All the above occurrences have been interpreted by Furnish *et al.*[2] as representing the Chhidruan stage of the middle Ozhulfian Series.

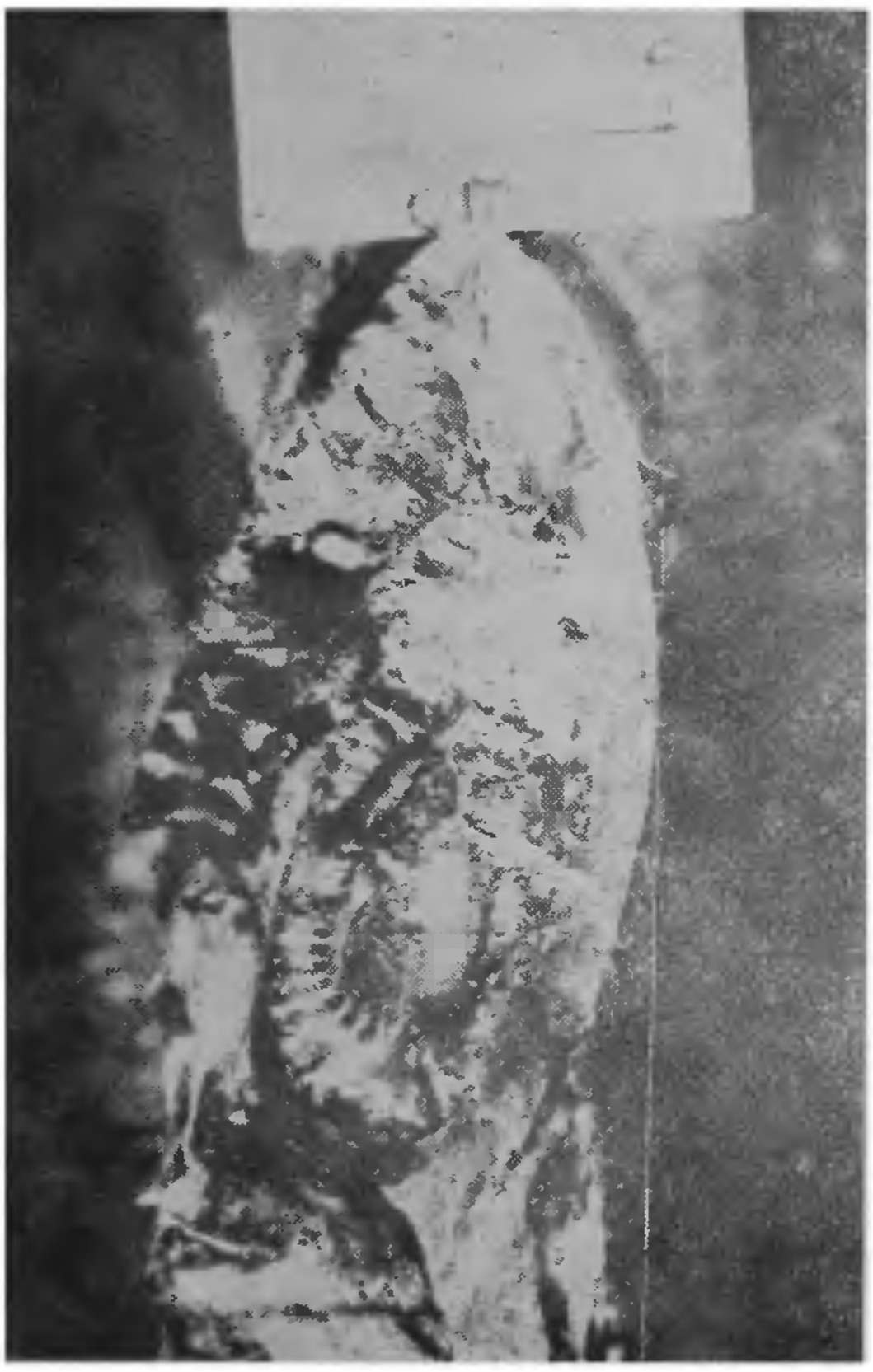

FIG. 2

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August 4, 1976.

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1. Diener, C., *Palaeont. Indica,* Ser. 15, 1903, *1 (5),* 204.

2. Furnish, W. M., Glenister, F., Nakazawa, K. and Kapoor, H. M., *Science,* 1973, 180, 188.

3. Pascoe, E. H., *A Manual of the Geology of India and Burma,* 1968, 2, 808.

DIURNAL RHYTHMIC ACTIVITY OF ALKALINE PHOSPHATASE IN THE SCORPION, *HETEROMETRUS FULVIPES*, C. KOCH.

A REVIEW of the literature has shown that dehydrogenases[1,2] and esterases[1] exhibited diurnal rhythmic activity in the scropion, *Heterometrus fulvipes*, C. Koch. In view of the existence of diurnal variations in the scorpion, it is of interest to find whether such changes would also occur in the activity of alkaline phosphatase (EC 3·1·3·1), an enzyme that catalyzes the hydrolysis of phosphamides and compounds other than simple orthophosphoric acid monoesters[3]. Hence an attempt has been made to study the activity of alkaline phosphatase in different tissues of the scorpion.

The hepatopancreas, heart, pedipalpal muscle and nervous tissue were isolated from the live scorpions of similar size at six different timings of the day (*viz.*, 08·00, 12·00, 16·00, 20·00, 00·00 and 04·00 hrs.) The tissues were immediately transferred to pre-chilled glass tubes and 2% (w/v) homogenates were prepared in 0·25 M ice-cold sucrose solution and centrifuged at 2500 rpm for 10 min; 0·4 ml of each supernatant, containing 8 mg. of tissue, was assayed for the alkaline phosphatase activity by the method of Fiske and Subba Rao as given by Oser[4].

Figure 1 indicates that, in general, the enzymic activity on the basis of gram weight of tissue followed the order hepatopancreas > heart > pedipalpal muscle > nervous tissue. The enzyme exhibited maximal

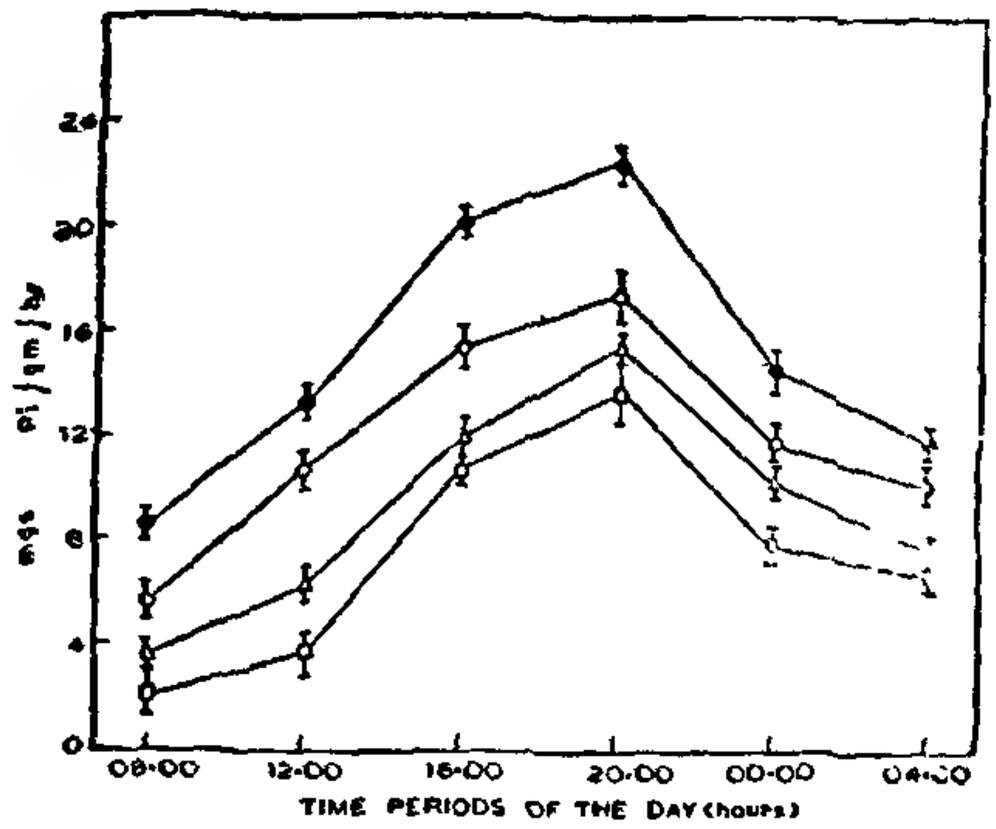

FIG. 1. Diurnal rhythmic activity of alkaline phosphatase in different tissues of the scorpion. (Values, expressed as mgs pi/gm/hr, are mean ± S.D. of five observations.)

●—● Hepatopancreas; O—O Heart;
△—△ Pedipalpal muscle and
□—□ Nervous tissue.

activity at 20·00 hr. and minimal activity at 08·00 hr. of the day (Fig. 1). The higher levels of enzymic

activities might be due to the increased locomotor activity[5], and metabolism[2]. Morover, these results are in agreement with the earlier investigations on dehydrogenases[1,2] and esterases[1]. Based on these observations it may be suggested that the alkaline phosphatase activity followed a regular circadian rhythm.

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1. Devarajulu Naidu, V. and Padmarabha Naidu, B., *Ind. J. Exp. Biol.*, 1976, 14, 1.
2. Venkateswara Rao, P. and Govindappa, S., *Proc. Ind. Acad. Sci.*, 1967, 66 B (6), 243.
3. Burstone, M. S. In: *Enzyme Histochemistry and its Applications in the Study of Neoplasms*, Academic Press, New York and London, 1962, p. 166.
4. Oser, B. L., *Hawk's Physiological Chemistry*, McGraw-Hill Book Company, New York, 1965, p. 636.
5. Gopalkrishna Reddy, T., *Thesis*, Sri Venkateswara University, Tirupati, 1967.

A COMPARATIVE STUDY OF THE EFFECTS OF PALMITATE AND ACETATE FORMS OF VITAMIN A ON TOAD TADPOLES

VARIOUS forms of vitamin A given in excess differ in their toxicity and biological effects produced[1-3]. In studies on amphibians also different forms of this vitamin are found to vary in their effect[1]. The present study was undertaken to compare the effect of the two esters of vitamin A, palmitate and acetate, on the tadpoles of *Bufo andersonii* Boulenger of identical age in equal periods of time. Two age groups of the tadpoles, 4 and 7 days old after hatching from the same spawn, were divided into groups of 50 individuals each. One group each was reared in solutions containing 1, 5, 10, 15, 20 and 30 I.U./ml of vitamin A palmitate (Arovit-Roche) and vitamin A acetate (Glaxo) and in tap water (controls). Known quantities of the vitamins were dissolved in small amounts of ethanol and the solutions were then diluted with water to the required concentrations. The animals were transferred to fresh media every two days and fed maximally with boiled spinach. The experiments carried out at room temperature lasted for 10 days in each case.

The numbers surviving on the 10th day in each experiment are shown in Table I. The older tadpoles were in general much more tolerant to the toxic effects of the two vitamins as compared to the younger ones. However, the acetate was far more toxic than the palmitate for both age groups. Even in 1 I.U./ml solution of the acetate only 72 to 76% of the two age groups survived the 10 days treatment and in concentrations of 15 I.U./ml and higher all or nearly all died during the same period. On the contrary, in all palmitate treated groups of 7 days old tadpoles the least number surviving in even the highest concentration of the drug was still as high as 74%. Even among the younger larvae the survivors on 10th day were less than 50% when the palmitate concentration was 20 I.U./ml; but the next higher concentration of this form also was extremely lethal to this age group. Most mortality occurred earlier in the acetate than in the palmitate treated groups.

TABLE I

Percentage of Bufo andersonii *tadpoles surviving after* 10 *days of treatment with vitamin A palmitate and vitamin A acetate*

Rearing medium	% of survivors on Day 10			
I.U. of vitamin A/ml	4 days old tadpoles		7 days old tadpoles	
	Palmitate treated	Acetate treated	Palmitate treated	Acetate treated
Nil (water—controls)	100		100	
1	100	72	100	76
5	100	42	96	50
10	100	2	98	18
15	96	0	84	2
20	44	0	82	0
30	4	0	74	0

The two esters affected the tadpoles in various other ways also but not identically. Growth of the larvae was retarded by both but it was particularly noticeable in the tadpoles treated by even a low concentration, 5 I.U./ml, of the acetate (Figs. (1*a–c*) which also caused severe haemorrhage in the head region and curving of the tail. Both acetate and palmitate produced general oedema and some depigmentation particularly of the head and branchial regions. However, while these changes occurred in tadpoles at high concentrations (15 I.U./ml and more) of palmitate, even low amounts of acetate produced similar effects; but higher concentrations of the acetate did not cause any noticeable changes of this nature. The tadpoles treated with 15–30 I.U./ml palmitate secreted large quantities