, the Southern Appalachians possess what is probably the largest of the older forest plantations in the United States. Many different tree species, both native and introduced, were planted there from ten to thirty-five years ago, and the plantations now afford an invaluable field for experiment as well as a practical test of the species used. A study of the more important of these plantations is about finished. Records are also to be kept of other plantations in the region, and tests of a large number of native and exotic species are contemplated in different sites within the territory of the station. As a start, seedings and plantings of exotics have already been made in the spruce type in the Black Mountains of North Carolina, and elsewhere, in cooperation with the administrative branch of the Forest Service, the Champion Fibre Company, the State Forester of North Carolina, and others.

Forest Measurements. This is a very wide and necessary field of investigations which has already been entered by the station in connection with other projects. It embraces the study of the growth and yield of stands; the rate of growth in height, diameter and volume of individual species; and the form of trees with reference to their merchantable contents for the construction of volume tables. Data secured in such studies are essential to the preparation of forest management plans, and are necessary also in the other branches of the research work.

Forest management. This is one of the largest and most important fields of endeavor which the station has before it. In a sense it is the culmination of the other lines of research previously outlined, since it depends upon them for basic data and is the means by which much of the other investigative work will be made available for practical application.

The objects of forest management investigations are chiefly (1) to discover means of encouraging reproduction of desirable species; (2) to determine, for different forest types, the methods of cutting best fitted to secure natural reproduction in the shortest possible time; and (3) to work out by experiment the methods and frequency of thinnings which are best adapted to particular species and sites. There are other management problems but these are the most important and the most in need of solution. The management studies are relied

upon to furnish the data necessary to transform the generally culled, fire damaged, poorly stocked forests of the Southern Appalachians into a working stand of thrifty, actively producing second-growth.

The studies of natural reproduction and methods of cutting are especially dependent upon a knowledge of the physical and biological factors of the environment and of the characteristics and requirements of the various tree species. Until this knowledge is at hand, the investigation must be, to a greater or less extent, empirical. Two projects are now under way, one a study of natural reproduction on cut-over and burned lands in the spruce type, the other a study of reproduction in the hardwood types following different methods of cutting. Work on the latter study will be centered, for the present, upon permanent sample plots, which will be established on areas on which logging is in progress. In these plots different cutting methods will be practiced, and records will be kept of the progress of the succeeding reproduction by means of numerous small quadrats. Such experiments will involve repeated observations extended over a period of years. The results will not be wholly conclusive because of our ignorance at the present time of the relative significance of the several factors which will affect them. Some results of value are practically assured, however, and it is within the bounds of possibility that data secured meanwhile in the studies of species and of the environmental factors will furnish the means of correctly interpreting the sample plot results. In this, as in other lines of forest research, the assistance of ecologists and plant physiologists may be of the greatest benefit.

To carry out the program thus briefly outlined the Appalachian Station, with its small staff and its large field of operations, cannot depend entirely upon its own efforts. It must have the coöperation and the counsel of interested and progressive men in the sciences as well as in the industries which are represented in the region. To this end the station would like nothing better than to enlist the interest and, to the extent of its facilities, the active participation of those members of the Academy who are engaged in related lines of work.

ASHEVILLE, N. C.