fulgens (Walk.) in flight at an elevation of 10–12 m above ground level. The flight pattern was not random, but directional, and generally southwesterly around two sides of the terrace. The following morning at 0600, upon walking onto the front balcony of the hotel which faced on the main street of Tela, we saw large numbers of individuals flying along the street from northeast to southwest. They flew singly or in small groups at levels ranging from one or two m to 12 or 15 m above the street level. The sky was overcast and a light rain was falling after intermittent heavy tropical showers during the night. Five minute counts yielded more than 150 individuals and we estimate that 1,500–1,800 flew past during the hour in which they were under observation. When we terminated observation at 0700, there had been no visible let-up in the flight.

At about 0800 we left Tela by car for El Progresso. This section of highway runs in a generally northwesterly direction and in the northwesterly stretches, the moths continued to cross the highway toward the southwest in large numbers over a distance of at least 30 km but began to disappear or lose their directional flight as the road moved into the mountains.

Where the road crossed the flight lanes, hundreds of dead or stunned moths were on the highway. Stopping to collect a sample of perfect specimens we found that ants reached them within minutes, eating the abdomens of still-living individuals. However, we obtained 39 freshly-emerged specimens in satisfactory condition in half a dozen brief stops. The sex ratio in our samples was 26 ♂♂:13 ♀♀.

Thus, in the flight observed by us in late August, the direction was from northeast to southwest, in contrast to reports of others for this general time period.

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Journal of the Lepidopterists' Society
33(4), 1979, 261–264

CAPTURES OF LARGE MOTHS BY AN ULTRAVIOLET LIGHT TRAP

Early in April 1978, J. Muller installed a standard black light trap, made by the Ellisco Company, on C. B. Worth's farm in Eldora, Cape May Co., New Jersey (Fig. 1). This trap, plugged into an ordinary electric outlet, uses a tube of only 15 watts, emitting both visible blue and ultraviolet (black) rays. Insects striking the four vertical baffles surrounding the tube fall through a funnel into a collecting chamber containing cyanide or other lethal volatile chemicals. The trap is standard equipment for agents of Rutgers University monitoring the abundance of flying phototropic agricultural pests throughout the state of New Jersey.

Muller had been collecting moths on this farm by other means since August 1972, as part of his statewide survey of the macrolepidoptera of New Jersey (Muller, 1976, J. New York Entomol. Soc. 84: 197–200, and unpublished). Since the farm is isolated and not close to competing lights, this new trap presented an opportunity to study the extent to which an ultraviolet light diverts moths from their natural nocturnal functions. It was decided to record all sphingids and larger saturniids that were removed from the environment at this focus (Table 1).

For a few days, from time to time, the trap did not operate well because of exhaustion of the lethal gases. However, the kill (summarized in the table) remains representative for comparative purposes, since the flight period of most species occupies several weeks. In the case of double-brooded species there must obviously be two peaks of abundance; these have not been separated in the table.

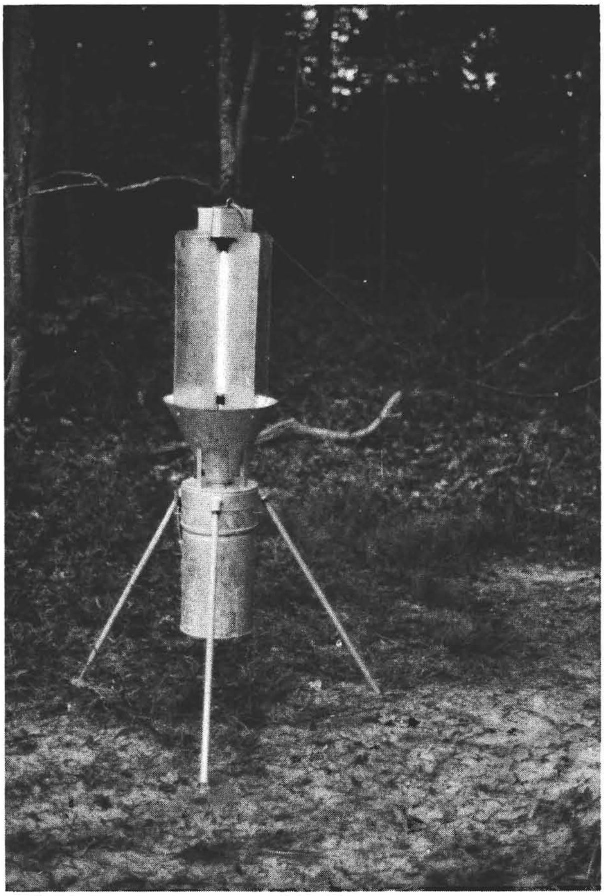

FIG. 1. Standard black light trap, the Ellisco Co.

The grand total of moths killed, 330, may look impressive, but compared to the number of smaller forms taken it is insignificant. Each night's catch contained perhaps as many as a half dozen large moths, along with a pint to a quart of smaller ones. The latter fraction must have numbered several hundreds. Thus, over a period of about four months, the trap caught in the neighborhood of 50,000 moths. This may have represented the removal of a considerable number of ovipositing females, and thereby ought to have affected the biomass of foraging caterpillars in the population of 1979.

However, it is difficult to draw conclusions when the status of captured moths is unknown. Have females already laid their eggs? Have males already mated? If both the answers are "Yes," removal of the moths would not affect next year's crop.

Examining the catches of the four commonest species (in those cases when the sexes were largely known), we see that among *luna*, *polyphemus*, *io*, and *imperialis*, 138 males and 13 females were taken (91.4 percent males and 8.6 percent females). These figures suggest first that females may be less mobile and secondly that they may be more strongly motivated to fly on ovipositional errands rather than be diverted by attractive lights.

TABLE 1. Large moths caught in a black light at Eldora, New Jersey, 2 May to 12 September 1978.

Species	Sex M	Sex F	Sex ?	Total	Inclusive dates
Actias luna (Linnaeus)	48	4	2	54	2 V to 2 IX
Deidamia inscripta (Harris)	1	1	7	9	2 V to 16 VI
Antheraea polyphemus (Cramer)	12	1	—	13	5 V to 5 VIII
Paonias astylus (Drury)	9	5	23	37	26 V to 24 VIII
Smerinthus jamaicensis (Drury)	—	—	2	2	26 V to 12 VI
Lapara coniferarum (J. E. Smith)	1	2	45	48	26 V to 6 VIII
Hyalophora cecropia (Linnaeus)	3	—	—	3	30 V to 1 VI
Paonias myops (J. E. Smith)	—	—	2	2	30 V to 29 VIII
Darapsa pholus (Cramer)	1	1	16	18	30 V to 12 IX
Cressonia juglandis (J. E. Smith)	1	—	4	5	30 V to 5 VIII
Callosamia promethea (Drury)	—	3	—	3	1 VI to 12 VI
Paonias exaecatus (J. E. Smith)	4	1	17	22	4 VI to 24 VIII
Sphecodina abbottii (Swainson)	—	—	1	1	4 VI
Amphion nessus (Cramer)	—	—	1	1	4 VI
Automeris io (Fabricius)	31	3	1	35	4 VI to 30 VII
Sphinx gordius Cramer	6	—	3	9	12 VI to 30 VI
Ceratomia catalpae (Boisduval)	—	—	3	3	13 VI to 3 IX
Manduca quinquemaculata (Haworth)	1	—	3	4	26 VI to 24 VIII
Eacles imperialis (Drury)	47	5	—	52	30 VI to 12 VIII
Citheronia regalis (Fabricius)	1	1	—	2	7 VII to 26 VII
Hyles lineata (Fabricius)	1	—	1	2	28 VII to 2 VIII
Dolba hyloeus (Drury)	—	—	1	1	5 VIII
Eumorpha pandorus (Hübner)	—	—	1	1	16 VIII
Paratrea plebeja (Fabricius)	—	—	1	1	24 VIII
Manduca sexta (Linnaeus)	—	—	2	2	31 VIII to 9 IX
Total	167	27	136	330	

The obvious question then becomes whether or not males are so drawn to lights that they do not respond to female pheromones. One test of that possibility gave inconclusive results. During the course of these observations, Worth tethered 16 newly emerged *Citheronia regalis* females within a few hundred yards of the light trap. They were definitely in competition with the ultraviolet light source, and cruising wild males had an easy choice of which target they would select. Fourteen females secured wild mates, while the trap took only one male. However, during the same three-week interval, 15 reared and marked males were liberated but none of these was trapped. This species is apparently only mildly phototropic.

A further suggestive finding was that the two trapped female *Eacles imperialis* that were dissected were found to be devoid of eggs.

As an incidental observation, it is interesting that *Callosamia promethea*, a common species in this region, was represented in the trap by three females but no males, the latter being largely diurnal.

This study bears on the question of rather new "light pollution" as it relates to populations of phototropic insects. For several decades it was presumed that new insecticides such as DDT were responsible for the decline of large moths in our great urban centers and their suburbs. However, it has not been clear in more recent years why these insects survived in regions such as Worth's farm in Eldora, New Jersey, where DDT and related insecticides have been used vigorously to combat agricultural pests, mosquitoes and gypsy moths.

The difference may lie in rapidly increasing popularity of mercury vapor lamps for urban street lighting as well as for community and private use. These emit ultraviolet light. Given the number of these light sources, insects must be attracted in inestimable numbers, perhaps withdrawing them from reproductive duties to the point of local species extinction. Of course such lamps do not kill insects, but they immobilize them, rendering them as biologically inactive.

In rural areas the use of this type of illumination is much less common. This may account for the greater abundance of large moths in these areas.

Finally, the light trap contained many other orders of insects, among which Hymenoptera were abundantly represented. None of these was saved for identification, but the possibility remains that some were parasitoids of large moths. In such a case black lights might have a favorable effect on moth populations.

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Journal of the Lepidopterists' Society
33(4), 1979, 264–265

JAMES GRAHAM COOPER (1830–1902)

James Graham Cooper was an important 19th century naturalist in California. Collections of Lepidoptera made by him became the basis for several new species described by H. H. Behr, including *Melitaea quino*. Other entomological material he collected was the basis for new taxa described by J. L. LeConte (Coleoptera) and J. W. Greene (Hymenoptera). New species that were named after him include *Anthocaris cooperii* Behr, *Melitaea cooperi* Behr, both Lepidoptera; and *Lytta cooperi* LeConte, and *Amphicoma cooperi* (Horn), both Coleoptera. A very brief biography by Essig (1931, A History of Entomology, Macmillan, New York) is sketchy and inaccurate. More complete biographies by Grinnell (1905, The Condor, Vol. 5) and Emerson (1899, Bull. Cooper Ornithol. Cb., Vol. 1) are more complete, but only cite his achievements in ornithology. In researching some of the species of Lepidoptera named by Behr, I have uncovered a fair amount of information on Cooper that may be of benefit to other lepidopterists in the future.

James G. Cooper was born in New York City 19 June 1830. His father was a close friend of James Audubon. He had an early interest in natural history and in 1850 accompanied LeConte on a collecting trip to California. After graduating from the College of Physicians and Surgeons in New York in 1853, he took a position as physician and naturalist on an expedition exploring a potential railroad route through Oregon. In 1861 he was back in California and petitioned J. D. Whitney to join Whitney's California Geological Survey as zoologist. For the next several years he did work with Whitney off and on with the Survey Team. Whitney's chief assistant, W. H. Brewer described him as "a man of more than ordinary intellect and zeal in science, but not a very companionable fellow in camp" (1966, Up and Down California, Univ. California Pr., Berkeley). His primary duties with the Survey were to collect plant specimens, but his primary interest was vertebrate animals and not botany as was cited by Essig (op. cit.). During the 1860's he became associated with Behr and the California Academy of Science in San Francisco. His primary interests during this period were fish (both marine and freshwater) and marine animals, and he presented many papers to the Academy describing new species. During this period he collected entomological materials that he supplied to Behr and other specialists. His explorations ended in 1866 when he married Rosa M. Wells of Oakland. He practiced medicine in Oakland, where he lived until 1871. In 1871 he moved his practice to Ventura County and his close