# INTRODUCTION

Franklin (26) relates how the Benedictine and Cistercian monks of the Eleventh Century took advantage of the warmth found on south-facing walls to grow grapes in an area where the climate was generally prohibitive to such a crop. In many respects, the periphery of a plant society such as a forest boundary influences microclimate in the same way as a vertical wall (27, 28). Dependent upon the direction of exposure, the boundary receives or is blocked from the direct rays of the sun, it impedes the wind, and it acts as a barrier to wind-driven rain and snow. In the northern hemisphere, the southern boundary receives more solar radiation and is generally warmer and drier than the northern boundary. In addition to the effect of exposure, the microclimate at the margin of the stand is conditioned to a greater or lesser extent by influences from both field and forest, and is therefore transitional in nature (28). Silviculturists have long taken advantage of the microclimatic conditions at the edge of the stand to favor the growth of tree seedlings (65). The point to be made, however, is that while the general relationships have been known and put to use for some time, the basic dynamics of the microclimates themselves have been studied very little thus far (27, 28).

The principal aim of this study is to investigate certain microclimatic features of the north and south boundaries of a native deciduous forest in New Jersey. Specifically, the first objective was to evaluate changes in light penetration and temperature distribution within the layer near the ground (defined in this study as the layer from the surface of the ground to 2 meters for temperature and a height of one meter for light) at both boundaries, associated with changes in vegetation and weather from winter through spring into summer. Comprehensive evaluation of vegetative influences on the microclimates required the measurement and analysis of certain characteristics concerning the structure, composition and phenology of the natural vegetation growing on respective boundaries. Since the microclimate influences the vegetation and is in turn influenced by it, it was fully expected that certain ecological considerations would come to light. Although many biological studies have been conducted in the forest, little emphasis has been placed on boundary vegetation. Therefore, the second objective was to investigate, to some extent at least, inter-relationships between microclimate and vegetation at the margin of the stand.

The microclimatologist attempts to define the "constant significant features of the habitat (micro) climate"

(28). However, all observations are influenced by conditions of weather and climate. It is known, for example, that slope microclimates vary from region to region depending upon prevailing winds, incidence of cloudiness and other factors (28, 65). In Europe, precipitation patterns around small hills are related to "precipitation falling obliquely from the west" (28). Although cognizance of these relationships between climate and microclimate is necessary to place microclimatic results from different regions in their proper perspective, few studies have considered them in detail. As in the case of slopes, the microclimate of the forest boundary is dependent upon the climate of the region. During the course of this study, it was discovered that wind-driven snow is distributed in such a way as to significantly influence the thermal differences between the two boundaries. Therefore, a third objective was formulated not only to investigate this relationship, but also to explore the influence of regional climate on the microclimates of north and south forest boundaries in New Jersey. The techniques used were those of dynamic climatology. It was hoped that a detailed study of the weather during the period would provide a means whereby the dynamic analysis of New Jersey's climate prepared by previous investigators at the New Jersey Agricultural Experiment Station could be extended into the micro-

layer. Thus, as the title implies, the ultimate goal of this study is the analysis of some relationships between climate, microclimate and vegetation on north and south forest boundaries in New Jersey.

The study was conducted in Hutcheson Memorial Forest, a mature oak forest (11) of 65 acres in extent situated about one mile east of East Millstone (40°30'N, 74°34'W) on the Piedmont in New Jersey. Adjacent to the woodland are gently-rolling fields planted to agricultural crops or covered with low-growing native vegetation characteristic of farmland in the early stages of abandonment. The forest has been described most recently by Monk (47, 48, 49), who states that it is a variant of the oak-hickory forest type common to the Piedmont Plateau. However, it does not appear to possess the climax status which this community reaches in the Southern States, because the limited reproduction of oaks and hickories is probably not sufficient to maintain the prevalence of these species.

The forest shows a distinct vertical stratification into four layers. In the upland portion where the study was carried out, the almost continuous main canopy is dominated by white oak (Quercus alba),[1] black oak (Q. velutina), red oak (Q. rubra) and red hickory (Carya ovalis).

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[1]Nomenclature follows Gray's Manual (Fernald 1950).

It reaches to heights of 95 feet. Beneath this is a pronounced understory of flowering dogwood (Cornus florida) which reaches heights to 35 feet. The shrub layer consists primarily of maple-leaved viburnum (Viburnum acerifolium). The herb layer is best developed in spring when May-apple (Podophyllum peltatum) is abundant (48).

The area is underlain by Triassic red shale of the Brunswick Formation (39). Wisconsin terminal moraine is located a few miles north of the forest, and Salisbury (58) postulates that gravel scattered over the area represents fluvial material deposited by a river flowing south from the glacier. In a recent study by Ugolini (66), the soil in the upland section of the forest is classed as a deep, well-drained silt loam. Although gravel is occasionally observed through the profile, the major influence is that of the shale. The characteristic red color of the soil as well as its poor profile development are inherited traits carried over from the shale, which is highly resistant to pedogenic processes.

Owned and set aside as a natural area by Rutgers - The State University, Hutcheson Memorial Forest has been the site of an ever-widening program of biological research. Although some microclimatic data have been collected in connection with these investigations, this work represents the first systematic study in microclimatology to be conducted in the area.