A METHOD OF COMPARING CLIMATIC CONDITIONS IN DIFFERENT LOCALITIES

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Ecologists and plant physiologists have given much attention to the water relations of plants, and various methods have been devised for the purpose of studying and expressing quantitatively the differences between different habitats with respect to these relations. For instance, atmometers of various types have been used. These instruments are made of porous porcelain, and in various forms, cylindrical, spherical, and with flat circular surfaces; they are made either black or white, and used in batteries of both black and white to measure the effects of absorption and reflection of light in terms of evaporation. The atmometer is designed to integrate the effects of temperature, relative humidity, light, and wind flow. Placed in different habitats, the amount of evaporation from standardized atmometers in a given time has been used to measure the differences in evaporation intensity in the given habitats.

Because of the fact that the plant is a self-regulating mechanism, and has physical properties widely different from those of porous porcelain, some investigators have preferred to use phytometers, living plants, as indicators of evaporation intensity in different localities. It is, however, difficult to choose and standardize plants for such work. *Helianthus* and *Cyperus* have been used as phytometers, and are probably as satisfactory as any other plants for this purpose.

Neither atmometers nor phytometers are entirely satisfactory as indicators of habitat differences with respect to the severity of the atmospheric water deficit. A method of expressing atmospheric conditions in terms of water equilibrium has recently (1) been devised that offers ready use in the field, and which requires very simple measurements. It consists essentially of a mathematical computation of the equilibrium forces which would exist in dry organic matter when it had reached dynamic water equilibrium with the environment. The fundamental equation for the calculations is a thermodynamic equation which has been in use many years for other purposes. The only instrument needed for observations is a sling psychrometer; or, if available, the readings from properly calibrated thermographs and hydrographs may take the place of the simpler instrument. The necessary data are the dry bulb temperature, and the relative humidity of the atmosphere. Comparisons may be made at some given moment, or by averaging continuous readings. The latter method is preferable, but when the sling psychrometer is used, one must depend on averaging a number of readings. In this paper, a comparison of the climatic conditions at Oklahoma City and at Goodwell, Oklahoma, is made for the month of September, 1938, for 6:30 A.M., noon, and 6:30 P. M. These hours were chosen because they are the ones used in the Weather Bureau reports for Oklahoma City. The data from Goodwell were read from continuous thermograph and hydrograph records, but for the same hours.

The equation used for the calculations is as follows:

$\Delta Pl = 2.3026 \frac{RT}{Vl} \log \frac{Pv}{Pv'}$, in which ΔPl is the force with which water is retained or evaporation resisted, in any air dry organic material, or on any air dry object, at dynamic water equilibrium. It is expressed in atmospheres. R is the gas constant, (value, 82.06); T, the absolute temperature, measured by the dry bulb readings and converted into the absolute scale; Vl, the volume of the gram mol of water at the given value of T; Pv, the relative humidity of the air at saturation at the given value of T (=100%); Pv', the relative humidity observed at the time the instruments are read. The factor 2.3026 converts natural logarithms into those of the Briggsian system, which are used in the calculations.

The following observations indicate the differences between Goodwell and Oklahoma City conditions:

	6:30 A.M.	12:00 noon	6:30 P.M.
Goodwell,	T=288	298	300
	Pv'= 71%	48%	49%
Oklahoma City,	T=292	302	300
	Pv'=73%	39%	44.5%

These figures represent the averages for thirty daily readings during September, 1938, at the hours indicated.

These values have been substituted in the equation with corrections for changes in Vl at different temperatures, and the resulting computations show that the force at dynamic water equilibrium at Goodwell was 449.3 atm. at 6:30 A.M.; 994.2 atm. at noon, and 972.3 atm. at 6:30 in the evening. The corresponding figures for Oklahoma City are 418.1 atm., 1291.2 atm., and 1117.4 atm. It is obvious from these figures that during the month of September, the climatic conditions at Oklahoma City were more severe than at Goodwell, as measured by these three periods of the day.

The method of integrating the temperature and humidity conditions into a single simple expression of the drying that would occur if the drying were carried to its ultimate conclusion seems to be one that could be applied to many ecological and physiological problems. Aside from the mathematical computations, the method is one that can be easily used, and it requires a minimum of expense. The final values are as accurate as those from any other thermodynamic calculations.