Field Methods

Also shown in Table 1 are the locations of the stands and their approximate elevations as determined from maps. The precise location of my stands is not important for the purpose of this study, so no map of the forests is included. However, a map showing the location of the stands which were studied is on file at the Geobot. Institut in Zürich.

The degree and direction of slope were measured in the field. The moisture regime was estimated in the field, being reevaluated in the several visits to each stand. The listing in Table 1 is on no absolute scale, but is relative for the 25 stands studied. Note that there are five relative moisture classes: dry, *dry*-mesic, dry-*mesic*, mesic, and moist.

Underlying geology or soil parent material was determined from a map by MÜHLBERG (1908), and is correlated with a description of the various layers by SAXER (1967) in a footnote to Table 1. About 80% of the stands are on differing ages of Tertiary molasse deposits, primarily sandstone of various sorts. About 20% of the stands are on glacial deposits, mostly Würm moraine.

Soil types and site factors were determined from the site type map of EBERHARDT. A key to the symbols is given in footnote 2 to Table 1. Since EBERHARDT expresses many subtle differences, the descriptions are given in his German terms (with only the major categories also in English) to avoid mistranslations.

II. Field Methods

A. Selection of stands

As mentioned above, stands were selected from associations as mapped by FREHNER (1967) with the ultimate aim of including several stands from each of his associations. The first criterion in choosing which stands to study was topographic homogeneity—approximately the same slope and aspect was required for the whole stand. The second criterion was "visual" vegetational homogeneity—approximately the same size classes and species were to be represented throughout the stand, *i.e.*, two halves of the stand could not have markedly different ages or composition. Stands which had had recent cutting were avoided, as were areas of pure conifers, in order to study vegetation as close to "natural" as possible. No two stands of the same association were placed adjacent to one another except for stands 11 and 12 which were located on opposite sides of a ridge.

The size of the stands had to be large enough to accommodate the plots used in sampling trees. The actual size of the stands sampled ranged from

approximately 25 × 35 meters in stand 24 to 100 × 100 meters in stand 10. The average stand size was approximately 0.25 hectare or 0.6 acre.

The field methods used are designed to be rapid and to furnish the most information about the vegetation in the simplest way possible. A further aim is to use objective, quantitative measures rather than subjective estimates.

B. Sampling of trees

The trees and saplings of each stand were sampled using circular plots which had a radius of 26.3 feet and an area of $^1/_{20}$ acre (equivalent to a radius of 8 meters and an area of 2 ares). It was originally intended to use five plots per stand, but it was found necessary to use four plots in 14 of the stands in order to fit the plots into the stands without overlapping each other or the outer limits of the stand. The outer perimeter of a plot was determined using an Edscorp field rangefinder. Within a plot, all saplings were listed by species, and trees were listed by species and by size as measured with a basal area tape. Saplings and trees are defined by specific size limits. For this study, I have used the same size limits as used in studies of Wisconsin forests.

Saplings are small trees having a diameter at breast height (d.b.h.) of 1 to 4 inches (2.5 to 10 cm), with the d.b.h. measured at 4.5 feet or approximately 1.35 meters from the ground. Tree species less than 1 inch d.b.h. are considered as seedlings regardless of their height, and are listed in the small quadrats with herbs and shrubs.

Trees are those individuals over 4 inches d.b.h., *ie.* , having a basal area of more than 12 sq. in. (*c.* 77 cm^2), and are measured with a basal area tape giving readings in square inches. As a measure of size or importance of trees, such factors as height, spread of canopy, volume, etc., all play a part. However, basal area is more easily and objectively measured than the other factors and is often used as a quantitative approximation of relative size for trees.

C. Sampling of understory vegetation

Herbs, shrubs and tree seedlings were sampled in May and June using twenty-five 1 m^2 quadrats per stand. Shrubs are woody species which seldom or never attain tree size (4 in. d.b.h.). The presence of each species in a quadrat was recorded, and frequency was later determined for each species present in a stand. Understory species not found in any quadrats but seen in the stand were recorded in a "stand presence list". While sampling the trees in mid-June, the understory presence list was rechecked for corrections or additions. A few errors in identification of herbs have possibly been made, but these would not affect the overall trends or conclusions.

Bryophytes (mostly mosses) were collected if they occurred in the quadrats, and were later identified by Dr. F. Ochsner. They were not recorded by species in the quadrats for frequency purposes, however. Thus, presence in a stand by species and total Bryophyte frequency per stand were the only data determined. The presence of mosses in stands often seemed to be correlated with the presence of a certain substrate, *i.e.*, certain species seemed to be associated with rocks or with stumps, fallen branches, etc., rather than to occur on the soil where they would seemingly have closer correlation with certain vegetation types. The possibility of substrate specificity may therefore confuse the moss picture.

D. Other field methods

As mentioned earlier, slope and aspect were measured in each stand. Soil samples were collected from the A-1 horizon at three places in each stand and were combined into one sample for each stand. The soil samples were collected from all 25 stands in one day. Soil samples were later analyzed by technical staff members of the Geobot. Institut under the direction of Mrs. M. Siegl for pH, moisture, and various nutrient factors.

Relative moisture estimates were made over the period of three or more visits to each stand, and were made on the basis of the feel of the soil underfoot and between the fingers. Some soils were definitely spongy or soft, had water seeping out in places, etc., while others were obviously quite dry. However, it is difficult to avoid being influenced by such factors as herbaceous cover of certain species when making estimates such as these.

III. Analytic Methods

A. Understory species

Frequency was determined for each species of herb, shrub, or tree seedling in each stand on the basis of percentage occurrence in the 25 quadrats. Frequency is, of course, influenced by the size, shape, and number of quadrats used. It only indirectly reflects density, and gives diverse results for aggregated or clumped species as opposed to those which occur singly and more at random. It is, however, the most rapid method available to give a somewhat objective and relatively quantitative estimate of understory species present. Understory species checked as present in the stand but not found in any quadrat were assigned a frequency of 4% as if they had occurred in only one quadrat. Frequency for bare ground, a quadrat not containing a single individual of