$MgHPO_4$. On the seventh day the plants were transferred back to KNO_3 and the above sequence continued. The plants were rinsed in distilled water with every change of culture from one solution to another. Whether this apportionment of exposure of culture to the several solutions would continue to be the best for the growth of wheat can not be stated until the plants have matured. It appears the best apportionment of exposure of the plants to the different solutions may vary, being not inconsiderably influenced by the aerial growth environment and by the nutrient requirements of the plant at different stages of growth.

Because of its simplicity, the method appears well adapted for investigation of these points as well as for instruction in the principles of plant nutrition. It should aid materially in throwing more light on the causative interrelations of the growth of plants and the composition of the growth media.

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A NOTE ON THE SPERMS OF VALLISNERIA

AFTER trying for many years to secure favorable fixation of ovules of *Vallisneria spiralis* the writer recently succeeded in getting more fortunate material. Perhaps a few words, by way of preliminary publication, on the method and results may be of interest to workers in this field.

The ovules are borne numerously in the epigynous ovary surrounded by a mucilaginous substance which greatly retards the action of reagents and is but slowly dissolved by water. Cutting the ovary across permits one to squeeze out the contents which in their mass movement break off the ovules and carry them out. Several hours of washing in water are then necessary to free these ovules from their gelatinous matrix. In repeated earlier attempts it was found that all ovules having received pollen tubes completed their fertilization and double fertilization before killing agents penetrated to them. If pistils were killed *in toto* the pollen tubes running down their inner walls in the edge of the gelatin would be well fixed, but the interior ovules were invariably found in poor shape due to the influence of this slime.

Last year the writer modified the method by lowering the temperature of the water used in dissolving the mucilage from the expressed ovary content. The water was cooled by adding small pieces of ice, and the container was set in a larger vessel of iced water. It was hoped in this way to slow down or stop both growth and cyclosis and to hold all parts *in status quo* until killing was possible.

The results were very satisfactory. Sperms were found not only in the tip of pollen tube within the synergid but in all subsequent situations through to the completion of fertilization. Many points regarding the male cells of Vallisneria, previously left obscure through poor fixation, were cleared up by use of this material. A brief statement of findings is given below.

The sperms of *Vallisneria spiralis* maintain their integrity as male cells until the egg is reached. During the journey through the pollen tube they remain joined end to end and pass out of the tip of the tube together. The sperm that later fuses with the egg emerges from the tube as a cell and immediately flattens against the egg membrane. Many preparations showed the male nucleus with its definite mass of cytoplasm and bordering membrane pressed, as a complete cell, against the egg cyst. One would hardly expect to find, in fixed material, stages showing events at the moment the two cells break together, for the union would probably be completed quickly. But the two masses of cytoplasm must intermingle in some degree in fertilization and probably the male cytoplasm partly or wholly enters that of the egg. The male nucleus soon moves to the center and unites with the egg nucleus. There can be no doubt of the morphology of the sperm up to the time of its union with the egg,—they come together as complete cells.

The second sperm loses its cytoplasm soon after it emerges from the pollen tube. Its nucleus is often observed as a spherical body within a strand of protoplasm extending from the egg-apparatus to the polars. Its successive positions suggest that it is carried to the polars by movement of cytoplasm within the embryo-sac. The male nuclei of Vallisneria are never vermiform in the slightest degree nor

is there any suggestion of motility on their part.

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THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-ninth summer meeting of the American Mathematical Society was held at the University of Rochester, Thursday and Friday, September 7-8, 1922, in conjunction with the meeting of the Mathematical Association of America. Special features of the session included visits to the research laboratories of the Eastman Kodak Company and to the buildings of the Bausch and Lomb Optical Company, a chamber concert at the Eastman School of Music, and an automobile drive through the environs of Rochester, arranged by the alumni of the university. A resolution was passed expressing the thanks of the society for the generous hospitality extended.

The attendance included seventy members of the society. The secretary announced the election of ten persons to membership in the society; twenty-one applications for membership were received.

At the meeting of the council, committees were appointed as follows: Professors C. N. Haskins, T. S. Fiske and H. S. White on award of the Bôcher Memorial Prize; Professors D. R. Curtiss, Dunham Jackson and H. H. Mitchell on nomination of officers for 1923.

The medal presented to the society by the Royal Academy of Belgium on the occasion of its one hundred and fiftieth anniversary was exhibited.

A reciprocity agreement was ratified with the London Mathematical Society which grants to members of one society membership in the other at half-rates.

The session of Friday morning was especially marked by a paper read by Professor C. A. Fischer, at the request of the program committee, on "Functions of lines."

The following papers were read at this meeting:

Condition that a tensor be the curl of a vector: L. P. EISENHART.

A new class of topological invariants for two-sided manifolds: S. LEFSCHETZ.

The (1, 2) *quaternary correspondence associated with certain space involutions:* F. R. SHARPE and V. SNYDER.

On the summability of the double Fourier series: C. N. MOORE.

The theory of sets and the foundation of arithmetic: N. J. LENNES.

Kirkman parades: F. N. COLE.

On the definition of a simple closed surface: R. L. MOORE and J. R. KLINE.

The theory of functions of one Boolean variable: K. SCHMIDT.

Representation of rectilinear motion by the geodesics of a surface: A. MYLLER.

Note on steady fluid motion: S. D. ZELDIN.

Real representatives of analytic complex curves: W. C. GRAUSTEIN.

Extension of Bernstein's theorem to Sturm-Liouville sums: ELIZABETH CARLSON.

A Bohr-Langmuir contact transformation: G. C. EVANS.

An elementary theory of competition: G. C. EVANS.

Groups in which the number of operators in a set of conjugates is equal to the order of the commutator subgroup: G. A. MILLER.

Expansions in terms of solutions of partial differential equations. First paper: Multiple Fourier expansions: C. C. CAMP.

On the minimum of the sum of a definite integral and a function of a point: E. H. CLARKE.

A simple proof of a fundamental lemma concerning the limit of a sum: H. J. ETTLINGER.

Application of Duhamel's theorem to the convergence proof for approximate solutions of differential equations: A. H. COWLING.

Two theorems on multiple integrals: P. FRANKLIN.

An extension of the theorem of Bayes, by the use of a certain limit: E. L. DODD.

Fundamental systems of protomorphic formal modular seminvariants of binary forms: W. L. G. WILLIAMS.

An example in potential theory: O. D. KELLOGG.

On certain systems of differential equations containing a parameter: F. H. MURRAY.

Periodic solutions in the problem of three bodies: F. H. MURRAY.

Functions of lines: C. A. FISCHER.

The expansion of a certain function: I. J. SCHWATT.

The summation of a family of deranged series: I. J. SCHWATT.

The sum of the harmonic series: I. J. SCHWATT.

R. G. D. RICHARDSON,
Secretary