"Domesticated" insects such as honeybees and silkworms have long associations with man and have been improved in many ways. Some parasitoids have also undergone selection to improve insectary production and/or field effectiveness.

Parasitoids, or any insects destined to survive and reproduce in a natural environment, present particularly difficult problems for an improvement program. Desirable attributes to be selected must be clearly definable. Adequate genetic variability must be provided to allow selection to operate. Adequate selection procedures are a must. Finally, maintenance of the integrity of the improved strains under field conditions may need to be provided for.

Heterosis has been largely ignored in genetic improvement programs, except for the spectacular improvements exhibited in silkworm and honeybee improvement programs. Some data suggest that heterosis may be useful to improve the effectiveness of inoculative or inundative releases of parasitoids or predators. There is yet inadequate experimental evidence to judge the general value of selection and hybridization for improving insects. Future field testing will demonstrate the value of such improvement methods.

**Symposium: Biosystematics**

**GORDON GORDH, MODERATOR**

**Systematics and Ecology of Chrysopidae (Neuroptera): Theoretical and Applied Implications.** CATHERINE A. TAUBER AND MAURICE J. TAUBER, DEPARTMENT OF ENTOMOLOGY, CORNELL UNIVERSITY, ITHACA, N.Y. 14853

**Some Evolutionary Trends in the Chalcidoidea (Hymenoptera) with Particular Reference to Host Preference.** GORDON GORDH, SYSTEMATIC ENTOMOLOGY LABORATORY, AGR. RES. SERV., USDA.

**Territoriality in Male Bees (Hymenoptera: Apoidea).** EDWARD M. BARROWS, DEPARTMENT OF BIOLOGY, GEORGETOWN UNIVERSITY, WASHINGTON, D.C. 20057

**Systematics and Ecology of Chrysopidae (Neuroptera): Theoretical and Applied Implications**

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The family Chrysopidae—green lacewings—is a member of one of the most primitive holometabolous orders (Neuroptera), and clarification of the evolu-
tionary changes within the Neuroptera is not only of intrinsic value and interest, but it can contribute to an understanding of the evolution of the more highly evolved insect orders. In addition to their taxonomic value, many chrysopid species are useful as subjects in ecological-physiological studies, and as important predators in integrated control programs in various agricultural ecosystems.

Our recent investigations with the Chrysopidae encompass 4 categories: systematics, phenology, behavior, and biological control. The systematics work is based on a classical, comparative morphological approach and on data derived from experimental studies in phenology and behavior. By combining the results of morphological and experimental studies, we not only broaden the basis for the classification and thus advance the systematics of the group, but we also provide information essential to the use of Chrysopidae (e.g. chrysopid strains) as biological control agents (1).

Specifically, in the area of systematics, our studies with the Chrysopidae represent the 3 levels or stages of biological classification:

1. alpha taxonomy—The larvae of most North American species have not been described. To promote species identification, we have reared and studied larvae of most North American species and the process of description is well underway (2,3,4).

2. beta taxonomy—Comparative analyses of the larval morphology (3,4) and the biological characteristics of adults and larvae (5,6) provide a basis for a sound classification and for keys to the taxa.

3. gamma taxonomy—The phenological adaptations of geographically diverse populations are valuable indicators of species-complexes and evolutionary trends within the genus Chrysopa. Phenological studies, in combination with hybridization tests, contribute to an understanding of the genetic diversity and the evolutionary history of geographic populations (7).

Success or failure of biological control projects depends in large part on the degree to which selected strains of beneficial species are adapted to biotic and abiotic factors of particular environments. Our recent investigations have led to the recognition of strains or races within geographically diverse chrysopid species that are currently used as biological control agents. These strains are characterized on the basis of morphological, phenological and behavioral criteria (7,8), and our studies show that some of these strains are better adapted than others to particular localities and particular agricultural ecosystems (9).

**Literature Cited**

Some Evolutionary Trends in the Chalcidoidea (Hymenoptera) with Particular Reference to Host Preference

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Taxonomically, the parasitic hymenopteran superfamily Chalcidoidea is among the most poorly known within the Insecta because the number of systematists working on the group is small, the group is large, and progress has been slow. Presently, we recognize about 1,220 genera and 9,950 species of chalcidoids. Hosts for 27% of the genera are unknown.

I believe this superfamily ultimately will be recognized as numerically the largest and biologically most diverse insect group. Several sources of information and lines of reasoning lead me to this conclusion: (1) the chalcidoid host spectrum extends from ticks and spiders to aculeate Hymenoptera. (2) Rapid genetic recombination of superior genotypes and subsequent speciation has been accelerated among chalcidoids because generation time is short (sometimes less than 8 days), they possess several modes of parthenogenesis (ar-rhenotoky, thelytoky, deuterotokq), and intensive inbreeding via sibmating is widespread. (3) Chalcidoids demonstrate several host-exploitation strategies: they develop as obligate egg parasites, larval parasites, pupal parasites, egg-larval parasites, larval-pupal parasites, and many species are obligate or facultative hyperparasites. Thus, each insect species represents several potential niches for parasitic chalcidoids. Also, phytophagy has evolved several times in the Chalcidoidea. (4) Chalcidoids display a finite number of morphological types, but there are no a priori reasons why morphological criteria must accompany the species status; sibling species are abundant in the Chalcidoidea. (5) The Neotropical, Ethiopian, Oriental and Australian faunas are almost totally unknown.

Analysis of generic and suprageneric levels in the taxonomic hierarchy shows that different taxa of chalcidoids have adopted different progenative strategies, which are categorized as specialists, generalists and opportunists. Specialists attack a specific host-taxon, such as a genus or family (Desantisca spp. on Latrodectus spp.; Chalcis spp. on Stratiomyiidae); generalists prefer a habitat rather than a taxonomically cohesive group of hosts (Zagrammosoma spp. on...
Bibliography of the Neuropterida

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