Esterase-1 patterns and genotypes of parents and offspring of 30 matings of *Peromyscus truei*

No. Pairs	Es-1 pattern of parents	Genotype of offspring			Analysis	
		100/100	100/93	93/93	χ^2	P
1	100/100 × 100/100	3	—	—	—	—
0	100/100 × 100/ 93	—	—	—	—	—
10	100/ 93 × 100/ 93	8	22	12	0.86	> 0.50
2	100/100 × 93/ 93	—	5	—	—	—
12	100/ 93 × 93/ 93	—	30	32	0.06	> 0.70
5	93/ 93 × 93/ 93	—	—	11	—	—

considered heterozygous for the 100 and 93 alleles. No other patterns were observed in this colony, in additional specimens (n = 100) from Colorado, New Mexico, Utah, and Arizona or from specimens (n = 35) analyzed by JOHNSON and PACKARD[8]. Genetic data from 123 mice from 30 laboratory matings were consistent with an hypothesis of 2 codominant alleles segregating from a single locus (Table). Furthermore, all 3 electrophoretic patterns were found in both sexes, indicating Es-1 is inherited autosomally.

Es-1 patterns in several species of *Peromyscus* have been described. Variation in Es-1 in *P. maniculatus* has been interpreted as the product of 3 alleles segregating from a single locus[9]. One of the alleles was considered a 'silent' allele and produced no electrophoretic bands. Progeny data confirmed this interpretation. A similar inheritance for Es-1 has been shown in *P. boylei*, *P. attwateri*, and *P. polius*[2,7]. A system of Es-1 inheritance similar to that of *P. truei* was found in *P. polionotus* and was considered homologous to the system in *P. maniculatus*, except no silent allele was found[1]. Es-1 patterns in *P. leucopus* have been shown to be the product of 2 alleles, 1 of which is silent, segregating from a single locus[10]. The simple inheritance and ease in detecting Es-1 in *P. truei* makes this protein useful for studying genetic variation in natural populations.

Zusammenfassung. Kreuzungsversuche und elektrophoretische Analyse der Erythrocytenesterase bei der Maus *Peromyscus truei* zeigten, dass die Homozygoten je eine Enzymbande mit unterschiedlichen Beweglichkeiten aufweisen, während bei den Heterozygoten beide Enzymbanden vorkommen, was mit der Annahme der Abspaltung von zwei kodominanten Allelen eines einzigen autosomalen Locus übereinstimmt.

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Maturation Divisions with Double the Somatic Chromosome Number in the Privet Mite *Brevipalpus obovatus*

The privet mite *Brevipalpus obovatus* Donnadieu (Fam. Tenuipalpidae = false spider mites; Acarina) reproduces by thelytokous parthenogenesis. HELLE et al.[1] found 2 chromosomes in the female embryonic tissue and assumed that the haploid chromosome number is n = 1. In order to investigate whether the 2 chromosomes form 1 bivalent during meiosis and are thus homologous, we examined the maturation divisions.

A population of *B. obovatus*, which originated from a glasshouse at Amsterdam, was received from Dr. W. HELLE and reared in our laboratory on detached leaf cultures of ivy under continuous light at 27 °C. Eggs were fixed in 1:3 acetic acid-alcohol mixture for at least 1 week, stained and squashed in aceto-ironhaematoxylin-chloral hydrate according to WITTMANN[2].

The maturation divisions are accomplished in the pointed part of the ovoid egg within 3 h after oviposition. Immediately after oviposition, the egg is in metaphase I showing 2 bivalents (Figure 1). These are ring-shaped or, in side-view, rod-shaped. The spindle is orientated parallel to the egg periphery. During anaphase I each chromatid in a dyad remains connected by a thin thread to one of the chromatids in the corresponding dyad (Figure 2). In telophase I the chromosomes despiralize partially, and a thin layer of 'elimination chromatin' is visible in the equatorial plane (Figure 3). Without passing an interkinesis, 1 pair of dyads gives rise to a metaphase II (Figure 4) and the other pair to the first polar body. The metaphase II chromosomes are situated entirely in the equatorial plane with one of the two chromatids facing one spindle pole and the other aligned to the opposite pole. The spindle is orientated obliquely to the surface. During early anaphase II, the median regions of the separating chromatids remain connected by a thread while the telomeres precede to the poles (Figure 5). One polar group of 2 chromosomes change into 2 karyomeres, being the pronucleus, the other group form the second polar body. The first polar body passes through a mitosis about simultaneously with division of the second oocyte.

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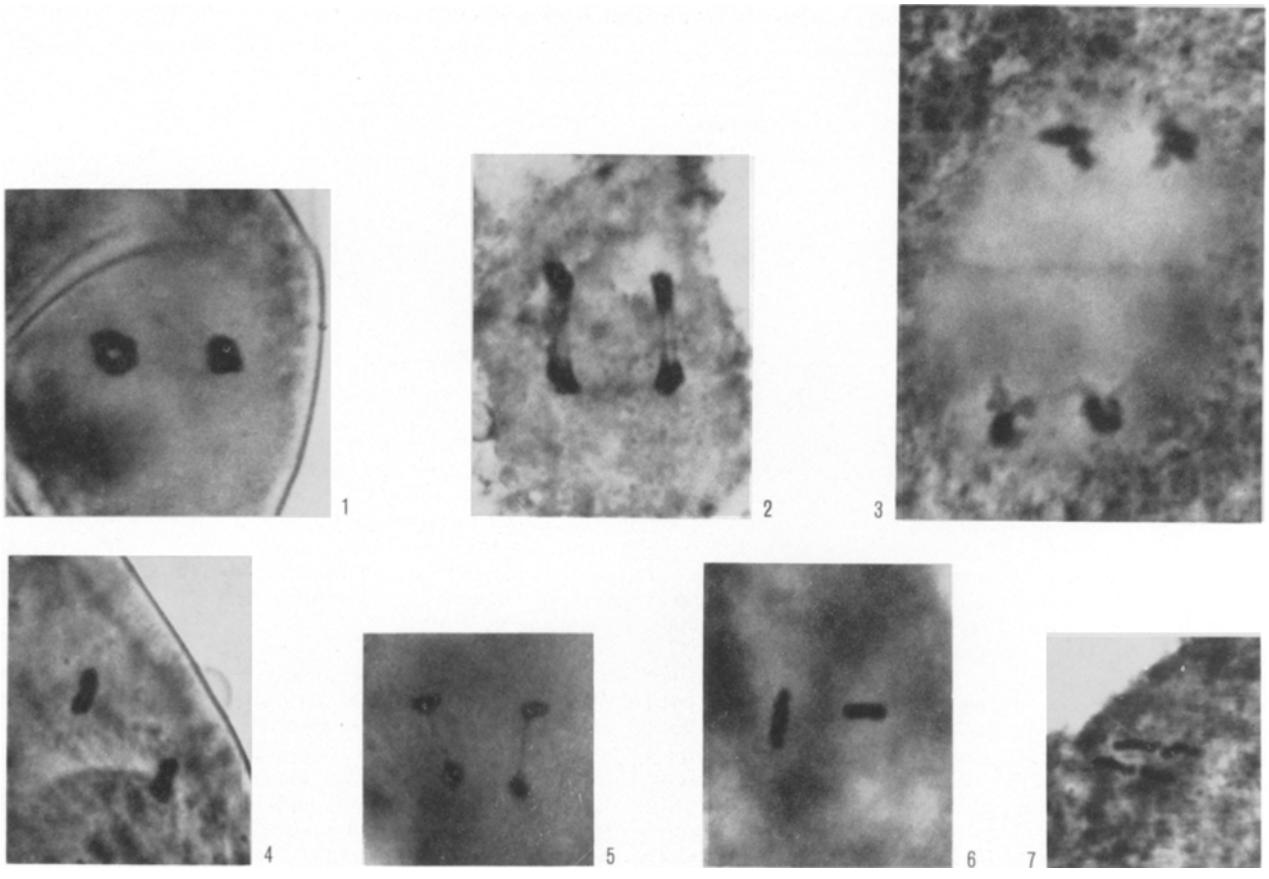

Figs. 1–7. *Brevipalpus obovatus*, squashes of eggs. ×2000. 1. First metaphase. 2. First anaphase. 3. First telophase. 4. Second metaphase. 5. Second anaphase. 6. Prometaphase first cleavage division. 7. Parallel separation of chromatids in cleavage anaphase.

The second polar body enters a mitosis which remains blocked in the metaphase. The polar bodies are expelled from the egg and start degeneration during the cleavage divisions.

The first cleavage mitosis takes place in the centre of the egg and has a set of 2 chromosomes (Figure 6). Since the cleavage divisions up to the 4th division are completely synchronous, it could be established that all the cells at the 16-cell stage contained 2 chromosomes. Also in somatic mitoses of older embryonic stages, only this chromosome number was observed, which confirms the results of HELLE et al.[1]. Movement and orientation of these chromosomes (Figure 7) occur as described for the chromosomes of the two-spotted spider mite[3], indicating the presence of diffuse kinetochores.

These observations show that two bivalents occur during metaphase I, though only one was expected. This means that an extra chromosome reduplication must take place in the female germ cells before metaphase I. As yet the exact time of the extra reduplication which can take place in parthenogenetic organisms either before or after pachytene[4,5], could not be established. Consequently, the question whether the 2 somatic chromosomes are homologous cannot be answered, though the absence of multivalents points to nonhomology. It is, therefore, not yet clear whether apomictic or automictic parthenogenesis is involved.

The common type of sex determination in many mite families is haplo-diploidy. This mechanism also operates in the only bisexual species of the Tenuipalpidae (*Raoiella indica* Hirst) investigated thus far[1]. Investigations by HELLE et al.[6] on the induction of *B. obovatus* males by irradiation indicate the presence of 2 chromosomes in male embryonic tissue. Then, together with the present observations, it may be assumed that the haploid chromosome number is rather 2 than 1. This would mean that the female somatic cells are haploid, a unique condition among animals. Further investigations are required, particularly concerning the determination of sex differentiation.

Zusammenfassung. Das chromosomale Verhalten in den Reife- und Furchungsteilungen im Ei der thelytok-parthenogenetischen Milbe *Brevipalpus obovatus* wird beschrieben. In den Reifeteilungen befinden sich doppelt soviele Chromosomen wie im somatischen Gewebe; die weiblichen Milben sind vermutlich haploid ($n = 2$).

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