Functional infertility resulting from spermatozoon nucleus dimegaly has been reported in insects (Sidhu 1964, Beatty and Sidhu 1967, Meyer 1969). The present observations record statistically the variable spermatozoon nucleus length of both normal and abnormal strains of *C. maculatus*. The normal and abnormal forms for this analysis were procured from natural environments, from normal laboratory cultures, and also from laboratory populations subjected experimentally to thermal shocks at various stages of development (Gill et al. 1971).

The spermatozoa were obtained from the testes and male genital tracts. For statistical analysis, 1, stained and unstained, 2, fixed and unfixed, and 3, mounted and unmounted sperm smears were studied. Table 1 furnishes data on variation in mean lengths of spermatozoon nuclei from normal and abnormal *C. maculatus*.

Such mensuration studies on spermatozoon nuclei from the 2 strains, we feel, are meaningful considering recent work on these lines by Van Duijn (1960), who discussed their relevance. Our studies establish sperm nucleus dimegaly in the 2 strains of *C. maculatus*.

Meyer (1969) reported spermatozoon dimegaly in *Drosophila* which, according to him, is explained by abnormal Y-chromosomes that carry fertility factors. In *C. maculatus*, because the abnormal strain is not restricted to males only, this factor seems to reside elsewhere, viz., X-chromosome, the autosomes, or it could even be a non-chromosomal factor.

Transformation of the spermatid nucleus into a long threadlike sperm nucleus does involve rearrangement of the DNP molecules. According to Sjostrand (1969) such an elongation and differentiation of protein molecules in the cell is controlled by certain enzymes.

It may be added that phase-contrast microscopic examination of live spermatozoa and cytochemically treated spermatozoa obtained from both the normal and abnormal strains did not reveal any other difference in morphology or the cytochemical makeup of the 2 types of sperm involved.

Table 1.—Variation in mean length (in μ) of nuclei of sperm, subjected to differing techniques, from normal and abnormal *C. maculatus*. For means, 100 sperm in each category were measured.

	Length of nucleus		
	Normal	Abnormal	Difference
	Unstained and unmounted		
Unfixed	4.70	3.42	1.28
Fixed	4.52	3.56	0.96
Means	4.61	3.49	1.12
	Stained and unmounted		
Unfixed	5.00	3.70	1.30
Fixed	4.80	3.57	1.23
Means	4.90	3.63	1.27
	Unstained and mounted		
Unfixed	4.70	3.42	1.28
Fixed	4.60	3.50	1.10
Means	4.65	3.46	1.19
	Stained and mounted		
Unfixed	5.00	3.70	1.30
Fixed	4.70	3.63	1.07
Means	4.85	3.66	1.19

REFERENCES CITED

Arora, G. L., and H. R. Pajni. 1959. Sterility and the associated morphological changes in *Callosobruchus analis* (F.). Curr. Sci. 28: 19–20.

Beatty, R. A., and N. S. Sidhu. 1967. Spermatozoan nucleus-length in three species of *Drosophila*. Heredity 22: 65–82.

Caswell, G. H. 1960. Observations on an abnormal form of *Callosobruchus maculatus* (F.). Bull. Entomol. Res. 50: 671–80.

Gill, J., K. C. Kanwar, and S. R. Bawa. 1971. Abnormal "sterile" strain in *Callosobruchus maculatus*, a stored-grain pest. J. Econ. Entomol. (In press.)

Meyer, G. F. 1969. Experimental studies on spermiogenesis in *Drosophila*. Genet. Suppl. 61: 79–92.

Sidhu, N. S. 1964. A quantitative study of the spermatozoan nucleus length in *Drosophila melanogaster*. Proc. Roy. Soc. Edinburgh B 68: 327–35.

Sjostrand, F. S. 1969. Molecular structure and function of cellular membranes. *In* International Symposium of Electron Microscopy in Biophysics and Molecular Biology. Chandigarh, India.

Southgate, B. J., R. W. Howe, and G. A. Brett. 1957. The specific status of *Callosobruchus maculatus* (F.) and *Callosobruchus analis* (F.). Bull. Entomol. Res. 48: 79–89.

Utida, S. 1954. "Phase" dimorphism observed in the laboratory population of the cowpea weevil *Callosobruchus quadrimaculatus*. Oyo Dobutsu Zasshi 18: 161–8. [In Japanese with English summary.]

Van Duijn, C. 1960. Mensuration of the heads of boar spermatozoa. Mikroskopie (Sonderdruck) 39: 142–62.

Parasitism of *Anatis quindecimpunctata*[1] by *Homalotylus terminalis*[2,3]

H. M. KULMAN

Department of Entomology, Fisheries, and Wildlife, University of Minnesota, St. Paul 55101

Anatis ocellata mali (Say) and *A. quindecimpunctata* Oliver, both frequently called the 15-spotted ladybeetle, are large coccinellids that often attract attention because their prey includes defoliating larvae. McKenzie (1936) pointed out that earlier records of *A. quindecimpunctata* and *A. ocellata mali* were probably confused. Their geographical distributions overlap greatly, and *A. ocellata mali* was considered a variety of *A. quindecimpunctata* in many earlier papers. McKenzie reported *A. quindecimpunctata* feeding on the Colorado potato beetle, *Leptinotarsa decemlineata* (Say); gypsy moth, *Porthetria dispar* (L.); browntail moth, *Nygmia phaeorrhoea* (Donovan); and *Erannis tiliaria* (Harris). Graham and Knight (1965) reported extensive predation on the jack pine budworm, *Choristoneura pinus* Freeman, by *A. ocellata mali*.

Although the *Anatis* are abundant and are the largest of the North American coccinellids, there is only one record of natural parasitism in this genus. Timberlake (1920) reported on a single male specimen of the encyrtid wasp *Homalotylus terminalis* (Say) from a larva of *A. quindecimpunctata* in Pennsylvania in 1886. This parasite has been reported from many other coccinellids from New York to Illinois and south to the West Indies.

[1] Coleoptera: Coccinellidae.
[2] Hymenoptera: Encyrtidae.
[3] Received for publication Nov. 23, 1970.

Table 1.—Frequency of *H. terminalis* as a parasite of the coccinellid *A. quindecimpunctata*.

Tree	Larvae collected	Larvae parasitized	Parasites per parasitized larva	
			Range	Average
1	37	9	4–21	9.5
2	6	2	4–11	7.0
3	9	2	4–9	6.5
4	14	5	4–19	10.0
5	14	0	–	–
6	10	4	1–9	5.0
7	6	1	15	15
8	6	4	4–16	10.2
9	12	3	5–16	9.3
Total	114	30	1–21	9.1

Cushman (1913) reared the braconid *Perilitus coccinellae* (Schrank) from *A. quindecimpunctata* in laboratory cultures where adults of *P. coccinellae* were caged with the coccinellids. I found no reports of rearing this parasite from field-collected *Anatis*.

The purpose of this paper is to report new information on parasitism of *A. quindecimpunctata*.

Four collections of 4–37 last-stage larvae of *A. quindecimpunctata* from several tree species in western Virginia were obtained in early June 1966. These larvae were not parasitized, but a 5th collection on June 14 had 114 larvae parasitized by *H. terminalis*. These larvae were collected from 9 sassafras trees on the campus of Virginia Polytechnic Institute at Blacksburg.

As shown in Table 1, 26% of the larvae were parasitized, yielding 273 wasps. From 1 to 21, average 9.1, wasps issued from each parasitized larva. These figures represent minimum parasite production, since cadavers were not dissected to account for additional specimens that failed to issue from the hosts.

Timberlake (1920) reported an average of 5 (range 2–8) *H. terminalis* wasps emerging from various other species of coccinellids. The larger numbers reported in this study are probably related to the larger size of *Anatis*.

In conclusion, *A. quindecimpunctata* appears to be an acceptable host for the encyrtid parasite *H. terminalis*. Since 26% of the coccinellid larvae from one collection were killed by the parasite, *H. terminalis* probably influences the biological control potential of *A. quindecimpunctata*.

ACKNOWLEDGMENT

I acknowledge the courtesy of B. D. Burks in identifying the parasite and of P. J. Clausen in confirming the identity of the coccinellid by examining the male genitalia. The collections were made while I was on the staff of Virginia Polytechnic Institute, Blacksburg.

REFERENCES CITED

Cushman, R. A. 1913. Biological notes on a few rare or little known parasitic Hymenoptera. Proc. Entomol. Soc. Wash. 15: 153–61.

Graham, S. A., and F. B. Knight. 1965. Principles of Forest Entomology. McGraw-Hill Book Co., New York. 417 p.

McKenzie, H. L. 1936. An anatomical and systematic study of the genus *Anatis* of America. Univ. Calif. Publ. Entomol. 6: 263–72.

Timberlake, P. H. 1920. Revision of the parasitic chalcidoid flies of the genera *Homalotylus* Mayr and *Isodromus* Howard, with descriptions of two closely related genera. Proc. U. S. Nat. Mus. 56: 133–94.

Effects of Drone Comb on Brood and Honey Production in Honey Bee[1] Colonies[2]

T. S. K. JOHANSSON AND M. P. JOHANSSON
City University of New York, Flushing 11367

There is a long-established bias in beekeeping against drones on the grounds that they consume honey but do not contribute to its production. Colvin's statement (1863) is representative. It is logical that with 1500–3000 drones contributing nothing to the colony except body heat and an occasional mate for a queen, there should be a severe drain on honey stores collected by worker bees. Levenets (1956) calculated that it required 6.89 kg of honey to rear and feed 1000 drones during the season. Beekeeping manuals admonish the novice to sort his combs regularly, cutting out those with appreciable drone cells and substituting sheets of worker foundation on which the bees will draw out new combs. Such foundation left on a colony when the nectar flow ceases is nibbled at the edges and around embedded wires. Later these spaces are frequently filled with drone comb. Bretschko (1958) provided perforated foundation to colonies and found that during a flow only 20% of the perforations were filled with drone cells compared to 70% during the absence of a flow. Results were comparable on complete sheets of worker foundation. On the other hand, natural and artificial swarms (nuclei) built worker cells almost exclusively.

Occasional observations in favor of drones have been made. Gibbs (1884) doubted the wisdom of using foundation in the brood chamber as he believed bees would raise drones no matter what. Zander (1923) showed that stocks with the most drone brood produced more honey, and Holick (1931) concluded that colonies deprived of drones lost interest in building comb, developed slower, produced less surplus, changed queens oftener, and were queenless more frequently. Clark (1933) tested an increase of drone comb on the incidence of swarming and was "sure that drone comb does not reduce the crop of honey." Évrard (1921) summarized the above ideas in elegant prose.

MATERIALS AND METHODS

On May 31, 1965, the combs in 12 colonies were sorted and those with large areas of drone cells moved into one half the colonies (drone colonies) in exchange for combs with a minimum of drone comb (worker colonies). The dimensions of the patches of drone cells on each comb and the area actually occupied by drone brood were measured. The combs were examined at intervals during the 1965 season and the occupancy by drone and worker brood recorded as well as the honey production of the colony.

The total comb area for any one colony was the sum of combs in all boxes (supers) used for brood at any time. Because queen excluders were not used, the number of supers occupied varied from 2 deeps and 1 shallow

[1] *Apis mellifera* L. (Hymenoptera: Apidae).
[2] Received for publication Dec. 16, 1970.