while germinal zones of the testis and ovary were completely devoid of this enzyme (figure 4). Manifesting diffuse reaction in different parts of the body including reproductive organs, α-glycerophosphate dehydrogenase activity was relatively more intense in the distal part of the musculature and digestive tract (figure 5).

The localization of TCA cycle enzymes and hydrolytic enzymes in various organs have been reported in *Litomosoides carinii, Setaria cervi, Diplotriaena tricuspis, Ascaris lumbricoides, Trichuris muris*[2–6]. Biological significance and apparent involvement of these constituents in the energy metabolism of the parasite have already been demonstrated by histochemical and biochemical procedures by various investigators[7–9]. According to Bell and Manners[10] the enzymatic synthesis by helminth tissues follows the same pattern as demonstrated for vertebrate tissues.

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1. Pearse, A. G. E., *Histochemistry: theoretical and applied*, 2nd ed., J. and A. Churchill, London, 1960.
2. Maki, J. and Yanagisawa, T., *J. Helminthol.*, 1980, **54**, 39.
3. Khatoon, H. and Baqui, A., *Helminthologia*, 1981, **18**, 259.
4. Wajihullah and Ansari, J. A., *Riv. Parasit.*, 1983, **44**, 253.
5. Lee, D. L., *Nature (London)*, 1961, **192**, 282.
6. Reznik, G. K., *Trudy Vses. Inst. Gel'mint.*, 1977, **23**, 103.
7. Van den Bossche, H., In: *Comparative biochemistry of parasites*, New York and London, Academic Press, 1972.
8. Walter, R. D., *Ztschr. Tropenmed. Parasit.*, 1979, **30**, 463.
9. Anwar, N., Ansari, A. A., Ghatak, S. and Krishnamurti, C. R., *Z. Parasitenkde.*, 1977, **51**, 275.
10. Bell, D. J. and Manners, D. J., *J. Chem. Soc.*, 1954, p. 1891.

MITOSIS AND MEIOSIS IN TWO SPECIES OF MOSQUITOES

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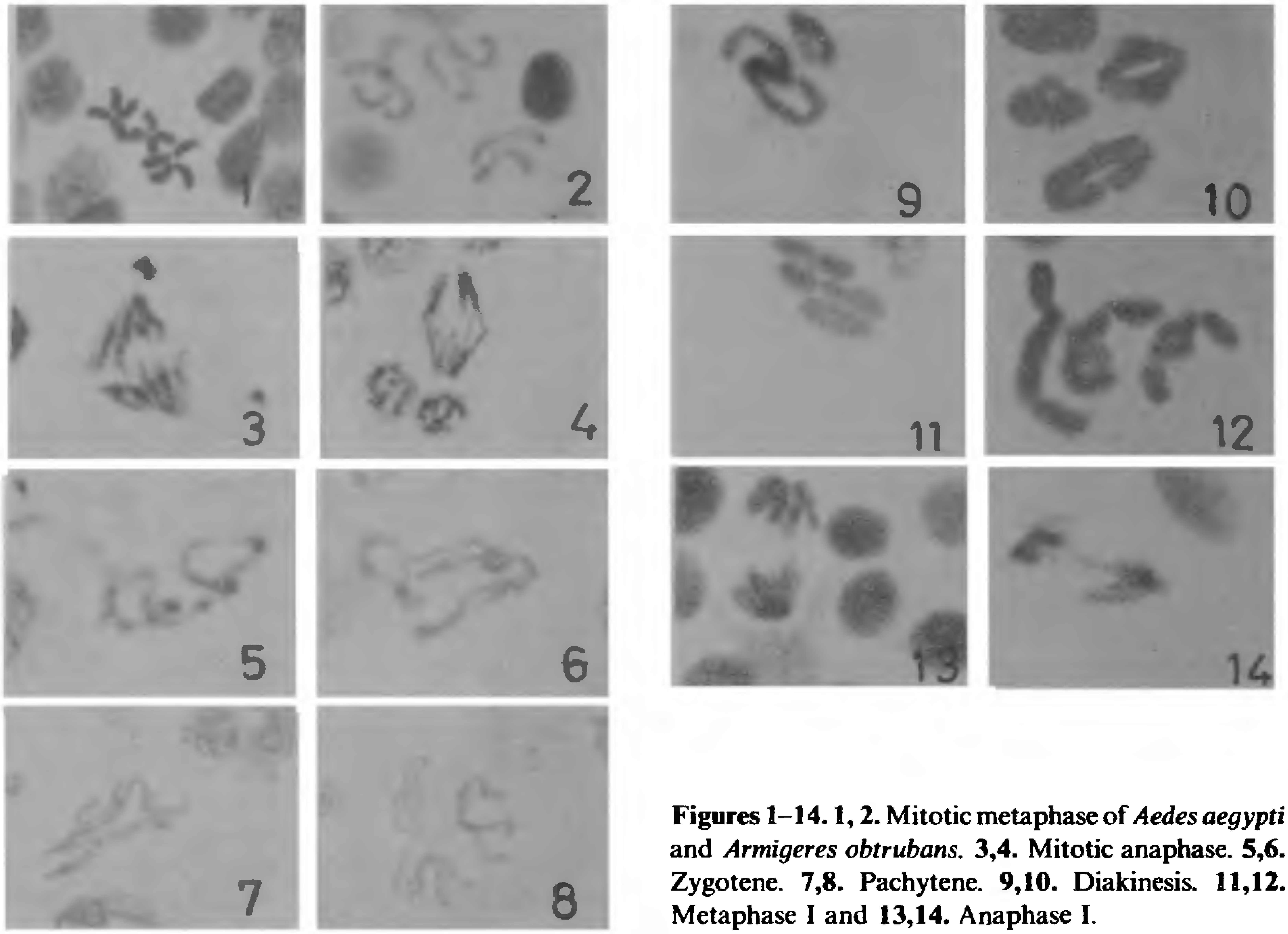
ALTHOUGH chromosomes of several dipteran species are known for a long time, their studies in mosquitoes are of recent origin. The general cytogenetic interest, however, has centred on species-specific chromosome number and their behaviour during cell division with a view to understanding the karyotypic evolution among this group[1–3]. *Aedes aegypti*, a vector for both Dengu and Yellow fever and *Armigeres obtrubans*, a vector for Malaria, belong to the tribe Aedini, under subfamily Culicinae of the family Culicidae[4]. It was considered worthwhile to study the chromosomes of these two species from the point of view of medical entomology as vectors, and their behaviour during cell division.

The strains of *A. aegypti* and *A. obtrubans* were collected from local populations. Mitosis was studied from the neuroblast cells of late third instar larvae and meiosis from the testes of early pupae. The tissues were dissected in Shen's physiological saline and fixed in 1 : 3 acetic acid : methanol. They were then stained and squashed in lacto-aceto-orcein[1]. The somatic metaphases contained 6 metacentric chromosomes in both the species studied (figures 1, 2). During prophase, the chromosomes begin to condense, appearing as a network of coiled threads. During metaphase the chromosomes are maximally condensed with smooth surfaces arranged on the equator by their centromeres. The homologous chromosomes, during this stage, lie so close that the chromatids of each chromosome were not distinguishable. During the onset of anaphase the chromosomes repel each other and progress synchronously towards the poles (figures 3, 4). The repulsion seems to be initiated at the centromeric region so that the chromosomes appear 'V'-shaped.

Unlike as reported for most mosquito species[5–7], the first recognisable stage during the meiosis of these species was the zygotene stage (figures 5, 6). Pairing is clearly evident and the chromosomes show gradual condensation. The formation of chiasma is well observed as the cells enter pachytene (figures 7, 8). The homologues contract further as they enter into diplotene. With centromeric repulsion, the two homologues separate from each other except at the points where crossing over has probably occurred. During



Figures 1–14. 1, 2. Mitotic metaphase of *Aedes aegypti* and *Armigeres obtrubans*. **3,4.** Mitotic anaphase. **5,6.** Zygotene. **7,8.** Pachytene. **9,10.** Diakinesis. **11,12.** Metaphase I and **13,14.** Anaphase I.

diakinesis (figures 9, 10) the bivalents become all the more condensed and the chiasmata gradually terminalise. Each bivalent bears a pair of chiasmata and they appear to have originated interstitially. As in other mosquito species[5,7,8], the terminalisation is usually incomplete at metaphase-I (figures 11, 12). As polarisation continues the chiasmata free the homologues and the same enters into anaphase-I. In *A. obtrubans*, all the chromosomes move to the poles in synchrony (figure 13), however, in *A. aegypti*, of the three pairs of chromosomes, one pair of the homologues seems to take a slightly longer time for the separation of its members (figure 14). The second meiotic division appears to be normal.

All mosquitoes so far studied[9] except, for the genus *Corethra* where the $2n = 8$[10], have a $2n = 6$. Since among the mosquitoes the $2n = 6$ has been obtained in different genera like the *Anopheles*, *Culex* and *Aedes* and the chromosomes are mostly biarmed, it may be argued that the mosquitoes have a primitive modal number of six with chromosomes originally biarmed. Mescher and Rai[6] reported that the smallest pair of bivalents consistently separates first during anaphase-I in *A. aegypti*. However, we find that the diads of one of the bivalents take a longer time to separate. But the exact reason for such delay is not very clear.

Although Craig *et al*[11] and Hickey and Craig[12,13] have concluded that the males of *A. aegypti* contain a heteromorphic sex pair X and Y, we have not been able to make such an observation. On the other hand, as McClelland[14] and Motara[15] have argued, probably the sex in mosquitoes is determined by a small segment of a chromosome by a block of genes.

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1. Breland, O. P., *Ann. Entomol. Soc. Am.*, 1961, **54**, 360.
2. Kitzmiller, J. B., *Bull. WHO*, 1963, **29**, 345.
3. Rai, K. S., *Ann. Entomol. Soc. Am.*, 1963, **56**, 160.
4. Ramchandra Rao, T., *The Anophelines of India*,

ICMR, New Delhi Publication, 1981.
5. Breland, O. P., Gasser, G. III and Riemann, J. G., *Ann. Entomol. Soc. Am.*, 1964, **57**, 472.
6. Mescher, S. A. L. and Rai, K. S., *Mos. News*, 1966, **26**, 45.
7. Asman, S. M., *J. Med. Entomol.*, 1974, **2**, 375.
8. Akstein, E., *Bull. Res. Counc. Israel*, 1962, **B11**, 146.
9. McDonald, P. T. and Rai, K. S., *Genetics*, 1970, **66**, 475.
10. White, M. J. D., *Animal cytology and evolution*, Cambridge, Univ. Press, 1973.
11. Craig, G. B. Jr., Hickey, W. A. and Vandehey, R. C., *Science*, 1960, **132**, 1887.
12. Hickey, W. A. and Craig, G. B. Jr., *Can. J. Genet. Cytol.*, 1966a, **8**, 260.
13. Hickey, W. A. and Craig, G. B. Jr., *Genetics*, 1966b, **53**, 1177.
14. McClelland, G. A. H., Ph.D. Thesis, Univ. of London, 1962.
15. Motara, M. A., *The Nucleus*, 1982, **25**, 113.

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Madurai Kamaraj University, Madurai has awarded the D.Sc., Degree in Biological Sciences to Prof. M. K. Chandrasekhran for the thesis entitled 'Studies on Biological Rhythms'.

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