on the tissues, the problems of the medical and the technical use of light, the effects of electric waves and of radioactive substances and the study of idioradiation of living organisms, especially of the hypothetical rays of cell division. The new institute will be under the direction of Professor Rajewski.

# DISCUSSION

## A STANDARDIZATION OF OSMOTIC PRESSURE AS A TERM

THE vast amount of confusion which arises from certain physiological terms makes it advisable to bring about a standardization of such terms so that each term will convey a definite and clear concept. Osmotic pressure is a term which most of all needs standardization. At national botanical meetings in discussions involving osmotic relations it is apparent that no two of the botanists have quite the same idea or definition for osmotic pressure. Authors of botanical texts also show a diversity of opinion on the subject. Apparently, some authors either are undecided about a definition or regard the usual definition as unsatisfactory because they present no definition for osmotic pressure.

The definition of osmotic pressure which is generally accepted is that it is or is equal to the maximum hydrostatic pressure exerted by a solution when it is in equilibrium with pure water at the same temperature. This definition is poor and confusing because it either infers erroneously that osmotic pressure is the result and not the cause of osmosis or merely evaluates the pressure in terms of another variable without explaining or describing the nature and the cause of osmotic pressure. Shull[1] in explaining an example which he cited states that "the actual osmotic pressure here is the pressure of the water molecules passing through the bladder membrane." This idea of Shull is a splendid one and is the one which should be universally adopted, because it describes osmotic pressure as a dynamic and functional force, and not as an end result, which it certainly is not.

Since the author has given this subject considerable thought and has discussed it at great length with Dr. Lyons, of Dartmouth University, and has discussed it somewhat with several other plant physiologists, he wishes to propose the following standardization for osmotic pressure. Please bear in mind that the proposed standardization is merely an expansion of Dr. Shull's sound and logical idea.

Water molecules diffusing through a membrane exert a diffusion pressure. Since this special type of diffusion is called osmosis, the diffusion pressure of the water molecules tending to diffuse through the membrane can logically be referred to as *osmotic pressure*. It should be understood that osmotic pressure is not the result of osmosis but that it is the cause of osmosis, and that osmotic pressure is both the diffusion pressure exerted inwardly by water diffusing into the cell and the diffusion pressure exerted outwardly by water diffusing out of the cell.

The osmotic pressure of the water in the vacuole of a plant cell is increased by turgor pressure and decreased by the solute concentration of the cell sap. The water in the plant vacuoles at a given turgor pressure has a maximum osmotic pressure when there are no solutes present. With increased concentrations of solutes in the cell sap, the osmotic pressure of its water is proportionally reduced. To say that the osmotic pressure of the cell sap of a given cell is 1.5 M means that the diffusion pressure of the water in the cell sap is the same as the diffusion pressure of the water in a 1.5 M aqueous solution of cane sugar. To say that the osmotic pressure of the cell sap of a given cell is 4.2 atmospheres means that the diffusion pressure of the water in the cell sap is 4.2 atmospheres less than that of pure water at the same temperature and external pressure. Each gram molecular weight of cane sugar or of any non-electrolyte dissolved in enough water to produce a total of one liter of solution reduces the diffusion pressure of the water molecules 22.4 atmospheres at standard conditions (0° C. and 760 mm. barometric pressure).

The rate of osmosis into a cell is directly proportional to the difference between the osmotic pressure of the water surrounding the cell and the osmotic pressure of the water inside the cell.

Water diffuses osmotically from the cell with the greater osmotic pressure to the adjacent cell with the less osmotic pressure. For example water diffuses from the cell with an osmotic pressure of .2 M to a cell with an osmotic pressure of .4 M. Distilled water which has an osmotic pressure of *zero molar* will diffuse into a cell with an osmotic pressure of .2 M. It must be remembered that the greater the solute concentration the less is the osmotic pressure of the solvent (water), because solute molecules decrease the activity of the solvent molecules.

If one defines osmotic pressure as the diffusion pressure of solvent (water) molecules tending to diffuse through a membrane, there is no need for the terms "diffusion pressure deficit" and "suction tension." These latter terms are not desirable. The term "diffusion pressure deficit" erroneously conveys the idea to many that a cell with a diffusion pressure deficit is in an abnormal state. The term "suction tension" indicates that a cell takes up water by a sucking action which in reality does not exist.

The above standardization for osmotic pressure as a term is advisable, therefore, (1) because it is simple, sound and logical, (2) because it does not necessitate the use of the undesirable terms "diffusion pressure

[1] Charles A. Shull, "A Textbook of Botany Revised." Vol. II. "Physiology," p. 16. Cincinnati: American Book Company, 1930. (Coulter, Barnes, and Cowles.)

deficit" and "suction tension," and (3) because there is no need for the term "net osmotic pressure."

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## STRAIN SUSCEPTIBILITY TO THE EUROPEAN CORN-BORER AND THE CORN-LEAF APHID IN MAIZE

THE European corn-borer (*Pyrausta nubilalis* Hubn.), a chewing insect, and the corn-leaf aphid (*Aphis maidis* Fitch), a sucking insect, are both serious pests of *Zea mays* L. Differential susceptibility to the corn-borer among corn strains has been recognized for several years. The authors have recently found: (1) a differential susceptibility among corn strains to the aphid and (2) significant correlations in the degree of strain susceptibility to these two widely different pests.

Among corn hybrids grown in northwestern Ohio, significant correlation coefficients of 0.570 and 0.844 were found in different seasons between expected aphid infestation based on aphid susceptibility ratings of the parent inbred lines and estimates of actual corn-borer infestations. Estimates of aphid abundance were based on actual counts of infested plants. Estimates of corn-borer abundance were based both on counts of infested plants and on stalk breakage associated with corn-borer damage. These correlation values are as high as have usually been found between corn-borer infestation counts on the same corn strains in different seasons. Correlations between corn-borer and aphid infestations on the same plots may, however, be very low because of competition between the insect species.

The relation has one immediate practical application. For corn-growing areas where the corn-borer is a serious pest, the differential strain susceptibility to corn-borer infestation provides a basis of major importance in classifying breeding material. The chief difficulty in measuring strain susceptibily has been burdensome techniques. In general, the choice lay between (1) adequate sampling of stalks with either natural or manual infestation and (2) feeding etiolated leaves of different strains to young larvae in the laboratory. Manual infestation reduces the number of plants needed for dissection but adds the requirement of rearing moths and applying eggs; it adds also an uncertainty of simulating natural conditions. Further, stalk dissection readings are subject to a large error unless properly timed with reference to the usually different maturity of the strains under study. Laboratory feeding also requires the rearing of moths and handling of eggs and larvae in addition to providing a constantly fresh supply of food.

Counts of aphid colonies, on the other hand, can be made rapidly. The evidence indicates that the degree of aphid infestation may be used as an index to the degree of strain susceptibility to the corn-borer, at least for preliminary classifications of corn-breeding material.

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## AN EXPERIENCE OF GENERAL ANESTHESIA

HAVING been occupied for some time with a disquisition on "Biology and Substance" I have had an experience in the last two days that furnished me facts and reflections on the subject that interests me a good deal and it has occurred to me might be of some interest to other people.

The discovery had recently been made by myself and my dentist that I had two teeth that were worse than useless, with the consequent decision that they had better be extracted. Passing over details in preparation for this I merely mention that the decision was that there should be general instead of local anesthesia —heretofore never experienced by me. Early in the morning I found the anesthetist with some sort of a contrivance beside my head with the instruction that I breathe perfectly naturally. My only response so far as I remember was the foolish question as to whether this was "N O" or "N O 2," to which she replied "N O."

Although I was naturally not holding the stop watch, as near as I could judge it could not have been many minutes at most before I was completely gone so far as my consciousness was concerned. When I came to my senses forty-five minutes later, as I was told, I was aware of some soreness in my mouth and not much later I was wide awake and restored to my regular bed in the hospital. What particularly interests me is the problem of what, during the period of nonexistence so far as my consciousness was concerned, that substance, "N O," was doing to me.

I note, first of all perhaps, that from my little knowledge of chemistry and biochemistry I know that nitrogen and oxygen were playing important parts in my existence up to the time my existence disappeared. Their action on me must, however, have been very different when the two were combined to make "N O" than when either was thus uncombined. How is such a thing possible? How was it that the combination of those two chemical elements could produce such a striking effect as compared with what either of them could do alone or in other combinations; and the gist of my inquiry is as to the latent qualities or properties which each separate chemical substance

[1] The Departments of Entomology and Agronomy, Ohio Agricultural Experiment Station, and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, cooperating.