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## PRESIDENTIAL ADDRESS, 1990: THE AGE OF DISCOVERY—LEPIDOPTERA IN THE WEST INDIES<sup>1</sup>

JACQUELINE Y. MILLER

Allyn Museum of Entomology, Florida Museum of Natural History,  
3621 Bay Shore Road, Sarasota, Florida 34234

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As we enter the decade of the 90's and approach the quinque-centennial anniversary of the discovery of the New World in 1992, perhaps this is a time to reflect on the progress—or lack thereof—that we have made in the study of Lepidoptera. While the study of the West Indian fauna may not appear to have contributed significantly to our general knowledge of North America or other continental fauna, these indeed share a parallel history in many ways. In this abbreviated space I will present a brief history of the study on the Lepidoptera of the West Indies, post some questions, and discuss the problem areas that remain to be addressed. Similar queries are applicable to continental faunas; all lepidopterists can play a significant role in resolving many questions.

Consider how our geographical horizons have expanded in the last 500 years. Despite the voyages of Leif Erickson and the Vikings to the coast of Newfoundland, the Western Hemisphere was unknown to most Europeans prior to the voyages of Columbus. The Ptolemaic map illustrated only two major land masses (Europe and Africa) and about a dozen islands; little was known about the relative positions or dimensions of even the recognized continents. On 3 August 1492, Columbus and his crew set sail from Spain to the Canary Islands, where they stopped for provisions and repairs. After 37 days crossing the Atlantic, Columbus arrived by 12 October on the eastern side of the Central Bahamian islands. Most historians agree that he made landfall on Guanahani, also

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<sup>1</sup> Delivered to the Annual Meeting of the Lepidopterist's Society in Milwaukee, Wisconsin, on 16 June 1990.

known as Watling or San Salvador, but the meandering path of his explorations through the islands and the West Indies is still in dispute. Ironically, the discovery of "America" actually occurred in the Bahamas.

### Biogeography of the West Indian Lepidoptera

The West Indies encompass an area of 600,000 square miles, about the size of the United States. The area is comprised of four major island groups: the Bahama Islands, the Greater Antilles (Cuba, Haiti, Dominican Republic, Puerto Rico, Jamaica), the Virgin Islands, and the Lesser Antilles (Leeward and Windward Islands). Geologically, the proto-Greater Antilles date from the late Cretaceous to the Paleocene (approximately 80–60 million years before present), with the subsequent break up of the individual islands sometime during the late Eocene, and reaccrion of some islands, such as Hispaniola, during early Oligocene to Miocene. The Lesser Antilles arose as a volcanic arc (the Aves Arc) with land emergent during most of the Tertiary.

Although limited in land area, a wide variety of habitats is extant throughout the Western Antilles. The topography and geographical position of islands with respect to the trade winds play a significant role in the distribution of fauna and flora. Habitats range from tropical rain forests, such as the Caribbean National Forest near Loquillo in eastern Puerto Rico, parts of Dominica, and northwestern St. Vincent in the Lesser Antilles, to desert scrub near Guanica in southwestern Puerto Rico and on the island of Barbuda. There are picturesque beaches edged by crystalline, aquamarine waters, but these may be bordered by salt flats, especially in the Bahamas. However, observing and collecting Lepidoptera in this tropical paradise are not without some problems.

With the exception, perhaps, of the Greater Antilles, the West Indies are not self-sustaining, and most goods are transported to these islands. Accommodations and restaurants may be sparse and expensive on some islands. In addition, available habitat is restricted either due to human encroachment or floristic diversity, and road access may be quite limited. I might also add that, for whatever islands you sample, you will work exceedingly hard for the observations made and the specimens collected. You will indeed find collecting a challenge in the West Indies.

With more than 322 described and a few undescribed species, the butterfly fauna of the West Indies is quite manageable. The number of moth species represented is obscure at this juncture, yet another problem area beset by the lack of appropriate study and little available literature. Specimens in museum collections generally have been provided by a few collectors, and there have been a few faunal surveys.

Most noteworthy are those of the Van Voast expedition during the late 1930's to the Bahamas and the Bredin-Archibold-Smithsonian on Dominica during the mid-1960's. Although the lepidopteran fauna may appear to be limited by the available geographical area, our knowledge of species diversity, host plant associations, and other aspects of life history is severely hampered by the paucity of studies completed and **published**.

In a recent address, one of our honorable Presidents analyzed the specialized interests of lepidopterists, their collecting habits, and their selection of habitats. Some people find it rather peculiar that Florida residents would leave home to study similar habitats and taxa in the Caribbean. While this point has some merit, there are some definite advantages in studying island fauna and flora. One is that the actual land area and the associated fauna and flora are rather limited, providing an ideal laboratory setting for study. The lepidopteran taxa present are subject to a number of variables. The climate is quite stable for most of the year, but unpredictable storms and hurricanes, coupled with the ever present trade winds, affect the geographic distribution of species. There are indeed turnover and fluctuation rates of butterfly and moth species on these islands similar to those proposed in the theory of island biogeography by MacArthur and Wilson (1967). However, common taxa such as *Vanessa cardui* (L.) and *Danaus plexippus* (L.) may be present in large numbers one year, as for example on Great Inagua in the southern Bahamas, and inexplicably absent the next (Simon & Miller 1986). In these cases, other factors such as available larval hostplant, parasitism, pesticide use, or even migratory patterns need to be examined, but in many instances, these aspects do not adequately explain the complete absence of such species from one year to the next. In addition, there is a definite seasonal rain pattern, and emergence periods of species may be interlocked with the onset or end of the rainy season. Most of the material collected in the West Indies has been taken during the winter months, often by collectors seeking to avoid the northern winter, but the number of taxa represented during these periods is diminished, and unfortunately, many of the smaller islands have been omitted by such collectors.

Although our initial impetus was to survey the West Indian fauna and to determine the diversity of species present on these islands, it was also important that we glean the necessary rudiments about the conservation measures necessary to protect them. As mentioned previously, with the intervention of man, the loss of available habitats and associated host and nectar sources has diminished the areas available for collecting and observation. Limited land space on these islands means little arable land for cultivation and less potable water. For

residents of the rapidly developing states of Florida and California, this has new meaning and rather permanent significance.

There are apparent similarities in collectors' perceptions of species diversity of Lepidoptera in the southern U.S., especially Florida and the West Indies. The stable climate, warm temperatures, and the presence of palm trees apparently triggers something in the human psyche that conjures up the idea of an increase in species numbers and population sizes, especially of Lepidoptera. Such impressions are not necessarily true even in some areas of the Amazon basin, let alone the Caribbean. Even Gosse (1851) in his exploration of Jamaica stated: "I had left England with high expectations of the richness of the West Indian entomology; large and gaily-coloured beetles, I supposed, would be crawling on almost every shrub, gorgeous butterflies befilling the air, moths be swarming about the forest-edge at night, and caterpillars be beaten from every bush. These expectations were far from being realized." Gosse discusses further the various butterfly species that are exceedingly common on the island and also decries the paucity of larvae present. For example, he collected 20 species in Newfoundland during an hour and half one afternoon, but scarcely saw 20 species during his whole stay on Jamaica. Similar observations on the species diversity of the West Indies and other areas of the neotropics have been made by Longstaff (1907).

#### History of Lepidopterology in the West Indies

There is little information about early collecting in the West Indies, and that available is largely devoted to the fauna of the Greater Antilles. Perhaps the best known source is the diary of Hans Sloane, who visited Jamaica in 1687 as a physician to the Duke of Albemarle. Sloan recorded observations and collected on the island for 15 months. During this period he collected more than 3800 insects, including immature stages, most of which were illustrated and published in 1725. Sloane's notes and illustrations were of significant interest to Linnaeus in his compilation of butterflies in 1758, the official starting point for zoological nomenclature. Many of the butterflies described were endemic Jamaican species, but others such as *Phoebis sennae* (L.) have associated subspecies on the continent. Many of these New World taxa were described by Linnaeus (1758), Fabricius (1775), Cramer (1775–80), Drury (1770–73), and other early authors who depended on other collectors to obtain specimens and who relied on the accuracy of their data. There are still some definite concerns about the precision of the locality data associated with these species. In some cases the distributional ranges were extended by thousands of miles and sometimes by entire continents!

TABLE 1. Faunal Studies in the West Indies.

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General
Clench (1964)
Comstock and Huntington (1943)
Godman and Salvin (1879–1901)
Scott (1971)
Riley (1975)
Walsingham (1897)
Specific
Bahama Islands
Clench (1977a, 1977b)
Clench and Bjorndahl (1980)
Rindge (1955)
Simon and Miller (1986)
Greater Antilles
Alayo and Hernandez (1981)
Avinoff and Shoumatoff (1946)
Bates (1935)
Brown and Heineman (1972)
Carpenter, Hale, and Lewis (1943)
Comstock (1944)
Gundlach (1881)
Hall (1925)
Holland (1916)
Poey (1832)
Ramos (1982)
Schwartz (1983; 1989)
Smith et al. (1988)
Torre y Callejas (1954)
Wolcott (1927)
Lesser Antilles
Godman and Salvin (1884; 1896)
Hall (1936)
Pearce (1969)
Pinchon and Enrico (1969)

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The major faunal studies in the West Indies have been devoted to the larger islands, especially those of the Greater Antilles (Table 1). These surveys include the works of Gundlach (1881), Poey (1832), Bates (1935) in Cuba, Darlington (1934, 1939) and Schwartz (1983, 1989) in Hispaniola, Comstock (1944), Ramos (1982), and Wolcott (1927) in Puerto Rico, and a long list of collectors and researchers in Jamaica summarized in the invaluable *Jamaica and its Butterflies* by Brown and Heineman (1972). The references in Table 1 are restricted to faunal surveys and do not include individual revisionary treatments. While time does not permit me to discuss the merits of each work in detail, I would like to mention a couple of these and other studies briefly and note some of their major contributions.

W. J. Kaye, an engineer by profession, first visited the West Indies about 1918. While he worked for the British government, especially on Jamaica and Trinidad, his spare time was spent studying the Lepidoptera. Perhaps his favorite tropical genus was *Heliconius* Kluk, but his scientific contributions included comparative analyses between the Greater Antillean and Central American faunas, noting, for example, the absence of mimicry complexes in the Ithomiidae on Jamaica as compared with the genera and families represented in Central and South America. Kaye willingly shared his field notes and observations on endemic taxa with Holland, Bell, and Rothschild, among others. In addition, he described a number of species, including *Thecla burdi* (= *Electrostrymon angerona*), *Leptotes perkinsae*, *Phocides perkinsae*, and *Rhinthon thermae*. He also began to delve into the geographical and geological separation of these islands, noting differences in sea depths long before plate tectonic theory and vicariance biogeography came into the fore. Some of these latter observations were presented in an address to the Royal Entomological Society in 1925 by this learned entomologist who considered himself to be amateur! For more than 40 years, Kaye traveled throughout the Caribbean collecting, and he was an active member of the Royal Entomological Society of London for 63 years.

Another avid lepidopterist interested in the West Indies was Harry Clench, a co-founder of the Lepidopterists' Society. Harry served as an Associate Curator at the Carnegie Museum of Natural History, and was best known for his keen interest in and work on the Lycaenidae, especially the Central American fauna. From about 1967 onward his interests changed somewhat to include the comparative study of the butterfly faunas of Florida and the Bahamas, especially of the islands of Andros and Great and Little Inagua. In 1978, Harry and his wife, Mary, a prominent ornithologist, completed a major faunal survey of many of the Bahamian islands previously or rarely collected, making notes and observations on foodplant associations and perching behavior. Although some of these observations and new taxa were published, a great deal of unpublished knowledge was lost with Harry's untimely death in 1979. However, his legacy lives on in the new discoveries shared and the uncanny enthusiasm that he generated through correspondence with other researchers and collectors, particularly Don Harvey, Al Schwartz, and the Millers, among others.

### The Future: Where Do We Go From Here?

Since that momentous discovery of the Western Hemisphere in 1492, man has continued to explore the world and record its natural phenomena. However, in these almost 500 years, how much of this infor-

mation concerning the fauna and flora has been actually documented and published? Are there some new discoveries and observations to be made on Lepidoptera in the West Indies, the United States, and elsewhere? The fact that this Society meets each year indicates that there is indeed new knowledge and information to be shared. In preparation for the forthcoming volume on the butterflies of the West Indies and southern Florida, we have learned how incomplete our knowledge of the area is. Although Norman D. Riley produced a superlative volume in 1975 (*A Field Guide to the Butterflies of the West Indies*), additional field work, study of collection records, and some limited life history work have expanded our knowledge about the butterfly taxa in the area.

In conducting faunal surveys, we need to continue to pose what appear to be rather ordinary questions. First, what taxa are present and what time of the year are these species observed? Are these derived from or associated with the current continental fauna, or are they part of the endemic fauna of the West Indies? It is generally not difficult to obtain the appropriate identification of endemic taxa to the generic level such as the satyrid, *Calisto* Hübner, or the hesperiid, *Ephyriades* Hübner, or with such distinctive species as *Electrostrymon angerona* (Godman & Salvin), *Polites dictynna* (Godman & Salvin), *Wallengrenia ophites* (Mabille), and *Chiodes vintra* Evans. However, exploring the phylogenetic relationships of continental and West Indian taxa can be a stimulating mental exercise, particularly with some HesperIIDae such as *Pyrgus* Hübner, *Astraptus* Hübner, and *Rhinthon* Godman. Among the Heterocera, consider the dilemma of the origin of *Ircila hecate* (Herrich-Schaeffer), the only endemic castniid species in the West Indies and recorded from Hispaniola. The wing maculation is similar to the Mexican species, *Athis inca inca* (Walker), but other characteristics closely align this species with the Brazilian genus *Synpalamides* Hübner. This evidence would appear to indicate that the ancestral stock is relatively old and dates from the late Cretaceous or early Paleocene.

Other questions that should be addressed include: What are the current distributional ranges of these Lepidoptera, and Where are they found (ecological associations)? The literature is replete with broad assumptions about geographic distribution of taxa, and the West Indies presents some rather interesting puzzles on occasion. For example, on Puerto Rico, the lycaenid *Strymon columella cybira* (Hewitson), a distinctive subspecies, occurs; however, just on the offshore on Culebra Island, less than eight miles to the east, the nominate species, *S. c. columella* (Fabricius) is found. Other curious distributional patterns include those of *Hemiargus thomasi* Clench, a species that is widely distributed throughout the West Indies, with nominate *thomasi* Clench

on Long Island, and *H. thomasi bahamensis* Clench from Crooked Island, 70 miles to the south. On Mayaguana Island, another subspecies of *H. thomasi* is being described (Miller, Simon & Harvey in press). Finally, on the Virgin Island of Tortola, we find *H. t. watsoni* Comstock & Huntington. What is the evolutionary history of these subspecies? How did these taxa arrive here: was it through dispersal or vicariance or both?

To explain their present distribution, we need to analyze the present and previous distributions of other groups with fossil records in conjunction with the geological evidence. For example, the current geological evidence indicates that the fauna of the southern Bahamian islands is most closely related to the Greater Antilles, and, curiously enough, another subspecies of *H. thomasi*, *H. t. noeli* Comstock & Huntington, has been described from Hispaniola. The latter has not been recorded from Cuba, Jamaica, or Puerto Rico in the Greater Antilles.

All of the above questions need to be addressed if we are to analyze the biodiversity of an area properly. Obviously, thorough systematic and taxonomic revisions are required to make the appropriate identifications and evaluate phylogenetic relationships. However, this is only a minute portion of the problem. Unfortunately, the Heterocera and a number of other insect orders have been inadequately sampled or totally ignored.

Although Gundlach, Poey, Perkins, Kaye, and Turner have made some considerable contributions to our knowledge of the life histories of West Indian Lepidoptera, there have been few studies **published** since the mid-sixties. Of the above, Lilly Perkins, for whom Kaye named *Phocides perkinsae* and *Leptotes perkinsae*, is an unsung heroine and was an excellent correspondent, researcher, and collector from Jamaica. Like Kaye, she provided information, specimens, and logistical support to a number of collectors and researchers who frequented Jamaica. Perkins' major contribution was the study of immatures and she kept detailed records of their associated larval food plants. Although a number of collectors have subsequently published on the Jamaican fauna, her observations on life histories are the only information available on many species. These descriptions often were documented in her correspondence and published by other authors.

What about the behavior of Lepidoptera in the field? These studies should include a variety of parameters, including observations of flight and mating behavior. In 1844–46, Philip Gosse, the British zoologist, made observations on flight behavior of different lepidopteran species in the West Indies, noting, for example, the crypsis of *Phoebis sennae* in association with yellowish flowers, in addition to the seasonality of



Lepidoptera. These were unparalleled contributions to the general study of the Lepidoptera and are some of the earliest studies published. Likewise Schwartz (1989), in his notable *Butterflies of Hispaniola*, recorded adult behavior and ecological associations of butterflies. Other behavioral observations that are rarely noted but that should be recorded include perching (where does "x" or "y" prefer to perch, its position, and preferred substrate), flight levels (how far above nectar sources does the butterfly normally fly?), and feeding (a record of the identified preferred nectar sources). Other information to record might include the main emergence periods for particular species and the number of broods each year.

How about other discoveries in the West Indies? The age and geological picture of this area, especially of the Greater Antilles and the Bahamian and Virgin Islands, has always been cloaked in mystery and is constantly under review (Pindell & Dewey 1982, Case et al. 1984, Burke et al. 1984). We presented evidence in support of a vicariance/dispersal distribution and origin of the West Indian lepidopteran fauna (Miller & Miller 1989). Recent data confirm that there are proximal Cretaceous-Tertiary boundary impact deposits in the Caribbean to the south of Cuba (Hildebrand & Boynton 1990). Upon reevaluation of the present lepidopteran distributions, this evidence may affect our current concepts of the age and origin of certain Lepidoptera in the West Indies.

Finally, but not least, is conservation. It is absolutely essential that we address as many of the previous questions as possible before we can make the intelligent decisions concerning conservation management and protection of the remaining available habitat and its associated species. With the rapid disappearance of unique habitats, such as tropical rain forests or xeric broadleaf forests, our ability to document the species biodiversity throughout the tropics or in other critical habitats may have been diminished by other economic considerations. However, lepidopterists' concern for the environment and the protection of species is nothing new. Kaye, in a letter dated 13 May 1930, stated his concern for the habitat protection of *Papilio homerus* Fabricius and its possible association with water mahoe, *Hernandia catalpaefolia*, as the potential larval food plant. At that time the government saw no special reason to protect this disappearing habitat. Recently, through the efforts of Tom Turner, John Parnell, the World Wildlife Fund and others, some progress has been made. However, politics and human economic concerns are seemingly more important, and the future of *P. homerus* is uncertain. Again, man's impact on the environment in the West Indies has perhaps altered it forever, and definitely not for the better.

All of these critical questions that I have posed are applicable to other biogeographical areas, and for those of you more interested in

North American fauna, I would direct you to any of the major references, such as Scudder (1875), Holland (1898), Klots (1958), Howe (1975), Opler and Krizek (1984), and Scott (1986), and let you evaluate for yourself as to how incomplete our knowledge about North American butterflies actually is. You may have unknowingly made some significant observations on some these species but never published the information. Documenting what a lepidopteran species does for a living is really a formidable task, and one which is curiously neglected in the literature.

In this brief space, I have summarized an encapsulated history of the study of the West Indian lepidopteran fauna, discussed some of the major workers, and presented some of the areas which require further study. How much knowledge about the lepidopteran fauna or other insect orders have we documented since Columbus' discovery of the Western Hemisphere? The answer comes back resoundingly: *not nearly enough!* There is a lot of work ahead and a number of questions and problems remain to be resolved. The sands of time will wait for no one. The age of discovery in the study of Lepidoptera is now!

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