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Changes occurring in mammalian muscle immediately after death.

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In the numerous observations made in recent years on the chemical changes which set in after death in muscle, little attention has been paid to those which occur in mammalian muscle during the first few minutes after the cessation of blood flow. The increase which occurs in free phosphorus after two hours incubation of muscle juice or chopped muscle, and from which the so-called lactacidogen is calculated, has not been clearly linked up with the changes which take place in glycogen, lactic acid and free sugar. In the theories of Meyerhof,[1] A. V. Hill,[2] and their co-workers,[3] with regard to muscular contraction, it is considered that lactic acid is very rapidly formed from glycogen. But this cannot occur directly; there must be some intermediate carbohydrate, and it was to obtain evidence of this that present investigation was undertaken. That such a substance may be formed in muscle during the action of insulin is suggested by various observers.[4]

The muscles were rapidly dissected from one hind limb of a rabbit immediately after stunning, and frozen to a brittle mass with liquid air. After thorough pulverization in an iron mortar, quantities of from 3 to 5 gm. each of the powdered muscle were placed in weighed vacuum tubes. After all the tubes had again been weighed, equal volumes of 0.9 per cent NaCl solution were added to each, and they were evacuated and well shaken at room temperature. At intervals of 3 to 5 minutes tubes were then taken for the determination of glycogen, free sugar, total carbohydrate, free phosphorus and lactic acid. The results of a typical experiment are shown in curve form.

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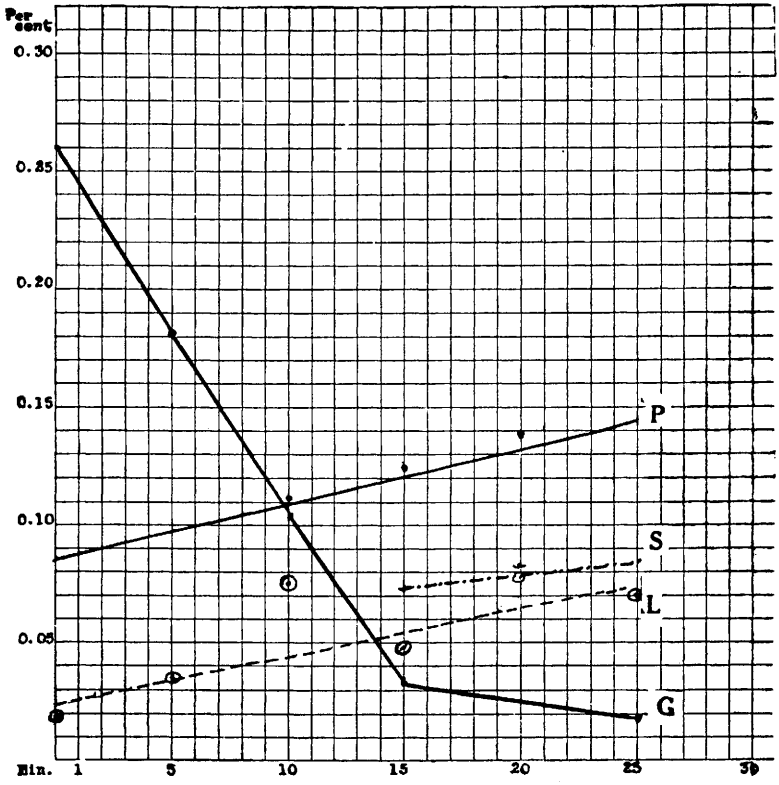
[1] Meyerhof, O., "Chemical Dynamics of Life Phenomena," Lippincott, 1925.

[2] Hill, A. V., "Muscular Activity," Williams & Wilkins, Balt., 1925.

[3] Andrews, S., Beattie, F., and Milroy, T. H., *J. Physiol.*, 1924-25, lix, *Proc.* 13.

[4] Embden, G., and Laquer, F., *Zeit. f. Phys. Chem.*, 1914, xciii, 94. *Ibid.*, 1917, xcviii, 181; *ibid.*, 1921, cxiii, 1.



The free sugar in this particular experiment was that found in the Schenck filtrate, but the results are the same in numerous others in which the sugar was dissolved out from the muscle by 80 per cent alcohol.

The most striking result is the very rapid disappearance of glycogen. This has been found in numerous experiments to occur invariably, and it indicates among other things that extreme care must be taken when determining the glycogen content of mammalian muscle, to work with great speed. In similarly treated liver, glycogen disappears very much more slowly, by a process which is evidently of an entirely different nature from that occurring in muscle. The lactic acid and the free phosphorus and the sugar increase slowly and steadily, from the moment of thawing, so that rapid disappearance of glycogen must be due to its conversion into some intermediary form of carbohydrate (lower dextrin?), and the process by which phos-

phoric and lactic acids are derived from this must be one that is quite independent of that by which the glycogen itself is broken down.

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Experimental relaxation of the pubic ligament of the guinea pig.

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The extraordinary separation of the pubic bones of the guinea pig in late pregnancy has been recorded by several investigators. Todd[1] has made the most recent contribution to this subject and has thoroughly discussed previous research as well as described the gradual changes that take place at the symphysis during normal pregnancy and the subsequent return to the post-parturient condition typical of multiparous females. The writer has been interested in this phenomena for the last four years, chiefly from the standpoint of its physiological explanation and possible correlation with a similar condition which has been studied in the pocket gopher.[2] In the pocket gopher the pubic bones are resorbed at the symphysis before pregnancy occurs, and the reaction is governed by the ovary, while in the guinea pig relaxation of the pubis occurs during pregnancy and little or no bone is resorbed, but the connective tissue at the symphysis is greatly increased, allowing a marked separation of the bones.

It has been possible to produce changes in the pubic ligament of virgin guinea pigs by experimental procedure and these are apparently identical with those occurring normally during pregnancy. If 2 cc. of blood serum of pregnant rabbits or guinea pigs are injected subcutaneously into virgin guinea pigs during early post oestrum a noticeable relaxation of the pubic ligament can be discerned within six to eight hours by movements at the

[1] Todd, T. W., *Am. J. Anat.*, 1923, xxxi, 345-357.

[2] Hisaw, F. L., *J. Exp. Zool.*, 1925, xlii, 411-441.