ence of hexokinase does it become a powerful phosphate acceptor. Glycogen induces a decrease of phosphate that is slower and less dependent on the presence of oxygen than the esterification of hexosemonophosphate. Respiratory phosphorylation in this instance is evidently involved only in the transformation into hexosediphosphate of the glucose monophosphoric ester formed by phosphorolysis. The esterification of phosphate in the presence of different acceptors is shown in Table 1.

TABLE 1

200 MG. MINCED RED MUSCLE OF RABBIT. TOTAL VOLUME 1,7 μL. SUCCINATE 0,05 M, $MgCl_2$ 0,004 μ, PHOSPHATE BUFFER 0,015 M (pH 7,4), $NaHCO_3$ 0,008 M. 40 MIN. AT 20° IN O_2. ADDITIONS: GLYCOGEN 4 MG., OTHER ACCEPTORS—25 μ M PER SAMPLE. H_3PO_4 DISAPPEARED (MG. P)

Without added acceptors	Glucose	Glucose + hexokinase	Hexose-monophosphate	Creatine	Glycogen
0,02	0,04	0,33	0,45	0,13	0,19

In spite of the presence of preformed glycogen in the muscle tissue, esterification was negligible without added phosphatic acceptor: glycogen added artificially is phosphorylated much more readily than the glycogen of the tissue. Hexosemonophosphate, likewise a constant ingredient of muscle tissue, exhibits similar behavior; a rapid accumulation of hexosediphosphate and phosphotriose in aerobiosis takes place only at the expense of added hexosemonophosphate. It is difficult at present to interpret this differential behavior of endogenous and added acceptors.

In several experiments the competition between simultaneously added acceptors was studied. It was found that when glucose + hexokinase and creatine are present together, the latter accepts almost no phosphate, and the phosphorylation of glucose predominates.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD FOR RECORDING ELECTROCORTICOGRAMS IN ANIMALS WITHOUT OPENING THE SKULL

THE following method enables one rapidly to implant electrodes directly in the cortex of small laboratory mammals by the simple method of thrusting Victrola needles through the skull. The needles may then be connected by wires to suitable recording or stimulating apparatus.

Common steel Victrola needles (Fig. 1a) if heated

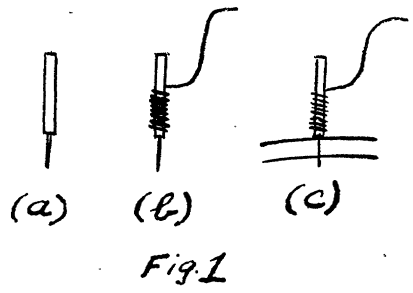

Fig. 1

red in a Bunsen flame for a few seconds lose their brittleness. The needle then is wrapped tightly with fine copper or silver wire from the lower part of its thickened shank to within about 5 mm of its top (Fig. 1b). It is well to let one end of the coiled wire extend for several inches from the shank so that clips connected to the recording apparatus can later grip the wire, thus making a flexible, non-rigid connection which will prevent pull on the implanted electrode. The needle and its wound wire is next dipped into enamel and baked, thus insulating it from subsequent contact with scalp and muscle. The point is scraped bare of enamel for a millimeter or so at the tip, and after sterilizing in alcohol the upper part of the shank is gripped firmly in a simple hand chuck by which the needle can be thrust through the skull.

The scalp and underlying muscles of the skull of the anesthetized animal are separated by a very small sterile incision 5 or 6 mm in length. The head is held firmly in one hand, the incision is spread, and the needle, gripped by the chuck, is thrust firmly through the bone by a straight downwards and rotating thrust. The enlarged shank of the needle stops the point just below the skull surface in the cortical layers (Fig. 1c). Needles thus imbedded are held firmly fast in the bone. The chuck head is carefully unscrewed so as not to loosen the needle in the bone, and the incised tissues are allowed to fall back around the projecting shank which is insulated from them by its enamel coating. A drop of collodion may be applied to the place of entry of the needle. This quickly hardens, helping to brace it and at the same time seal the slight wound from air.

Several dozen of these electrodes can be prepared in an hour and 5 or 6 of them can be implanted in almost as many minutes. When the animal recovers from anesthesia its behavior is normal and the projecting shanks appear to cause no inconvenience. Electrocorticograms recorded from them in unanesthetized rabbits, cats and rats are in all respects identical with those recorded from the exposed cortex. The

method is much to be preferred to recording through skull and scalp by electrodes pasted on the skin. Electrode artifacts, troublesome with this latter type of lead, never appear, localization is precise and the lack of resistance of skull and scalp with the needle, sufficient, in some animals, to make external recording impossible, permits one to record at very low amplification, thus eliminating instability and pick-up artifacts accompanying high amplification. The Victrola needles may be left *in situ* for a considerable period, a thing not possible with those externally applied to the skin.

The leads may be removed without reanesthetizing the animal by simply extracting each one by a firm jerk with a pair of pliers. This extraction appears to be painless. A drop of collodion placed on the small hole rapidly seals it off.

We have kept animals for several days with the leads in place and could have kept them longer. Some 50 electrode insertions have been made in a dozen animals without complications from infection. The electrode positions in the cortex could presumably be precisely determined if one wished in the freshly sacrificed animal by passing an electrolytic (D.C.) current through each lead in turn as cathode, thus producing a deposit of iron oxide at the point of contact with the cortex.

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AN INEXPENSIVE MOUSE CAGE

IT is often desirable to keep mice in small groups when they are under observation. This requires a number of small cages, which should be easily cleaned, and, if possible, inexpensive. The following cage is suggested for its simplicity, ease of cleaning and cheapness. The materials used are few and obtainable at any hardware store. They are as follows: coarse wire netting, sometimes called hardware cloth, 8 inches × 22 inches, two tin pie plates, 8½ inches in diameter and about 20 inches of 24-gauge soft wire.

The ends of the hardware cloth are brought together to form a cylinder, 6½ inches in diameter. By overlapping the ends one inch and weaving a length of the soft wire in and out through the meshes of the cloth they can be made secure. This is best accomplished by weaving down one side and up the other of the overlapping ends so that the ends of the wire may be brought together near one point and twisted. The cylinder thus made will fit into the bottom of one of the pie plates. The other plate is now placed over the open end of the cylinder, thereby completing the cage.

As many as six mice may be kept in the cage at one time with no danger of them pushing off the top plate. Rats may also be kept in like manner, but it is suggested that a lead weight be soldered on the plate which is used for the cover. The plate used for the bottom should be covered with a piece of 25 cm filter paper, which absorbs moisture and assists the sides of the plate in preventing the scattering of food. To clean the cage the paper is removed and fresh put in its place. The mice will tear the paper to some extent, but if they are well fed this is reduced to a minimum.

A drinking fountain may be made by inserting in a small, wide-mouthed bottle a one-hole rubber stopper fitted with a short length of small bore glass tubing. A bit of rust-resisting wire, such as nichrome, should be fastened in the tube to assist in the flow of water when the mouse is drinking. The fountain should be hung inside the cage by means of a wire sling.

Any other dimensions may be substituted for these suggested so that larger or smaller cages may be made. The total cost of the cage described is about twenty cents, and a half dozen can be made in an hour.

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CENTRE COLLEGE

BOOKS RECEIVED

BAITSELL, GEORGE A., Editor. *Science in Progress.* Second series. Pp. xii + 317. 129 figures. Yale University Press. $4.00.

BAVER, L. D. *Soil Physics.* Pp. xi + 370. 70 figures. 4 plates. Wiley. $4.00.

Cambridge Philosophical Society, Proceedings. Volume 36, part 4. Pp. 387 + 512 + vii. Cambridge University Press, London. 10/6.

CISSEL, JAMES H. *Stress Analysis and Design of Elementary Structures.* Pp. x + 335. Illustrated. Wiley. $4.00.

COLE, LUELLA. *The Background for College Teaching.* Pp. xxiv + 616. 43 figures. Farrar & Rinehart. $3.50.

EISENHART, LUTHER P. *An Introduction to Differential Geometry; With Use of the Tensor Calculus.* Pp. x + 304. 21 figures. Princeton University Press. $3.50.

FRAENKEL, GOTTFRIED and DONALD L. GUNN. *The Orientation of Animals.* Pp. vi + 352. 135 figures. Oxford University Press. $6.00.

HEWITT, REDGINAL. *Bird Malaria.* Pp. xvii + 228. 33 figures. 13 plates. Johns Hopkins Press. $1.10.

Japanese Journal of Astronomy and Geophysics; Transactions and Abstracts. Pp. 330 + 51. Illustrated. National Research Council of Japan, Tokyo.

MARK, H. *Physical Chemistry of High Polymeric Systems.* Pp. x + 345. 99 figures. Interscience Publishers, New York. $6.50.

MOELWYN-HUGHES, E. A. *Physical Chemistry; An Introduction.* Pp. viii + 660. Illustrated. Cambridge University Press, Macmillan. $9.50.

PATTERSON, AUSTIN M. and LEONARD T. CAPELL. *The Ring Index: A List of Ring Systems Used in Organic Chemistry.* Pp. 661. Reinhold. $8.00.

SAULNIER, RAYMOND J. *Industrial Banking Companies and Their Credit Practices.* Pp. xxi + 192. National Bureau of Economic Research, New York. $2.00.

Science Reports of the Tôhoku Imperial University (Mathematics, Physics, Chemistry) First series. September, 1940. Pp. 163–314. 4 figures. Maruzen, Tokyo.

WILLIS, J. C. *The Course of Evolution by Differentiation or Divergent Mutation Rather than by Selection.* Pp. viii + 207. 10 figures. Cambridge University Press, Macmillan. $3.00.