attention. The result of the experiments reported in these papers has always been the same, namely, water recently prepared by melting ice is a more favorable medium for the maintenance of life and for the rapidity of cell division of certain microscopic organisms (*Spirogyra* and *Euglena gracilis*) than water recently prepared by condensing steam and brought to the same temperature. These writers have generally interpreted their results in terms of a supposedly greater concentration of polymers in the water prepared from ice.

There are two features in the short-wave infra-red absorption spectrum of water which are associated with the presence of polymers or aggregates. They are (1) an unsymmetrical broadening of those bands (1.96μ, 1.44, 1.20, 0.97, 0.75) in the liquid which have quantum analogues in water vapor. These bands all sharpen greatly and shift their centers of gravity toward shorter wave-lengths, both when the temperature[2] of the water is raised and when certain substances are dissolved[3] in the water. Although the complete explanation of this effect is lacking, it has generally been associated with a partial breaking up of molecular aggregates. (2) The second effect is the diminution in intensity of certain other bands (4.7μ, 1.78) which do not occur in water vapor, upon raising the temperature[4] and upon introducing dissolved substances.[5] This effect is also consistent with the hypothesis of the destruction of polymers.

We have made use of the two preceding tests to see if we could get any spectroscopic evidence to support the notion that ice water and steam water have different amounts of polymers. A freshly prepared sample of each was quickly brought to a temperature of about 21° C. and placed in turn before the slit of a recording prism spectrograph which gives a photometric tracing of the absorption spectrum between 0.6μ and 2.7. The 1.96μ, 1.78 and 1.44 bands were favorably recorded through the use of a 0.25 mm absorbing layer, and the two curves were so extremely similar that there seems to be no possibility of assuming unlike concentrations of polymers in the two samples. Rises in temperature in the water cell caused by the radiation were guarded against by making the absorbing layer a part of a 40 cc volume of water.

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[2] J. R. Collins, *Phys. Rev.*, 26: 771, 1925.
[3] Suhrmann and Breyer, *Zeits. f. Phys. Chem.*, B, 20: 17, 1933.
[4] J. W. Ellis, *Phys. Rev.*, 38: 693, 1931; also some unpublished data.
[5] Tamman, *Naturwiss.*, 15: 632, 1927; also Suhrmann and Breyer, ref. 3.

EFFECTS OF SOIL TEMPERATURE ON THE ABSORPTION OF WATER BY PLANTS

FROM the time of Sachs's classical experiments it has been known that decreased soil temperature results in decreased absorption of water by plants. Apparently, most investigators have considered this decrease to result solely from the physiological effects of low temperature on the cells of the roots.[1] It has been suggested that the viscosity of protoplasm is increased and its permeability decreased, thus slowing up the movement of water into and through the root cells. Such a view results from the fact that most quantitative studies of this problem have been made with potometers in which the root system is surrounded by liquid water and is therefore under conditions entirely different from those to which a root system growing in soil is subjected. The use of this method of study has resulted in overlooking the purely physical effects of decreased temperature on the rate of movement of water in the soil and from soil to root. However, in view of the effect of temperature on the viscosity and other properties of water it appears probable that these physical effects are fully as important in retarding absorption as are the physiological effects on the root cells themselves.

So far as the writer is aware, no quantitative determinations of the effect of temperature on the movement of water through the soil or from soil to root have ever been made. In fact it would be impossible to measure directly the effects of temperature on the physical processes concerned in the movement of water from soil to living roots, because its effects on the physical processes involved could not be distinguished from its physiological effects on the root cells. It is readily possible, however, to determine the effect of temperature variations on the movement of water to a non-living absorbing surface such as that afforded by the porcelain soil-point cones of Livingston and Koketsu.[2] These cones measure the rate at which water is absorbed by a dry porcelain surface when placed in close contact with the soil. This is considered to be a measure of what is generally termed the water-supplying power of the soil, but which will here be referred to as the water-supplying capacity, because the term "capacity" seems to express more accurately the rôle of the soil.

A number of determinations were made of the water-supplying capacity of soils at various temperatures, and part of the data obtained are summarized in the accompanying table. The amount of water absorbed is stated in milligrams per square centimeter of absorbing surface for a period of one hour. Each

[1] N. A. Maximov, "The Plant in Relation to Water," summary, pp. 83–87. London, 1929.
[2] B. E. Livingston and R. Koketsu, *Soil Sci.*, 9: 469–485, 1920.

value given is the average of five simultaneous determinations.

Series A		Series B		Series C	
Temp.	Amount absorbed	Temp.	Amount absorbed	Temp.	Amount absorbed
0.0°C.	5.77 mg	0.0°C.	57.2 mg	0.0°C.	27.9 mg
8.5	8.5	8.2	96.6	9.5	38.3
23.5	12.2	24.0	132.2	23.8	49.0
35.0	15.1	34.8	171.8	35.0	59.8
				43.0	66.5

The soil used in Series A and B was a loam having a moisture equivalent of 23 per cent. The moisture content was 12 per cent. in series A and 18 per cent. in series B. Series C was obtained with a clay soil having a moisture equivalent of 30 per cent. and a moisture content of 22 per cent.

Inspection of these data shows clearly that increasing the soil temperature materially increased the rate of movement of water from soil to porcelain absorbing surface, or in other words increased the water-supplying capacity of the soil. While it can not safely be assumed that exactly the same relations hold between soil and soil-point cones as between soil and roots, yet it seems very likely that increasing soil temperature produces an equally marked effect on the movement of water from soil to root. If this is true, then lowering the temperature of the soil directly decreases the absorption of water in two ways: First, by its physical effects (chiefly increased viscosity and decreased vapor pressure), which result in a slower movement of water from soil to root; and second, by its physiological effects on the permeability of the root cells. Soil temperature also affects root growth and hence the size of the absorbing system, and thus indirectly the amount of absorption.

It is evident that studies of the effect of temperature on absorption in which the roots are surrounded by liquid water do not take into account the effects of temperature on the water-supplying capacity of the soil, the factor which may be of most importance in the field. Such studies may yield valuable information concerning the effects of temperature on the permeability of the root cells, but only by the use of plants rooted in soil can information be obtained which will apply to plants growing under natural conditions. It is also evident that diurnal and seasonal variations in soil temperature will affect field determinations of water-supplying capacity. Field studies should therefore be planned in such a manner as to minimize the effects of these variations.

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GOSSYPOL, A CAUSE OF DISCOLORATION IN EGG YOLKS[1]

IN preliminary experiments it was observed that egg yolks from hens fed cottonseed meal, when placed in an atmosphere of ammonia, changed in a short time to an olive, brown or chocolate color, depending on the level of this ingredient in the ration. Therefore eggs from hens fed various fractions of raw cottonseed or cottonseed meal were examined before and after this treatment and after storage at 30° C. from 30 to 60 days.

Cottonseed meal, cottonseed meal autoclaved at 20 lbs. pressure for 4 or 24 hours, acid-extracted cottonseed meal, ether-extracted cottonseed meal, raw cold-pressed cottonseed oil, crude and purified gossypol produced yolks that were naturally discolored or developed discoloration during storage at 30° C. or in the atmosphere of ammonia. One to two per cent. $FeSO_4 \cdot 7H_2O$ protected against discoloration in rations containing as high as 40 per cent. cottonseed meal.

Quercetin, cottonseed hulls, refined cottonseed oil, acid extract of cottonseed meal and ether-extracted raw cottonseed did not produce discolored egg yolks. Since free or bound gossypol is present in those fractions producing discoloration and absent in those not producing this condition, these studies indicate that free or bound gossypol is a cause of discoloration in yolks of eggs from hens fed cottonseed products.

Gossypol in rations that did not contain cottonseed meal was found to produce yolk-spotting and small egg size similar to that obtained in eggs from hens fed cottonseed products. It was laxative to hens, as is cottonseed meal. The addition of ferrous sulfate has been found to prevent this catharsis.

The natural amount of iron in rations composed of feeds of high iron content is beneficial to a certain degree but has been found to be insufficient to take care of 25 per cent. of cottonseed meal in the ration. This beneficial effect of soluble iron is proportional to the gossypol content of the cottonseed meal used. It is believed from a commercial point of view that the ammonia treatment cited above would be of value in testing sample eggs from lots believed to have been obtained from hens fed cottonseed meal. If found to respond to this test, these lots of eggs could be used for immediate consumption instead of being placed in storage.

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