A. H. Robin, I. M. Hunter, D. Leaf and R. W. Feachem.

DR. GEORGE D. BIRKHOFF, professor of mathematics at Harvard University, during his recent visit to Paris, gave on June 4 and 5 two conferences at the Institute Henri Poincaré. He spoke on analytic functions and on unsolved problems of dynamics.

AT a meeting commemorating the semi-centennial of the founding of the Denison Scientific Association, held on June 12, under the general topic "Contributions of Science to Human Welfare," addresses were made by Dr. Herbert Grove Dorsey, of the U. S. Coast and Geodetic Survey; Professor C. Judson Herrick, of the University of Chicago, and President William E. Wickenden, of the Case School of Applied Science.

THE fifty-first annual convention of the Association of Land-Grant Colleges and Universities will be held in Washington, D. C., from November 14 to 17. A part of the convention period will be devoted to the observance of the seventy-fifth anniversary of the Morrill Act, of the act establishing the U. S. Department of Agriculture and of the fiftieth anniversary of the Hatch Act.

THE Pacific Coast convention of the American Institute of Electrical Engineers will be held at Spokane, Wash., from August 31 to September 3.

THE First International Colloquium on Endocrine Glands in Relation to Reproduction was held in the Collège de France, Paris, from June 10 to 19, under the auspices of the Singer-Polignac Foundation. Opening addresses were made by MM. Bédier and Faral and by Professor P. Bouin, of Strasbourg, who presided at the meetings. Dr. Lucien Brouha, of Liège, was general secretary and interpreter. Among those who presented papers were Drs. Edgar Allen, of Yale University; Carl G. Hartman, of the Carnegie Laboratory of Embryology, Baltimore; F. L. Hisaw, Harvard University; P. E. Smith and A. E. Severinghaus, Columbia University; H. Selye and C. S. McEwen, McGill University. The Singer-Polignac Foundation was established for the support of scientific research in 1928 by the American-born Princess de Polignac in honor of the late Prince Edmond de Polignac. The officers of the foundation are: *honorary president,* Princess Edmond de Polignac; *president,* M. Joseph Bédier, chancellor emeritus of the Collège de France; *executive secretary,* M. André Mayer, Collège de France; *members of the council,* MM. Maurice Paleologue, Edouard Estaunie, Georges Maringer, Paul Léon, Edmond Faral and Emmanuel Fauré-Fremiet. The proceedings of the meeting will be published in book form.

THE *Experiment Station Record* states that under a memorandum of April 9, 1937, an Advisory Committee on Research of the U. S. Department of Agriculture has been set up by Secretary Henry A. Wallace, consisting of F. D. Richey, H. G. Knight, J. R. Mohler and L. A. Strong, chiefs, respectively, of the Bureau of Plant Industry, Bureau of Chemistry and Soils, Bureau of Animal Industry and Bureau of Entomology and Plant Quarantine, and E. N. Bressman, of the Agricultural Adjustment Administration. This committee will advise the secretary and director of research on such specific research problems as may be assigned them from time to time. It will also, upon its own initiative, survey the field of research within the department with a view to developing uniform research project systems and obtaining an able research personnel. The *Record* points out that the appointment by transfer from the Soil Conservation Service of Merrill Bernard, hydraulic engineer, to succeed M. W. Hayes, deceased, as chief of the River and Flood Division of the Weather Bureau marks a new departure of the bureau, namely, the selection of a hydrologist rather than a meteorologist to head one of its important divisions, the severe floods of the last few years having shown the need of specialists in hydrology in the task of developing new flood-forecasting methods.

THE *Journal* of the American Medical Association reports that the project for construction of a new building for the Faculty of Medicine, Buenos Aires, at a cost of $3,500,000, has been approved by the government. The government has asked the university to cut down expenses by twelve per cent. It is requesting, however, the same allowance for expense that it had in 1930, which has been cut down from that year up to the present by forty-seven per cent.

DISCUSSION

THE SCHÜTZ-BORISSOV LAW FOR ENZYMES

IT is frequently stated by investigators and writers on enzymes[1,2] that for preparations of certain enzymes, *e.g.,* pepsin, the velocity of reaction has been found to be proportional to the square root of the enzyme concentration. Reference to the original data

1 J. B. S. Haldane, "Enzymes, Monographs on Biochemistry," p. 11, London and New York, 1930.

2 S. Waksman and W. C. Davison, "Enzymes," p. 44, Baltimore, 1926.

upon which this law was based, that of E. Schütz[3] in 1885 and the confirmatory data of Borissov[4] in 1891 and J. Schütz[5] in 1900 shows merely that in the presence of varying concentrations of pepsin, the *amounts of protein digested at a given time* (*e.g.*, 16 hours in the work of E. Schütz) are proportional to the square root of the enzyme concentration. In so far as the Schütz-Borissov formulation limits itself to the summary of these particular results or similar results for other enzymes, it is correct, though naturally quite limited in its significance.

That formulation, however, of the Schütz-Borissov or of similar data which aim at wider significance by stating that the *velocity of reaction* is proportional to the square root of the enzyme concentration is based on an incorrect use of the term "velocity of reaction." This error is easily revealed by mathematical treatment of the kinetics of the reaction involved, and it may be shown that E. Schütz's own data support the general rule, established so widely for other enzymes, that the reaction velocity is directly proportional to the first power of the concentration of enzyme.

E. Schütz determined the extent of action at only one point, 16 hours, submitting no data on the course of the reaction. Arrhenius[6] in 1908, as well as others since then, noted that under most conditions the amount of protein digested at a given concentration of pepsin preparation could be fairly well expressed as being proportional to the square root of the time, for about the first 50 per cent. of the hydrolysis.

The course of the action may then be expressed at two levels of enzyme concentration, A and B, in terms of reaction constants, as follows:

$$k_A = \frac{1}{t} \cdot x^2$$

and

$$k_B = \frac{1}{t} \cdot x^2$$

where x is the amount of protein digested at time t. The ratio of the reaction constants is, for a given value of t as, for example, 16 hours in the experiments of E. Schütz,

$$\frac{k_A}{k_B} = \frac{x^2_A}{x^2_B}.$$

In other words, as the enzyme concentration is varied, the ratios of the reaction constants, which are a proper measure of the velocity of the reaction, are equal not to the ratios of the amounts changed in a given time, but to the ratios of the squares of these amounts. According to E. Schütz's own data, the amounts changed in a given time are proportional to the square root of the enzyme concentration,

$$\frac{x_A}{x_B} = \frac{\sqrt{E_A}}{\sqrt{E_B}},$$

or

$$\frac{x^2_A}{x^2_B} = \frac{E_A}{E_B}.$$

Since, as shown above,

$$\frac{x^2_A}{x^2_B} = \frac{k_A}{k_B},$$

then

$$\frac{k_A}{k_B} = \frac{E_A}{E_B},$$

or the reaction velocity is directly proportional to the concentration of enzyme, not to the square root thereof.

When the reciprocal of the time required to reach a given stage in the enzymic reaction is used as a measure of reaction velocity (and this is a more proper measure than the amount changed in a given time, although it also has limitations) there may be instances in which the Schütz-Borissov law seems to be approximated or even followed. But such simulation appears to be due, at high concentrations of enzyme, to the presence, as impurities in the enzyme preparation, of proteolytic products which apparently combine with the enzyme to form enzymically inactive compounds.[7,8]

There would appear to exist, therefore, no substantial data to contravene the general rule that the velocity of reaction is directly proportional to the concentration of enzyme, within rather wide range of the latter. Data indicating such contravention must be evaluated with respect to (a) the measure of reaction velocity used and (b) the possible presence of accompanying substances, impurities or reaction products which affect the activity differently at different enzyme concentrations.

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[3] E. Schütz, *Zeits. physiol. Chem.*, 9: 577, 1885.

[4] Borissov, Inaugural Dissertation, St. Petersburg, 1891, quoted by J. Schütz.

[5] J. Schütz, *Zeits. physiol. Chem.*, 30: 1, 1900.

[6] S. Arrhenius, *Medd. Kong. Vetsakad. Nobelinst.*, 1908, 1.

[7] J. Northrop, *Jour. Gen. Physiol.*, 2: 471, 1920.

[8] O. Bodansky, *Jour. Biol. Chem.*, 114: 273, 115: 101, 1936.

RELIC FLORA IN RELATION TO GLACIATION IN THE KEWEENAW PENINSULA OF MICHIGAN

IN a paper entitled "Critical Plants of the Upper Great Lakes Region of Ontario and Michigan," which