comes a critical factor, determining the response of the wall as a whole to NA. Although the special architecture of the aortic arch makes it difficult to determine in situ the exact longitudinal tension of the wall, the present results seem to indicate that the response of the aortic arch to NA does not differ considerably from that observed in other aortic segments, if we accept that the longitudinal tension applied to the archs of group 3 (52.5 g) was the most closely related to the actual values. It is interesting to point out that a longitudinal tension of 55 g was applied to the descending thoracic aorta in order to restore in situ the full length of previously excised segments[15].

The increase in distensibility has been explained on the basis of structural peculiarities[16], whereby the NA-induced contraction of the smooth muscle fibres would result in a reduction of the tension of the more fibrous, less distensible component of the vascular wall, so that the smooth muscle, which is more distensible, would determine the shape of the P-V curve.

Since the baroreceptors can be stimulated in a different way depending on the distensibility of the aortic wall, it is conceivable that changes in distensibility induced by the NA release of efferent fibres in the aortic arch could provide a mechanism for efferent control of the receptors activity. Alternatively, they could provide a system which would adapt the arterial tree impedance to variable cardiac output and heart rate during sympathetic stimulation[17].

[15] D. J. Patel and D. L. Fry, Circulation Res. *24*, 1 (1969).
[16] A. C. Burton, Physiol. Rev. *34*, 619 (1954).
[17] M. G. Taylor, Gastroenterology *52*, 358 (1967).

Influence of Gonadal Hormones on the Developing Amphibian Brain: Changes in Ribonucleic Acid, Protein and Activity Levels of Acetylcholinesterase on in vivo Administration of Progesterone

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Summary. The levels of RNA and protein and activity levels of acetylcholinesterase decreased in the brain of developing tadpoles of 13–15-day-old *Bufo melanostictus* on in vivo administration of progesterone (200 µg/0.1 ml refined peanut oil). These changes suggest decelaration in the activity of the protein-synthetic machinery in progesterone administered animals.

There are a large number of reports showing changes in the content and/or composition of RNA of the neural tissue of vertebrates under a wide variety of conditions[2–7]. For instance, the cytoplasmic RNA amount increases after excitation of nervous activity and decreases after inhibition of nervous activity, intoxication, and pathogenic action in mammals[2]. Increase of neuronal and glial RNA has been described in diseased areas associated with Parkinsons disease in rats[3].

Evidence is accumulating that various hormones affect the process of protein synthesis in the CNS of vertebrates at the translation level. For instance, steroid hormones are known to influence the protein synthesis by acting on the DNA – guided formation of RNA in the brain of rats[8, 9].

However, information is lacking on steroid hormone regulation of protein synthesis. Since gonadal steroids have an organizing influence on CNS centres during critical periods of development in vertebrates[2], the present study was proposed. The paper presents information about the effects of in vivo administration of progesterone on the levels of RNA and protein in the brain of a developing toad, *Bufo melanostictus*. Since manipulation of the hormonal environment in the early neonatal period affects the brain excitability, the activity levels of acetylcholinesterase as a function of progesterone administration were determined in the CNS of developing tadpoles.

Materials and methods. About 2-week-old tadpoles of *B. melanostictus* were collected locally and maintained in the laboratory at 24 ± 1 °C in glass aquaria. They were fed on water plants for a period of 3 days before they were utilized for experimentation. From this stock,

Changes in the levels of RNA, protein and activity level of acetylcholinesterase (AchE) in the brain of developing *Bufo melanostictus* on in vivo injection of progesterone

Constituent	Controls (normal active animals)	Experimentals injected with progesterone	Incidence of change
RNA (mg/g wet wt.)	20.7 ± 3.5[a] (3)	7.5 ± 1.3[a] (4)	− 64.6
Protein (mg/g wet wt.)	120 ± 6.1[a] (3)	96.0 ± 8.5[a] (3)	− 20.0
AchE µmol Ach (mg/min)	5.45 ± 38[a] (4)	3.6 ± .44[a] (4)	− 34.6

Figures in parentheses indicate the number of pools-observations Values are mean ± SD. For each observation tissue from 16–18 animals was pooled. Sign (−) indicating decrease over controls. [a] Significant $p < 0.01$.

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[2] A. Lajtha, *Handbook of Neurochemistry* (Plenum Press, New York 1971), vol. 6.
[3] G. Gomirato and H. Hyden, Brain *86*, 773 (1963).
[4] A. Lajtha, in *Regional Neurochemistry* (Eds. S. S. Kety and J. Elkes; Pergamon Press, Oxford 1961), p. 25.
[5] A. Lajtha, Int. Rev. Neurobiol. *6*, 1 (1964).
[6] A. Lajtha, Int. Rev. Neurobiol. *7*, 1 (1964).
[7] Nayeemunnsia, Experientia *31*, 942 (1975).
[8] R. Balazs, S. Kovacs, P. Teichgraber, W. A. Cocks and J. T. Eayrs, J. Neurochem. *15*, 1335 (1968).
[9] S. Gelber, P. L. Campbell, G. E. Deibler and L. Sokoloff, J. Neurochem. *11*, 221 (1964).

actively feeding, approximately same sized individuals were chosen for analyses. Commercially available progesterone (supplied by the Patel Chest Institute, Delhi), was injected (200 µg hormone in 0.1 ml refined peanut oil) into experimental animals in the vicinity of the brain. The controls were injected with 0.1 ml refined peanut oil alone. Injections were given in the early hours of the morning. Brain tissue, pooled from 16 to 18 animals at 0 °C (weighing 8 to 10 mg), was weighed in ice-cold Ringer[10], and analyzed 2 h after injection, for the estimations of total protein following the micro Biuret method[11].

RNA was extracted by the method of SCHMIDT-THANNHAUSSER-SCHNEIDER[12] and estimated by orcinol colour reaction following the colorimetric procedure described by GLICK[13].

Acetylcholinesterase (AchE, E.C.3.1.1.7). The tissues were homogenized in ice-cold 0.02 *M* phosphate buffer, pH 7.0. They were centrifuged for 30 min at 6,000 rpm and the supernatant was used for assay. AchE activity was determined spectrophotometrically by the method of HESTRIN[14].

Results and discussion. It is obvious from the data presented in the Table that the protein content decreased ($p < 0.01$) in the brain on in vivo administration of progesterone. Paralleling the decrease in proteins, RNA levels also decreased significantly as a function of progesterone injection (Table). The decrease in the level of proteins of the CNS of progesterone administered tadpoles appears to be the direct consequence of the protein destructive nature of progesterone[15,16]. It is also possible that such a decrease may be due to a change in protein synthesis. Significant decrease in RNA level observed in the brain of tadpoles on in vivo administration of progesterone, also points to deceleration in the activity of the protein-synthetic machinery in progesterone administered animals.

The significant decrease in the activity levels of acetylcholinesterase in the developing amphibian (Table) on injection of progesterone may be the direct consequence of proteine destructive action of progesterone as stated earlier[16]. It is therefore possible that the decrease in the activity levels of acetylcholinesterase is a reflection of the decrease in the enzyme synthetic processes caused by the progesterone administration.

[10] G. M. CAVANAUGH, *Formulae and Methods* (Marine Biological Laboratory, Woods Hole, Mass. 1956).
[11] R. F. ITZHAKI and D. M. GLICK, Analyt. Biochem. *9*, 401 (1964).
[12] SCHMIDT-THANNHAUSSER-SCHNEIDER, (1957).
[13] D. GLICK, *Methods of Biochemical Analysis* (Interscience Publishers, New York 1964), vol. 1.
[14] S. HESTRIN, J. biol. Chem. *180*, 249 (1949).
[15] K. SHAKUNTALA and NAYEEMUNNISA, Indian J. exp. Biol. *12*, 451 (1974).
[16] C. L. PROSSER and F. A. BROWN, *Comparative Animal Physiology* (W. B. Saunders, Philadelphia 1962).

The Tension/Length Relationship of an Insect (*Calliphora erythrocephala*) Supercontracting Muscle

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Summary. The tension/length curves of an insect supercontracting striated muscle are described. Both vertebrate and invertebrate smooth (non-striated) muscles show a close similarity to these curves. Thus, although insects possess only striated muscle, some of these muscles can perform the function of smooth muscle of other animals.

It has often been stated that insects posses only striated muscle[3,4]. Thus these animals do not appear to have any muscles which are structurally equivalent to the smooth (non-striated) muscles of other invertebrates and vertebrates. This lack of smooth muscle might be expected to impose limitations on the range of physiological type of muscle in insects. In particular, the functioning of the isotonic visceral muscles would be restricted. However, it was the isotonic body-wall muscles of the blowfly larva that provided an explanation of how certain striated muscles of insects could perform the type of activity more usually associated with smooth muscle[5,6]. These muscles possess perforated Z discs; at short sarcomere lengths the thick and thin myofilaments penetrate the Z perforations and enter adjacent sarcomeres (Figure 1). Thus it is possible for this type of sarcomere to contract down to below A band length with no concomitant change in myofilament length. This phenomenon of 'supercontraction' of striated muscle was first observed in molluscs[8], and has also been reported in chelicerates[9,10] and in vertebrates[11]. Reversible contraction has been observed down to lengths much shorter than those possible for 'classical' striated muscles with solid Z discs (22% of initial length in blowfly muscle[5]; < 30% of initial length in barnacle muscle[8]). However, there are no detailed reports in the literature of the tension/length relationship of this type of muscle.

Figure 2 shows the tension/length curves of a supercontracting bodywall muscle fibre from a blowfly larva. Active tension is produced during a change in fibre length from 0.47 mm to 2.19 mm (a 79% length change). Optimum length (muscle length where maximum active tension is developed) is 1.25 mm while passive tension is first recorded at approximately 0.8 mm and increases at greater lengths. It was not possible to measure a meaningful, in vivo resting length due to the usual difficulties

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[3] P. N. R. USHERWOOD, Adv. Insect Physiol. *6*, 205 (1969).
[4] H. Y. ELDER, in *Insect Muscle* (Ed. P. N. R. USHERWOOD; Academic Press, London, New York, San Francisco 1975), p. 1.
[5] M. P. OSBORNE, J. Insect Physiol. *13*, 1471 (1967).
[6] A. C. CROSSLEY, J. Insect Physiol. *14*, 1389 (1968).
[7] R. J. HARDIE, Ph. D. Thesis, University of Birmingham (1975).
[8] G. HOYLE and J. H. MCALEAR, Science *141*, 712 (1963).
[9] R. G. SHERMAN, J. Morph. *140*, 215 (1973).
[10] R. A. LEYTON and E. H. SONNENBLICK, J. Cell Biol. *48*, 101 (1971).
[11] M. J. RICE, Nature, Lond. *243*, 238 (1973).
[12] A. C. CROSSLEY, J. Embryol. exp. Morph. *14*, 89 (1965).
[13] L. H. FINLAYSON and M. P. OSBORNE, J. Insect Physiol. *16*, 791 (1970).