Heredity (1977), **38** (3), 409-411

ELECTROPHORETIC TECHNIQUES AND GENETIC VARIABILITY IN HYMENOPTERA

A. C. F. HUNG and S. B. VINSON
Department of Entomology, Texas Agricultural Experiment Station, Texas A&M University, College Station Texas 77843

Received 27.ix.76

SUMMARY

Evidence from both fire ants and honeybee suggests that with proper buffer systems and supporting media some degree of biochemical polymorphism may be found.

MALES of Hymenoptera are haploid and females diploid. Crozier (1970*a*) suggested that there is no *a priori* reason to believe that this haplo-diploidy reduces the likelihood of balanced polymorphisms in this order. Indeed, both chromosomal and biochemical polymorphisms have been found in ants (Crozier, 1968, 1969, 1970*b* 1973; Johnson *et al.*, 1969; Tomaszewski *et al.*, 1973; Halliday, 1975; Imai and Kubota, 1975; Hung and Vinson, 1976*a*) and bees (Mestriner and Contel, 1972; Contel and Mestriner, 1974). However, based on the results of electrophoretic studies, Snyder (1974) reported the lack of allozymic variability at as many as 22 enzymatic and two general protein loci in three bee species. Similar claims have also been made for the honeybee (Brückner, 1974), solitary wasps and bees (Metcalf *et al.*, 1975), and *Formica* ants (Pamilo *et al.*, 1975). However, we believe that it is very important to take the variation in degrees of resolution into account when deciding on heterozygosity levels using electrophoretic techniques.

In comparative studies of the enzymes of North American fire ants (*Solenopsis* spp.), we have found that the electrophoretic resolution of proteins varies considerably as a function of the different buffers and supporting media used. This in turn affects the detection of genetic variability in an organism. For example, using an improved discontinuous buffer system (Hung and Vinson, 1976*b*), we have detected a polymorphism for a non-specific esterase in *Solenopsis invicta* (Hung and Vinson, 1976*a*). This polymorphism is controlled by a pair of codominant alleles (fig. 1). However, when aliquots of these same samples were electrophoresed under identical conditions, except for the use of a different buffer (the phosphate-citrate buffer of Selander *et al.*, 1971), we found that the proteins migrated only about half the distance as with the improved discontinuous buffer and the resolution was so poor that this polymorphism could not be detected (fig. 2). On the other hand, using the phosphate-citrate buffer of Selander *et al.* (1971) we found one monomorphic and one polymorphic α-glycerophosphate dehydrogenase (αGPDH) loci in *S. invicta* (fig. 3). This polymorphic locus provides us with an additional evidence for diploidy in the sterile males of *S. invicta* (Hung and Vinson, 1976*a*). However, if we use the improved discontinuous buffer system which has a much better resolution for esterase, we found intensive streaks and could only detect one αGPDH locus,

the polymorphism of which cannot be definitely ascertained (fig. 4). Therefore, if we happened to use only the phosphate-citrate buffer system for esterase and the discontinuous buffer system for αGPDH, we would have concluded that these two enzyme systems are monomorphic in *S. invicta*.

Brückner (1974), based on an analysis using cellulose acetate strips and a 0·3M boric acid buffer, reported monomorphism for esterase, malate dehydrogenase and phosphoglucomutase in the honeybee *Apis mellifera ligustica*. Yet, using starch gels and the Poulik buffer system, Mestriner and Contel (1972) found a polymorphic esterase locus in the same subspecies of honeybee. Our assays, using improved discontinuous buffer systems in starch gels, have revealed a malate dehydrogenase polymorphism in *A. m. ligustica* (fig. 5). Although we did not detect any polymorphic esterase locus in our limited survey, a total of six bands (including one weak band migrating cathodally) were found (fig. 6). However, Brückner (1974) detected but one esterase and one malate dehydrogenase in her analyses.

We have been unable to obtain samples of the three bee species used by Snyder (1974). However, our experiences with both fire ants and honeybee cause us to believe that with proper buffer systems and supporting media, some degree of biochemical polymorphisms may be found in these bees.

Acknowledgments.—We thank Drs R. H. Crozier, G. E. Hart and E. K. Tomaszewski for reading and commenting on the manuscript. This study was supported in part by the Texas Department of Agricultural Interagency Agreement IAC (74-75)-0448 and approved as TA 12781 by the director of the Texas Agricultural Experiment Station.

References

BRÜCKNER, D. 1974. Reduction of biochemical polymorphisms in honeybees (*Apis mellifica*). *Experimentia, 30,* 618-619.

CONTEL, E. P. B., AND MESTRINER, M. A. 1974. Esterase polymorphisms at two loci in the social bee. *J. Hered., 65,* 349-352.

CROZIER, R. H. 1968. Cytotaxonomic studies on some Australian dolichoderine ants (Hymenoptera: Formicidae). *Caryologia, 21,* 241-259.

CROZIER, R. H. 1969. Chromosome number polymorphism in an Australian ponerine ant. *Can. J. Genet. Cytol., 11,* 333-339.

CROZIER, R. H. 1970*a*. On the potential for genetic variability in haplo-diploidy. *Genetica, 41,* 551-556.

CROZIER, R. H. 1970*b*. Pericentric rearrangement polymorphism in a North American dolichoderine ant (Hymenoptera: Formicidae). *Can. J. Genet. Cytol., 12,* 541-546.

CROZIER, R. H. 1973. Apparent differential selection at an isozyme locus between queens and workers of the ant *Aphaenogaster rudis*. *Genetics, 73,* 313-318.

HALLIDAY, R. B. 1975. Electrophoretic variation of amylase in meat ants, *Iridomyrmex purpureus*, and its taxonomic significance. *Aust. J. Zool., 23,* 271-276.

HUNG, A. C. F., AND VINSON, S. B. 1976*a*. Biochemical evidence for queen monogamy and sterile male diploidy in the fire ant *Solenopsis invicta*. *Isozyme Bull., 9,* 55.

HUNG, A. C. F., AND VINSON, S. B. 1976*b*. An improved discontinuous system of buffers in starch gel electrophoresis. *Isozyme Bull., 9,* 66-67.

IMAI, H. T., AND KUBOTA, M. 1975. Chromosome polymorphism in the ant, *Pheidole nodus*. *Chromosoma* (Berl.), *51,* 391-399.

JOHNSON, F. M., SCHAFFER, H. E., GILLASPY, J. E., AND ROCHWOOD, E. S. 1969. Isozyme genotype-environment relationships in natural populations of the harvester ant, *Pogonomyrmex barbatus*, from Texas. *Biochem. Genet., 3,* 429-450.

MESTRINER, M. A., AND CONTEL, E. P. B. 1972. The P-3 and Est loci in the honeybee *Apis mellifera*. *Genetics, 72,* 733-738.

METCALF, R. A., MARLIN, J. C., AND WHITT, G. S. 1975. Low levels of genetic heterozygosity in Hymenoptera. *Nature, 257,* 792-794.

PAMILO, P., VEPSÄLÄINEN, K., AND ROSENGREN, R. 1975. Low allozymic variability in *Formica* ants. *Hereditas, 80,* 293-296.

SELANDER, R., SMITH, K., YANG, S., JOHNSON, W., AND GENTRY, J. 1971. IV. Biochemical polymorphism and systematics in the genus *Peromyscus.* I. Variation in the old-field mouse (*Peromyscus polinotus*). *Studies in Genetics* VI (Univ. Texas. Publ. 7103), 145-153.

SNYDER, T. P. 1974. Lack of allozymic variability in three bee species. *Evolution, 28,* 687-689.

TOMASZEWSKI, E. K., SCHAFFER, H. E., AND JOHNSON, F. M. 1973. Isozyme genotype-environment associations in natural populations of the harvester ant, *Pogonomyrmex badius. Genetics, 75,* 405-421.