A NOTE ON THE EVAPORATION GRADIENT IN A WOODLOT.*

MALCOLM G. DICKEY.

The subject of evaporation has received much attention within the past few years. Very significant results have been obtained from the standpoint of plant physiology, and ecology as well as meteorology. The question in general, as to its relation to plant societies, has been discussed in connection with an earlier paper on evaporation in a local bog habitat.†

More recently, further work has been carried on in the same habitat to ascertain the evaporation at different heights,‡ and in this connection, it was thought desirable to obtain similar data as to the evaporation gradient in a wooded area.

Owing to the intimate relation between forests, climate, and waterflow, and the important bearing of the subject upon our national conservation policy, forest meteorology has been made the subject of a very careful study. Of especial value are the results of investigations, extending over a number of years, conducted by the German Forest Service. A summary§ of these results reveals the fact that the average evaporation from the ground within woods is about 44% of that within the fields. This reduction of evaporation is accounted for by a greater relative humidity due to lower temperature by shade, breaking of winds, and the protection of the soil litter. The forest, though perhaps less effective in adding moisture to the air than some other types of vegetation formations, gives off a more uniform supply, and continues to do so when elsewhere the saturation deficiency of the air is relatively high.

Although, some general conclusions have been presented as to the vertical gradient of temperature and humidity in the forest, there seem to be no similar data for evaporation. The experiment, discussed here, was undertaken with a view to gaining some light on this phase of the subject. The station selected was located in a woodlot about ten miles north of Columbus. The predominating species is beech, (Fagus americana), with a mixture of white oak, (Quercus alba), maple (Acer Saccharum), and hickory (Hicoria ovata). The stand is fairly dense, and the ground is

*Contribution from the Botanical Laboratories of Ohio State University, No. 63.

†DICKEY, M. G. Evaporation in bog habitat. OHIO NATURALIST 10: 17-23. 1909.

‡DACHNOWSKI, ALFRED. Vegetation of Cranberry Island (Ohio), and its relation to the substratum, to temperature, and evaporation. Bot. Gaz. 51. 1911.

§HARRINGTON, M. W. Review of forest meteorological observations. In Forest Influences. U. S. Dept. Agr. Div. of Forestry. Bull. 7. 1893.

well shaded. The undergrowth is quite sparse and the soil is covered with a thick layer of leafy litter.

The instruments were the porous cup atmometers similar to those used in previous experiments. A graduated cylinder served the purpose of a reservoir. The cups were loaned by the Carnegie Desert Laboratory at Tucson. Four instruments were installed, one on the ground, at the three-inch level, one at one foot above the soil, another on an upright support at 6 feet, and a fourth resting on a light framework which was raised to a height of thirty-five feet. The instruments were set up on May 28, and weekly readings were begun on May 30, and continued until June 27. At this time, the cups at the one foot, and six foot levels were removed, and returned to the laboratory to be used in other investigations. The remaining instruments were read for three weeks longer. The sixth reading, June 27 to July 12, is for a period of two weeks, and cannot be compared with the other readings. It was the intention to supplement the evaporation readings with the temperature, and humidity data, but unfortunately, the instruments were not available at the time. The data are indicated in the following table:

TABLE TO SHOW THE EVAPORATION GRADIENT IN A WOODLOT.

DATE	3 INCHES	1 FOOT	6 FEET	35 FEET
May 28–30.....	30.6	29.8	61.6	....
May 30 to June 6.....	41.5	36.5	77.0	56.0
June 6–13.....	36.7	38.2	75.9	54.0
June 13–20.....	91.1	74.7	154.0	126.0
June 20–27.....	83.1	73.8	140.8	116.0
June 27 to July 12....	74.2	....	....	198.0
July 12–18.....	54.4	....	....	88.0

It will be seen by comparison of the readings at the various levels, that the greatest evaporation has occurred in every case at the six foot level, pointing to a decrease in relative humidity from below upwards. The thirty-five foot reading exhibits a modification of this relation, which is due to the moisture given off in the transpiration of the leaves in the forest crown. Contrary to results obtained from similar investigations on Cranberry Island at Buckeye Lake, l. c. 2 and also to the observations of Yapp in an English marsh,* the data do not show a uniform increase of the

*YAPP, R. H. On Stratification in the vegetation of a marsh, and its relations to evaporation, and temperature. Annals of Botany 23:275–320. 1909.

saturation deficiency from the lowest level upward. With the one exception of the reading of June 6–13, which is doubtful in its accuracy, and is further made unreliable on account of heavy rainfall during the week, a greater evaporation has occurred at the one foot level than at the three inch level. Bigelow* has pointed out a similar relation in evaporation from open pans over a sandy desert soil, and explains it by data which show that the temperature at the ground level was from one to two degrees higher than that at ten inches. It may be said, of course, that there is a marked difference between the sandy soil of the desert exposed to the rays of the sun, and the shaded forest floor. However, similar temperature phenomena have been observed in Cranberry bogs of Wisconsin† which have entirely filled the former lake basin. They consequently differ from the bog at Buckeye Lake in that they are not surrounded by an exposed water surface, and have a much lower water table. There is also a distinct difference between the vegetation cover with its high water table in the bog at Buckeye Lake, and the forest litter of our station. Temperature readings at the bog show a much greater range at the three inch level than at one foot or five feet. In the forest, the litter of leaves, and mold acts as an insulator and prevents rapid changes in evaporation, absorption, and radiation from the soil. A much more constant temperature might therefore be expected here, and a more uniformly low evaporating power of the air. Whether this explanation is sufficient to account for the difference pointed out, can not be stated with certainty. Further data are needed to throw light on the subject.

*Bigelow, F. H. Studies on the phenomena of the evaporation of water over lakes, and reservoirs. Monthly Weather Review, U. S. Dept. Agr. 36:437. 1908.

†Cox, H. J. Frost and temperature conditions in the Cranberry marshes of Wisconsin. U. S. Dept. of Agr. Weather Bureau. Bulletin T.