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Trial of Membrane block electrical resistance unit for continuous measurement of soil moisture *

by

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The various types of electrical resistance units such as gypsum block, nylon, nylon coated with gypsum and fibre-glass units as well as others have been developed in recent past and used for moisture determination with varying degrees of success. These units are similar in principle. The electrical resistance of the block is inversely proportional to its moisture content and so the electrical resistance of the block in equilibrium with the soil moisture is a measure of the soil moisture itself which can be read on previously prepared moisture resistance calibration curve.

All the electrical resistance units so far developed have been reported to be more or less inefficient in precise determination of soil moisture *in situ* due to various factors such as excessive salts, organic matter, soil temperature, hysterosis effects and time lags, lines of electrical force extending outside unit, physical make up of the unit, and nonuniformity of the units etc. (Bouyoucos 1951; Ewart and Baver 1951; Weaver and Jamison 1951; Bourget 1959; Przestalski 1959).

The electrical resistance of the blocks embedded in the soil depends upon the amount of water within the insulating material enclosing the electrodes and this in turn depends upon (a) the relative attraction of the soil and the insulating material for water, (b) the amount of moisture present in the soil, (c) the rate of water transfer from one material to the other and (d) the electrical conductivity of the moisture that is within the electrical influence of the electrodes. The sensitivity of change in resistance readings over a small change in moisture tensions depends upon the relative attraction for soil and insulating material for water at the various moistute contents. Even if a material could be found that had exactly the same attraction for water as the soil over any given range in moisture contents, there would still not be a 1:1 change in resistance of the units because moisture content and resistance are not linearly related over all values of moisture (Taylor 1955). A

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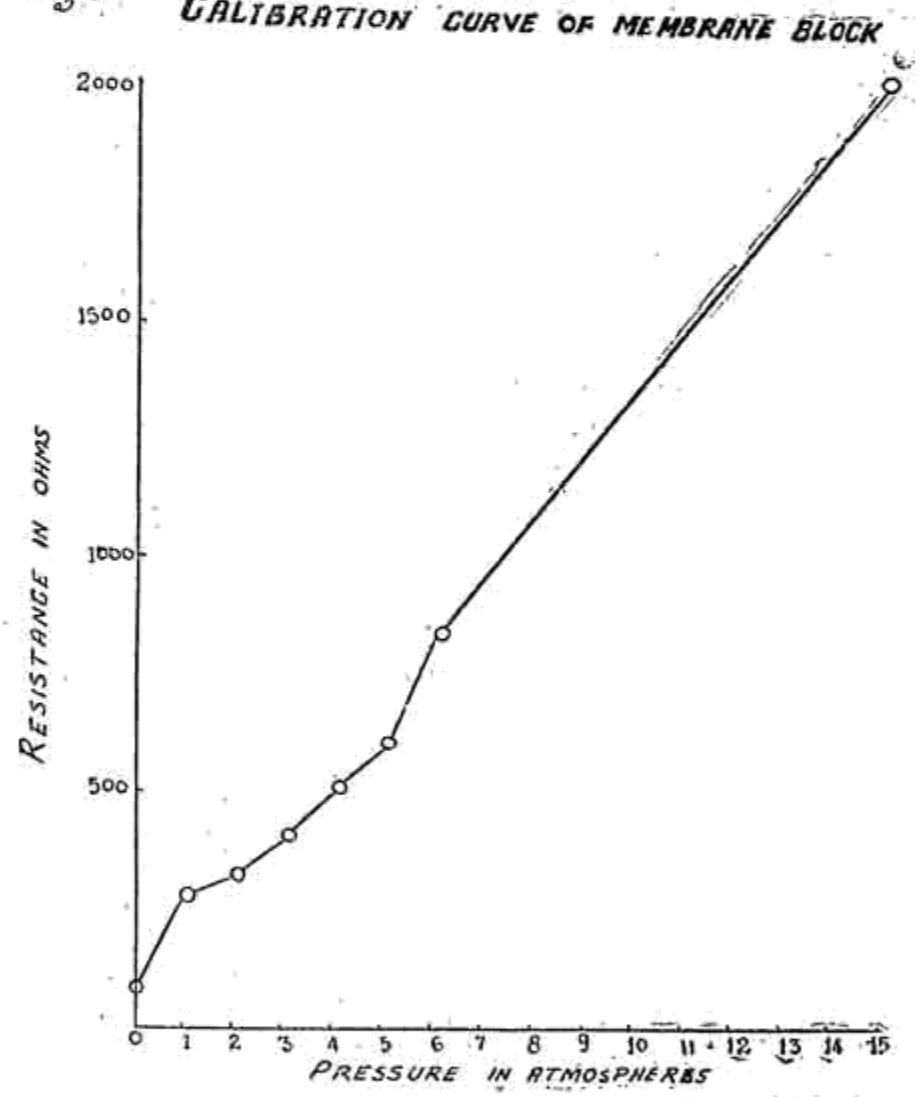
porous medium having a pore-size distribution such that it could gradually release moisture over the 0-15 atmospheres range would undoubtedly produce more satisfactory results (Haise & Kelley 1946).

Materials and methods: Cellophane membrane invariably used in pressure plate apparatus was used as an enclosing material for the electrodes. The casing and the electrodes used in nylon blocks were found quite suitable for use in the assemblage of the electrodes inside the membrane which was folded 4 times to make a thin layer separating the electrodes.

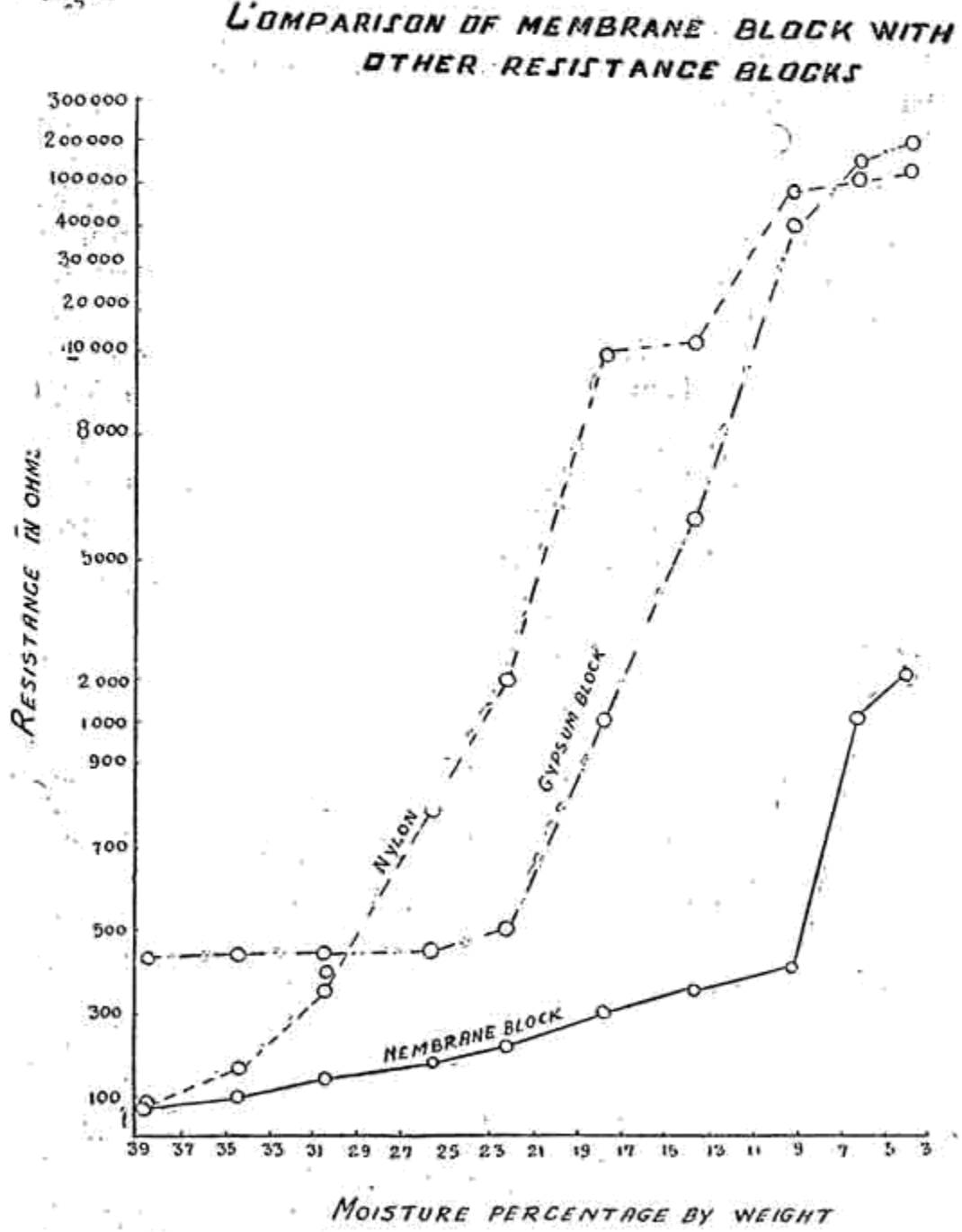
Fig. 1



Membrane blocks thus prepared in the Hydro-technical Laboratory, Copenhagen, were put along with gypsum and nylon units in soil contained in a sieve box and saturated with water by capillarity. The weight of the box, soil and units were taken. The resistance and the subsequent weights were recorded. The evaporation was allowed for about 7 hours in the day and it was entirely

covered for 17 hours with plastic to bring equilibrium through out the soil mass. The calibration of the membrane block was done in the pressure plate apparatus. Electrical resistance measurements in ohms were made with Bouyoucos portable wheat stone bridge meter. The calibration curve of membrane block and comparison of different electrical resistance units have been shown in fig. 1 and 2 respectively.

Fig 2



Results and conclusion: It is quite obvious through the examination of the figure 2 that the membrane block is more sensitive than the gypsum block in wet soil condition and less sensitive than the

nylon block. It is a good indication and rather an advantage over the other units that the membrane block has given almost a straight line curve up to 9 percent moisture after which it sharply bends upwards. So the lower sensivity than the nylon block may not be regarded as disadvantage. The figures 1 and 2 are indicative of the fact that the membrane block may by used as an electrical resistance unit in the entire moisture-tension range of 0-15 atmospheres. In view of this fact the membrane blocks need to be tried under field conditions for soil moisture determination. Effects of fertilizers and soil temperature on the performance of membrane block in comparison to other blocks deserve further investigations.

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