for the heterozygote, provide selection coefficients for the SS genotypes of approximately 0.50 (on hexanol), 0.25 (on butanol) and 0.20 (on ethanol).

In vitro activity assays show that the FF homozygotes of the Groningen population have a higher activity than the SS homozygotes (0.242 versus 0.069). Identical differences have been reported for other strains[7,8], where heterozygote activities were found to be intermediate. It is tempting to relate these differences in activity to the observed fitness differences. The fitness differences between FF and SS genotypes may then be brought about by a better conversion of the alcohols by FF homozygotes. The rise in F-frequency on methanol medium is quite unexpected, as we did not find alcoholdehydrogenase activity using methanol as a substrate. There are indications, however, that the heterozygote has a higher fitness than both homozygotes on methanol medium, leading to a equilibrium frequency of the F-allele around 0.70.

Concerning the ecological relevance of these experimental findings, it should be noticed that decaying fruit is a common feeding and oviposition site for *D. melanogaster* in nature. Yeasts generally flourish well on these fruits and ethanol is produced by fermentation in quantities, which can easily be detected by smell. A great variety of other alcohols are also present in fruits, though in smaller amounts[9].

Concluding, it may be stated that changes in substrate, relevant to the enzyme, induce determinate changes in allele frequencies at the Adh-locus. This proves the occurrence of selection at this locus and is not concordant with the neutrality hypothesis.

Résumé. Des populations de *Drosophila melanogaster*, élevées avec une nourriture contenant différents alcools, montrent une augmentation de la fréquence de l'allèle «fast» du locus alcool déshydrogénase. Ce phénomène est interprété comme étant le résultat d'une sélection et ne correspond pas à l'hypothèse de la neutralité des variants d'isoenzymes.

W. VAN DELDEN, A. KAMPING and H. VAN DIJK

Department of Genetics, University of Groningen, Kerklaan 30, Haren (Gn) (The Netherlands), 3 September 1974.

[7] J. GIBSON, Nature, Lond. *227*, 959 (1970).
[8] C. L. VIGUE and F. M. JOHNSON, Biochem. Genet. *9*, 213 (1973).
[9] A. C. HULME, *The Biochemistry of Fruits and their Products* (Academic Press, London–New York 1970 and 1971), vol. 1 and 2.

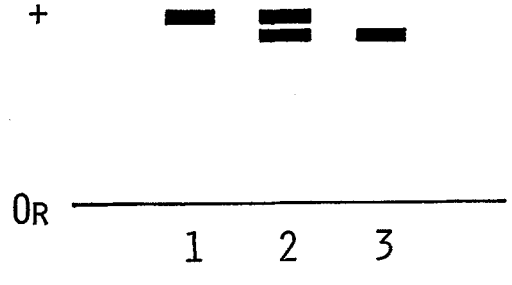
Genetic Control of Erythrocyte Esterase (Es-1) in the Pinon Mouse, *Peromyscus truei* (Shufeldt)

Recent use of techniques in electrophoresis for the study of enzyme polymorphism among vertebrate species has provided a wealth of information in attempting to elucidate the role of genetic variation in the evolutionary process[1]. Although it is accepted practice to consider multiple electrophoretic bands indicative of heterozygosity at a given protein locus, the Mendelian inheritance of most proteins is rarely examined experimentally. This report identifies a pair of codominant alleles segregating from a single autosomal locus controlling the electrophoretic mobility of a hemolysate esterase, Esterase-1. This esterase is commonly investigated by most workers studying vertebrates, especially mammals[1–8]. Furthermore, the species studied, *Peromyscus truei*, is a member of a common genus of North American rodents studied by vertebrate population biologists[1,2,4,7,8].

Materials and methods. The original stock of mice was collected from the vicinity of Canyon, Randall County, Texas, and their laboratory-bred offspring were used in inheritance studies. Blood was obtained from the suborbital canthal sinus, and a 4% sodium citrate solution was used to prevent clotting. Erythrocyte samples were washed 3 times with 5 volumes of buffered saline, lysed with approximately an equal volume of distilled water, and centrifuged at $1000 \times g$ for 10 min.

Starch gels were prepared using a 12% starch concentration and a 0.01 *M tris*-hydrochloric acid buffer (pH 8.5) according to SELANDER et al.[1]. The electrode buffer was 0.3 *M* sodium borate solution (pH 8.2). Horizontal electrophoresis was carried out at 3 °C at 250 V for 1.5 h. After electrophoresis, gels were sliced horizontally and incubated at 37 °C for 2 h in a solution of 25 mg Fast Garnet GBC salt, 24 ml 0.2 *M* monobasic sodium phosphate, 6 ml 0.2 *M* dibasic sodium phosphate, 20 ml distilled water and 1 ml 1% α-napthyl propionate. Alleles were numbered according to their mobilities relative to the fastest migrating allele (100) and calculated as a percentage of the 100 allele.

Results and discussion. Esterase-1 migrates anodally and in front of the hemoglobin on *tris*-hydrochloric acid gels. 3 electrophoretic patterns occur in *P. truei* as follows: a single fast migrating band designated 100/100; 2 bands a faster one designated 100, and a slower one designated 93; a single slow band designated 93/93 (Figure). The single banded patterns were considered homozygous for the 100 or 93 alleles, while the double banded pattern was



Zymogram of erythrocyte esterase-1 phenotypes of *Peromyscus truei*. Slot 1: genotype, 100/100. Slot 2: genotype, 100/93. Slot 3: genotype, 93/93.

[1] R. K. SELANDER, M. H. SMITH, S. Y. YANG, W. E. JOHNSON and G. B. GENTRY, Univ. Texas Publ. *7103*, 49 (1971).
[2] C. W. KILPATRICK and E. G. ZIMMERMAN, Syst. Zool., in press (1974).
[3] W. G. HUNT and R. K. SELANDER, Heredity *31*, 11 (1973).
[4] M. H. SMITH, R. K. SELANDER and W. E. JOHNSON, J. Mammal. *54*, 1 (1973).
[5] L. L. WHEELER and R. K. SELANDER, Univ. Texas Publ. *7213*, 269 (1972).
[6] J. E. WOMACK, Biochem. Genet. *9*, 13 (1973).
[7] E. G. ZIMMERMAN, B. J. HART and C. W. KILPATRICK, Comp. Biochem. Physiol., in press (1974).
[8] G. L. JOHNSON and R. L. PACKARD, Occas. Pap, Mus. Texas Tech Univ. *24*, 1 (1974).

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.

E. G. ZIMMERMAN[11] and C. W. KILPATRICK

North Texas State University, Department of Biological Sciences, Denton (Texas 76203, USA), and University of Vermont, Department of Zoology, Burlington (Vermont 05401, USA), 25 September 1974.

[9] S. RANDERSON, Genetics *52*, 999 (1965).
[10] P. L. WILMOT and D. K. UNDERHILL, J. Heredity *64*, 43 (1973).
[11] Supported by Faculty Research Grant No. 35064 from North Texas State University awarded to ZIMMERMAN.

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.

[1] W. HELLE, H. R. BOLLAND and J. GUTIERREZ, Experientia *28*, 707 (1972).
[2] W. WITTMANN, Stain Techn. *40*, 161 (1965).