tion of 0·82 per cent concentration has a relative viscosity of 52; on addition of potassium chloride to 0·1 *M* the viscosity falls to a value of 3·3 and flow-birefringence disappears. Both in absence and presence of salts the protein precipitates at *p*H 4·5–5 and redissolves below *p*H 4·2. Its solubility above *p*H 6 is not affected by heat treatment at any *p*H, nor is it rendered insoluble by organic solvents, strong urea solutions or trichloroacetic acid.

The fibrous character of the protein is indicated by the high frictional ratio of 3·1, the high viscosity, and the X-ray investigations carried out by Prof. W. T. Astbury and Mr. L. C. Spark. These latter reveal that tropomyosin belongs to the keratin-myosin-fibrinogen group. A dried film photographed with the X-ray beam perpendicular to the surface gives a disoriented pattern of the α-type in which the 5·1 A. spacing is unusually clear and strong, while the same film photographed with the beam parallel to the surface gives a partially oriented fibre pattern. The α-fold appears to survive treatments (such as stretching or squeezing in the cold moist state) which generally bring about the α-β transformation, but it is found that a strong β-pattern appears on heating to 105° or on squeezing between pieces of plate-glass that have first been heated in steam; and in the β-films produced by the latter method, not only do the main chains tend to lie parallel to the film, but also the side chains tend to stand perpendicular to the film, just as has been observed with keratin and myosin.

Tropomyosin contains no phosphorus, carbohydrate or hexosamine. Its amino-acid composition resembles that of myosin itself, especially with respect to the monoamino-monocarboxylic acids, determined chromatographically by Dr. G. R. Tristram. Differences are found in the high lysine nitrogen (18 per cent of the protein nitrogen as compared with 12·6 per cent for myosin), in the lower amide nitrogen (4·94 per cent, as against 7·2 per cent) and in the complete absence of tryptophan. The dicarboxylic acids, as yet undetermined, must be equivalent to the total base plus amide-nitrogen since the isoelectric point is in the acid *p*H range. It seems probable indeed that tropomyosin is unique among proteins in carrying the highest known valence both of positive and negative type. This property is obviously related to the aggregation phenomena implied by the high viscosity of tropomyosin in absence of salt.

The function of tropomyosin is as yet unknown. Since it is not present in the sarcoplasm it would appear to be associated with the fibril itself, where it is firmly bound either to the myosin or to some other structural component or to both. Though water-soluble after isolation, it is only extracted by salt solutions from ethanol-treated muscle, and without the latter treatment only partial extraction is possible. These facts suggest that *in situ* it forms an insoluble complex both with lipid and with protein, possibly myosin, from which it is liberated by a process of metathesis in presence of salt. The amount extracted is a linear function of salt concentration up to $\mu = 1$, and thereafter is maximal. The yield from rabbit skeletal muscle is 0·5 gm./100 gm. wet muscle weight, and rather more (1 per cent) in the case of very young animals.

The exact relation of tropomyosin to myosin itself is equally obscure, but the analytical and structural similarities indicate that it is a species of myosin differing mainly in the length of the polypeptide chain. In proposing the present name, we have deemed it desirable to retain the word 'myosin' and to add a prefix which suggests this specific relationship. Experiments have shown that tropomyosin is not derived from myosin itself by the disaggregation of denatured myosin in presence of salts, nor by any kind of post-mortem catheptic activity. 'Purified' myosin (that is, three times precipitated) itself contains about 0·1 per cent of tropomyosin, but the association is probably fortuitous; and current experiments do not indicate that it is responsible for the adenosinetriphosphatase activity of the myosin complex. It may conceivably be a precursor of myosin, a fragmentary chain used in the elaboration of the gigantic myosin molecule. It should be noted that the protein is unrelated to the actin preparations of Straub[1], for which no criteria of homogeneity have been advanced; unlike tropomyosin, these are susceptible to denaturing processes and show an increased rather than a decreased viscosity on addition of salt.

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Absence of Pseudo-Cholinesterase from the Tissues of Ruminants

In a previous paper[1] it was mentioned that the non-specific or pseudo-cholinesterase is absent from the blood and tissues of ox and sheep. Although the experiments with blood were conclusive[2], an observation, difficult to interpret at that time, was made with one of the tissues examined, namely, beef kidney. This tissue was found to be capable of hydrolysing benzoylcholine, a compound suggested by Mendel, Mundell and Rudney[2] as a substrate suitable for measuring the activity of pseudo-cholinesterase. The activity towards this substrate, however, proved to be resistant to a concentration of eserine which inhibits the pseudo-cholinesterase in other mammalian tissues—a fact which made it appear unlikely that the enzyme in beef kidney was a pseudo-cholinesterase.

Sawyer's demonstration of the existence of an esterase capable of hydrolysing benzoylcholine[3] offers an adequate explanation for this discrepancy. Benzoylcholine esterase, which, according to Sawyer, is present in the liver of certain rodents, hydrolyses benzoylcholine but not acetylcholine. Recent experiments in this laboratory[4] have shown that benzoylcholine esterase is not inhibited by 2×10^{-8} *M* eserine, a concentration which inhibits the activity of pseudo-cholinesterase. Experiments based on this finding reveal that the hydrolysis of benzoylcholine by beef kidney is due to benzoylcholine esterase, since the activity of this tissue towards benzoylcholine is insensitive to eserine in the above-mentioned concentration.

Other tissues of ox and sheep which, by their inability to hydrolyse benzoylcholine, were shown to contain no pseudo-cholinesterase are liver, spleen, pancreas, muscle (Masseter), gastric mucosa, intestinal mucosa, thyroid gland, parotid gland, adrenal gland, sublingual gland, lachrymal gland.

The fact that pseudo-cholinesterase, previously shown to be absent from brain tissue throughout the animal kingdom[5], has now been found to be absent from the tissues of ox and sheep, is a further indication of the irrelevance of this enzyme to the process of nerve impulse transmission.

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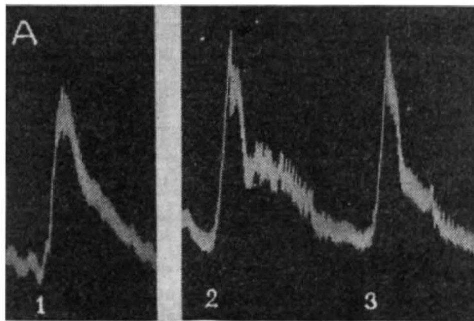
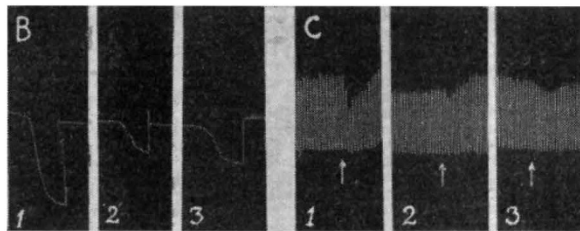
A Substance with Sympathin E Properties in Spleen Extracts

ALCOHOLIC extracts of fresh spleen from cattle contain high amounts, up to 10 μgm. adrenaline equivalents per gm. tissue, of a cardio-accelerator and blood-pressure raising substance, showing the characteristic properties of a sympathomometic catechol compound[1]. The active substance was taken up in an ether solution of organ lipids and extracted from this with a 5–10 per cent solution of sodium sulphate. A further purification was attained by treatment with sublimate in alcohol, which left the active substance in the filtrate. The purified extract was found to differ from adrenaline in the following respects. Ergotamine, in a dose which inhibited or reversed the action of adrenaline, was not equally effective in inhibiting the pressor action on the cat's blood-pressure; the isolated uterus of the virgin or non-pregnant cat was rather less inhibited than by an equipressor dose of adrenaline, and the same applied to the isolated intestine of the rabbit. The relative dilating effect on the iris was considerably greater with adrenaline. Whereas equipressor doses of adrenaline and the spleen pressor substance gave similar catechol reactions with ferric chloride, the fluorescence reaction in alkaline solution[2] was absent in purified spleen extracts. The active substance in spleen thus conforms better with an amino-base, such as *nor*-adrenaline, than with adrenaline.





A, BLOOD PRESSURE, CAT; *B*, ISOLATED VIRGIN CAT'S UTERUS; *C*, ISOLATED RABBIT'S JEJUNUM; 1, 2 μGM. ADRENALINE; 2, 0·1 PURIFIED SPLEEN EXTRACT; 3, 2 μGM. 3,4-DIHYDROXY-*nor*-EPHEDRINE.

Direct comparison of equipressor doses of adrenaline (I), 3,4-dihydroxy-*nor*-ephedrine (II) and spleen extracts (III) with regard to biological tests, colour and fluorescence reactions gave much closer agreement between (II) and (III) than between (I) and (III) (see figure). Dioxy-*nor*-ephedrine, on the other hand, is similar in action to the amino-base *nor*-adrenaline, which in its turn closely resembles the effect of stimulation of certain adrenergic nerves[3]. The good agreement between the action of purified spleen extracts, *nor*-adrenaline and the mediator of hepatic nerve stimulation[4] suggests, first, that the active substance in spleen is closely related to *nor*-adrenaline, and, secondly, that the spleen substance is, in fact, the postulated sympathin E.

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