The result lends support to the statement of Schimper and of Meyer[4] that starch is always formed in the plastids. It confirms also the anticipation of Hanes[6] that starch formation in the plastid (for that matter also outside the plastid, cf. *Batrachospermum*) is due to the phosphorylase mechanism.

H. C. YIN

Botany Department,
National Peking University,
Peiping.

[1] Sun, C. N., and Yin, H. C., Fiftieth Anniversary Papers, National Peking University (1948).
[2] Yin, H. C., and Sun, C. N. *Science*, **105**, 650 (1947); *Science Record*, **2**, 192 (1948).
[3] Tung, Y. T., and Yin, H. C., Fiftieth Anniversary Papers, National Peking University (1948).
[4] Sharp, L. W., "Introduction to Cytology", 65 (1934).
[5] Zirkle, C., *Amer. J. Bot.*, **13**, 301 (1926).
[6] Hanes, C. S., *Proc. Roy. Soc.*, B, **129**, 204 (1940).

Vestibular Effect of Streptomycin in the Mouse

UP to the present, experimental methods have yielded very little information concerning vestibular toxicity due to streptomycin; in medical practice these accidents are very frequent (80–90 per cent of cases treated). Indeed, the fundamental work of Molitor and his collaborators leads to the conclusion that most of the animals used in laboratory work show no recognizable vestibular disturbance, whether as the result of a single heavy dose of streptomycin or of several fractional doses administered over a period of time. According to Molitor[1], dogs are the only animals which show any evidence of cerebellar or vestibular damage comparable to that which has been observed in human beings, whereas mice, frogs, rats and guinea pigs are unaffected. Although Molitor kept under observation a considerable number of animals, we believe that his conclusions should not be accepted as final.

Our researches involved: (1) developing procedures which would enable us to study the vestibular function in the mouse; (2) the development of a suitable technique of labyrinthectomy for these animals, and a study of the phenomena which follow upon this operation, whether unilateral or bilateral; (3) the study of the reactions of a mouse upon receiving a single heavy dose of streptomycin or fractional doses over a period of time. By proceeding on these lines, we have been able to demonstrate a vestibular toxicity of streptomycin in the mouse, moderate in the case of acute intoxication, clear in the case of chronic intoxication[3]. When a heavy dose is administered, the response to the rotation test is in the nature of hyper-excitability. In chronic intoxication (30 mgm. in two daily doses), after about a week, a syndrome appeared which was progressively accentuated, and reproduced, in a lesser and variable degree, the effects of destruction of the labyrinth on both sides, namely, agitation, violent movements of the head in a vertical plane, absence of reaction to rotation, circling or waltzing, total loss of equilibrium and inevitable drowning in the swimming test.

In the mouse, then, the vestibular apparatus is remarkably sensitive to the action of streptomycin, a circumstance highly favourable for the study of this action, which at present is still very obscure.

Streptomycin is one of the two substances which are known to have specific toxic properties on the vestibular apparatus, the other being arsacetin, as Ehrlich[4] discovered when he described the 'artificial' dancing mouse. There appear to be no other compounds which, in the same conditions, display such a property.

R. CAUSSÉ
I. GONDET
B. VALLANCIEN

Laboratoire d'Otologie Expérimentale,
École Pratique des Hautes Études,
Paris.
June 18.

[1] Molitor, H., Graessle, O. E., Kuna, S., Mushett, C. W., and Silber R. H., *J. Pharm. Exp. Therap.*, **86**, 151 (1946).
[2] Magnus, R., "Körperstellung" (Berlin, 1924).
[3] Cf. *C.R. Soc. Biol.*, **142**, 45 (1948).
[4] Ehrlich, P., *Berl. Klin. Wochens.*, **44**, 280 (1907).

Permeability of Muscle Cells

SINCE the advent of artificial radioactive elements, a considerable amount of work on the exchange of labelled ions or molecules against unlabelled ones of the same chemical nature has been carried out on biological material. Krogh has reviewed[1] a number of applications of the technique to exchanges between living cells and their surroundings, and Ussing[2] reports results obtained for the exchange of sodium between isolated muscle and Ringer solution. The remarks made by A. V. Hill[3] concerning measurements of so-called permeability of tissues appear to have been overlooked. He emphasized that diffusion might play the most important part in determining the rate of transfer of dissolved substances from lymph to tissue, even when the size of the tissue is only that of, say, a frog sartorius muscle. It appears, therefore, necessary when attempting to study cell-wall permeability either to use single cells, or to make allowance for the effect of diffusion being the means by which the extra-cellular fluid comes into eventual equilibrium with the fluid surrounding the assembly of cells. Experiments made *in vivo* will be less affected by the retarding influence of diffusion than will those made *in vitro*. This is because in the former case the blood-flow through the capillaries brings the substance being investigated into the interior of the tissue.

We have been making measurements of the rates of exchange of sodium and potassium between isolated frog sartorii and the surrounding medium. Equations describing the time-course of the combined permeation-diffusion process have been obtained. These allow the calculation of the apparent diffusion constant of sodium in the extra-cellular space of the muscle, and of the permeability to sodium and potassium. The apparent diffusion constant for sodium is $2{\cdot}0 \times 10^{-6}$ cm.^{2}/sec., which is a third of the value in free solution; this would correspond to the ion having to traverse a path $\sqrt{3}$ times the measured distance between outside and centre, which is not far from that expected if it has to pass round a series of cylinders. The permeability constant has to be defined, as there is no generally accepted formulation. For a cell in which the total concentration of the ion in question is static (that is, irrespective of whether the ions are labelled or not), the amount of ion entering per unit time equals the amount being lost, and we can write

$$P_e M_o = P_i M_i$$

for the equilibrium of total M, and