of the opinion that these assumptions are inadequate, and that there is a further and possibly more important relationship.

Six connecting lakes in Northern Wisconsin were studied for the purpose of determining the vertical fall of the lakes over a period of years. It was found that a low rate of recession had been going on over a period of about 32 years. Very probably this recession can be associated with the timbering operations which were complete about 1894. For the past eight years, however the rate of recession has grown at an alarming rate. Nearly 60 per cent. of the total recession seems to be associated with a time period not greater than eight years, or since 1926. This new rate was calculated as being about eight times as great as the rate effective up to that date. Inasmuch as there have been no great changes in forest cover since 1894, and the precipitation during the past decade has remained nearly constant, it was obvious that some new factor must have entered that lacked explanation.

The clew to this new factor was furnished by an analysis of many conversations with local people. In most cases the low lake levels were mentioned with dry marshes. Further conversation on the marsh conditions disclosed that a good many of the marshes had gone dry in 1926—or the same date that the new rate of recession had started on the lakes. From this the writer assumed that further work on the marsh areas might give some explanation of the lake levels. From the facts given, it is believed that a relationship can be demonstrated that has not been suggested before.

The gradual recession of the lakes over a period of 32 years has already been noted; suppose that the water on the marshes was declining at about the same rate. Then, in 1926, for the first time in recent history, the marshes froze over without surface water on them. This does not mean total dryness, but suggests that there was a minimum of surface water on the marshes. The following spring, the writer believes would bring radical changes to the area. The dry frozen marsh would require less energy to thaw out than the typical wet marsh of former years.

This energy change can be expressed in terms of the specific heats, and the latent heat of fusion of the substances involved.

Given: Specific heat of clay or sand 0.19
Specific heat of ice 0.50
Latent heat of fusion (ice) 80.00
Unit areas of wet and dry marsh.
Cd for depth of clay or sand.
Id for depth of ice.
Tx for temperature change from start of spring thaw until final melting of all ice.

Then the heat requirements for each marsh can be computed. The problem disregards the free water in the soil, which would tend to equalize in each type marsh.

Wet Marsh	*Dry Marsh*
$I_d \times T_x \times .50 = H_a$	$C_d \times T_x \times .19 = H_a$
$I_d \times 80 = H_b$	—
$C_d \times T_x \times .19 = H_c$	ΣH_2
—	
ΣH_1	

Since ΣH_1 is much greater than ΣH_2, it follows that the wet marsh will require a great deal more heat to thaw out than the dry marsh. Since the total heat available each spring remains more or less constant, the effect of the ratio between ΣH_1 and ΣH_2 would be to demonstrate that the dry frozen marsh would thaw out much sooner in the season than the wet frozen similar areas.

If, then, the dry frozen marsh thaws out early, perhaps in two or three weeks of the early spring, does it not follow that the marsh will allow precipitation to seep vertically through the marsh into the deep water tables below? The wet frozen marsh, the writer believes, acts as a very effective barrier to vertical drainage, and forces the water laterally into the higher water tables, to stagnant pools, and finally into the brooks and streams that are tributary to the lakes.

This presentation does not allow for numerous variables that would enter into the problem. The writer believes, however, that if further detailed field study were done, there could be shown a high correlation between decreasing thaw periods for marshes and decreasing lake levels. It could also be demonstrated that the thaw period of a marsh is largely dependent upon the water content of the soil and the depth of surface water.

The implications of this theory, if acceptable, are numerous. The lakes tend to be dependent upon the marsh areas rather than the usual converse of this. The theory suggests that, if the marshes now dry could be frozen wet, lake levels could be raised. If marshes can be made to retain enough water over the summer months, it seems plausible that surface drainage could be restored. It would indicate to practical conservationists that it is fully as important to confine water on the surface of marshes as it is to retain water in lakes by means of dams. The theory may demonstrate enough dependence of lakes on marshes to change the economic use of marsh lands over a large area.

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BOOKS RECEIVED

RICE, VICTOR A. *Breeding and Improvement of Farm Animals.* Second edition. Pp. xiii + 516. 140 figures. McGraw-Hill. $4.00.

SMITH, DAVID E. *The Poetry of Mathematics and Other Essays.* Pp. 91. Illustrated. Scripta Mathematica, Yeshiva College, New York.

WEDDERBURN, J. H. M. *Lectures on Matrices.* Pp. vii + 200. American Mathematical Society.