ascertained from these experiments. However, artificial circulation offers other possibilities for the management of lakes. One possibility is the assurance of the vernal circulation of "spring meromictic" lakes, in which trout could not ordinarily be held during the summer period.

This technique can be used to prevent winterkill in ice-covered lakes. However, many details, particularly with reference to the effect of low water-temperatures on the fauna, remain to be examined (*9*).

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Thermocouple for Vapor Pressure Measurement in Biological and Soil Systems at High Humidity

All biological systems depend upon water regimes that are often delicately balanced with respect to the physical condition of the water. Water binding is determined by forces associated with bodies ranging upward in size from individual solute molecules, through colloidal particles, and on up to the larger solid surfaces bounding the system. The effect of binding energy on biological activity is expressible in terms of a colligative property of the water, such as vapor pressure. In addition, the effect of binding-energy gradients on the movement of water in biological systems is of immediate interest.

For example, the uptake of water by plant roots is restrained by forces associated with solute particles in the soil solution and also by forces based in the soil matrix which hold the water films on the soil surface. Both of these binding actions depress the vapor pressure of water in soil, and it has long been supposed that a measurement of this vapor pressure would give a good index of the suction that must be developed in the plant root to effect water intake. Unfortunately, the range of relative humidity of soil air that has agricultural significance lies above 99 percent and presents considerable difficulty with respect to measurement. Wet-junction thermocouples with adequate sensitivity (*1*) have been available, but problems connected with calibration and sample handling were not solved. The thermocouple-sample arrangement shown in Fig. 1 has evolved from tests of various designs and now makes possible precise relative-pressure measurements near saturation for a variety of sample materials. The method is based on the temperature difference between dry and wet junctions in the sample chamber. The dry junction follows ambient temperature, and the wet junction, through evaporation effects, responds to ambient vapor pressure.

In Fig. 1, *A* is the assembly as installed in the thermostat, and *B* is an enlarged view of the thermocouple. The insulating cover (1) helps to maintain the samples at constant temperature in the liquid bath (2). The masonite cover (3) supports a number of thin-walled brass test tubes (4). The thermocouple mount guides the couple into the sample container and makes it convenient to shift the couple from one sample to another. The mount consists of a cylinder of thin-walled brass (5) closed at the lower end with a disc of copper (8) and a copper tube (7) assembled with soft solder. The handle (6) is made of rigid plastic. The lead wires (11), have seven strands of 36-gage bare copper and have vinyl insulation of 0.1 cm outside diameter. The two lead wires make a tight fit in tube (7). The twisted strands extend a short distance (12) below the vinyl and are reduced to a single strand for an additional distance (13). Soft solder with low thermal electromotive force is used to join bare Chromel P (14) and Constantan (15) wire, 25 μ in diameter, and to attach the silver cylinder (16), which is of 0.185 cm outside diameter, with a wall 0.018 cm thick and 0.051 cm high. The thermocouple resistance is 20 ohms. A standard-size water droplet is obtained in the silver cylinder by submerging the cylinder in water and then rapidly lowering the vessel containing the water.

Sample containers are made of brass tubing (17) with end caps (18) of brass or plastic. The caps have a square shoulder and are prepared for use by dipping in hot universal wax. The fillet of wax thus left in the shoulder recess provides a vapor seal. Soil samples are prepared by filling the sample container with a closely fitting soil core and closing the ends with solid caps. Later, an end cap with a 0.9-cm hole is attached, and the container is supported upside down in a jig, while a central hole in the soil core is scratched out by a thin rotating tool. A cap (19) with a 0.6-cm hole is then attached, and the sample is inserted in the bath. Figure 1*A* shows a soil sample with the thermocouple in place. Vapor measurements of plant leaves are made by lining the sample chamber with leaf tissue. Measurements of aqueous solutions are made by supporting the solution on a filter-paper liner, including a paper annulus at the top of the chamber.

After placement in the bath, the vapor seal for the sample is accomplished by means of a water bag made from a rubber finger cot and supported on a plastic mount similar to the metal mount for the thermocouple. The measurement is made by inserting the thermocouple in the sample container. A steady electrical reading is usually obtained in from 10 to 30 minutes if the vapor condition of the sample is steady. A longer time is required at higher relative pressures. The thermocouple output is measured to an accuracy of 0.01 μv by means of the potentiometer arrangement described by Teele and Schuhmann (*2*). Precautions given by these authors for avoiding extraneous electromotive forces should be closely observed. Measurements thus far have been made at 25°C, with temperature fluctuations in the bath kept at less than $\pm 5 \times 10^{-4}$°C.

The thermocouples were calibrated at five points, each point being the vapor pressure of KCl at known osmotic pressure in the range from 5 to 65 bars. Values of osmotic pressure at 25°C for the standard solutions used in the calibration described above were obtained by use of the factor 13.33 bars of osmotic pressure per degree centigrade of freezing-point depression. The electrical output of the couples was proportional to the osmotic pressure. Sensitivities of the four couples expressed as microvolts per

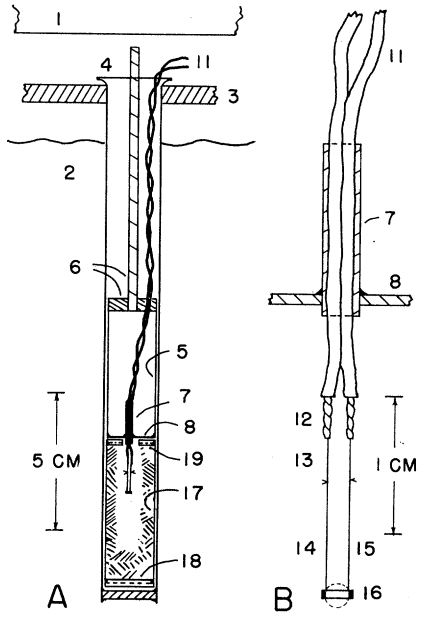

Fig. 1. Thermocouple and sample chamber for measuring vapor pressure.

bar of osmotic pressure were, respectively, 0.576 ± 0.004, 0.570 ± 0.004, 0.568 ± 0.004, and 0.562 ± 0.005. These sensitivity values for the separate couples are averages for determinations at five osmotic pressures. The standard errors measure the accuracy of proportionality between output, in microvolts, and osmotic pressure. The coefficient of variability of the voltage readings for five replicates of each of the KCl concentrations was determined for each of the thermocouples; the over-all average of these 20 coefficients was 0.5 percent. The highest variability occurred at the highest osmotic pressure for which the average coefficient of variability for the four junctions was 1.1 percent.

The calibration of a hygrometer that makes use of evaporative cooling depends on atmospheric pressure. For a given osmotic solution in the sample chamber of the couples here described, the rate of change of sensitivity with change in atmospheric pressure is constant but increases as the osmotic pressure of the sample is increased. The increase in sensitivity for a 10-mbar decrease in barometric pressure is 0.00145, 0.00155, and 0.00160 μv, respectively, per bar of osmotic pressure, for standard osmotic solutions of 5, 10, and 20 bars. Correction for change of atmospheric pressure from the value at calibration will not often be needed, but barometer readings should be taken so that correction can be made if necessary.

The physical condition of water in soil is usually specified in terms of equivalent membrane pressures, largely because measuring techniques employing membranes are available. With thermocouples which can be accurately calibrated in terms of relative pressure near saturation, it seems clear that the thermodynamic functions of free energy and activity will be more generally used for describing soil-water-plant systems.

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Effects of Selenium and Vitamin E on White Muscle Disease

Reports of the pharmacodynamic interrelationship of selenium and vitamin E in liver necrosis of rats (*1*) and "exudative diathesis" of chicks (*2*) prompted the inclusion of this element in an experiment designed to study the factor or factors involved in the cause of white muscle disease, a myopathy in lambs and calves which results when legumes from certain areas are fed to the dams during gestation (*3, 4*). Since reports concerning the role of vitamin E in this disease are somewhat contradictory (*4, 5*), that vitamin was likewise included in this experiment.

Table 1. Scheme and results.

Ration supplement	Lambs	
	Affected	Not affected
Lot 1, control ration		
None	1	17
Lot 2, basal ration		
None	11	4
Lot 3, basal ration		
770 I.U. of α-tocopherol per ewe per week*	11	4
Lot 4, basal ration		
100 I.U. of α-tocopherol per ewe per day†	16	4
Lot 5, basal ration		
0.1 part of Se per million, calculated for the total ration‡	1	15

* Administered parenterally as *d*-α-tocopheryl polyethylene glycol 1000 succinate (*8*).
† Administered orally, as Myvamix (*8*), with the oats.
‡ Administered orally, as Na_2SeO_3, with the oats.

Lots of 12 ewes each were used in this experiment. The ration fed the control lot consisted of Ladino clover and alfalfa hay grown in relatively nonaffected areas, plus 0.25 lb of oats per ewe per day. The basal experimental ration consisted of Ladino clover hay from a severely affected area, plus 0.25 lb of oats per ewe per day. Supplements were given as indicated in Table 1. A preliminary trial indicated that vitamin E as injected maintained satisfactory blood levels in ewes.

The ewes were placed on the experimental regime 50 days after the bucks were placed with them, and the respective rations were continued for approximately 140 days, the termination being governed by the ages of the individual lambs. One of each pair of twins occurring in lots 1 and 2 was sacrificed soon after birth. These, and other lambs that died, in all lots, were necropsied. With a few exceptions, all of the others were necropsied at approximately 6 wk of age.

Analyses of the hays (*6*) fed in this experiment indicate levels of less than 0.1 part of selenium per million, the limit of the analytical method employed. Tocopherol levels in the hays and in the blood of both the dams and the lambs are being determined.

These results appear to indicate that selenium had a definite protective pharmacodynamic effect with respect to white muscle disease under the conditions of the experiment and suggest that a more comprehensive and critical investigation should be made of the role of this element in white muscle disease and other myopathies occurring in animals, including man (*7*).

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Anaphylaxis in Passively Sensitized Guinea Pigs after Subcutaneous Eliciting Injection

Lethal anaphylaxis after a subcutaneous eliciting injection of homologous antigen has been reported relatively rarely. Recently it was shown that in actively sensitized guinea pigs an ultimately lethal but protracted anaphylactic shock can be regularly elicited by a subcutaneous injection of relatively large amounts of antigen (*1*). The signs of protracted shock include pruritus, dyspnea, bristling of fur, a fall in body temperature, and prostration. Symptoms first appear a few minutes after the eliciting injection (pruritus), but death may not occur until several hours have elapsed. At necropsy, the most consistent finding is stasis or hemorrhages of the intestine and stomach walls.

In the experiments to be described in this report, guinea pigs were passively sensitized by the intravenous route with graded amounts of guinea pig or rabbit antiovalbumin serum. Table 1 shows the results of subcutaneous injection of 50 mg of ovalbumin 19 to 20 hours after passive sensitization. In view of the lack