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PRESIDENTIAL ADDRESS, 1988: LEPIDOPTERISTS—COLLECTORS *AND* BIOLOGISTS?[1]

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Additional key words: food plants, diapause, behavior, longevity, seasonal abundance.

Traditionally this Society has invited the president to expose ideas and opinions in an address, even though they may reflect little hard data. Today is no exception. This discussion will try to encourage collectors, especially amateurs, to devote part of their seemingly limitless energy to the study of Lepidoptera biology.

For purposes of this discussion, an amateur is someone who has to pay money to study Lepidoptera; a professional is someone who gets paid to study Lepidoptera. We all know amateurs who do excellent work and accomplish an astonishing amount, and some professionals who don't get much done. There may even be a few examples of the reverse. Similarly, by this definition there are amateurs with Ph.D.-level training in biology and professionals without it. Hence, there is no inferior connotation in my use of the term amateur.

I thought it might be fun to begin by looking at a subject that is of interest to spouses and other people who get dragged to these meetings or into other embarrassing situations, that is: Why do we collect Lepidoptera?

The urge to accumulate collections is, of course, not restricted to Lepidoptera—the affliction is widely expressed in non-biological artifacts, and it seems unrelated to genetic or environmental inheritance.

My earliest recollections of collecting, when I was 7 or 8 years old, are of bottlecaps. (This was long before twist-top caps were invented, and it was a challenge to get specimens in perfect condition, because

[1] Delivered to the Annual Meeting of The Lepidopterists' Society in Pittsburgh, Pennsylvania, on 16 July 1988.

people would bend the caps when popping them off with openers called "church keys"; these were given out free with beer purchases and had beverage company names imprinted, so some people collected church keys, although I never found that particularly fascinating.) My parents, who never had the slightest interest in collections (which is also true of my brother, wives, and kids), watched, presumably bemused, as I progressed through matchbook covers, military implements, fossils, seashells, and moths, assuming I suppose, that I would mature, get over the penchant, and settle down to dentistry or some other respectable career. They were, of course, wrong on all counts.

Recently I heard a M.D. who collects art and antiques, express it on TV: "Collecting is an affliction that is intractable as any virus, one for which there is no immunity nor cure." We simply have it. I understand that psychologists term it a "personality disorder"; but, quite frankly, I find people who don't have the addiction kind of deprived.

Gary Larsen's cartoon depicting the guys returning triumphantly from the hunt with a huge swallowtail tied to the hood of their car probably gives a better perception of our feelings than most of us could verbalize; nonetheless, I will try to analyze why collectors collect Lepidoptera. I divide the phenomenon into four components: 1) Lure of Collectibles, 2) Hunter Instinct, 3) Acclaim from Peers, and 4) Satisfaction in Discovery.

Probably any lepidopterist would think of other ways to dissect the reasons why collecting is compelling, but most will recognize two or three elements here that contribute to the urge to collect. Any one of these might be the main source of pleasure for any given collector, but probably most of us have never tried to explain it and don't feel a need to. It is only our incredulous friends and relatives that ask, or don't ask but just sigh and look the other way.

Lure of collectibles. It is unfathomable what constitutes collectibles. Apparently, like a queue in England, it only takes two or three. A few of anything that can be conceived of as constituting a set or series will suffice to start a collection. I find it imponderable that someone recently paid $650 for a copy of the high school yearbook of Don Mattingly's graduating class. In fact I don't understand the urge to collect where it depends mainly upon purchases, such as art, yet it must be incredibly compelling. Every conceivable series of objects (or even non-series in the case of Andy Warhol) can be and is collected. The urge has nothing to do with biology, necessarily, as can be attested by the number of lepidopterists who also collect postage stamps—one even collects monogrammed golf balls!

Pleasure from the collection itself is the primary goal in some instances, as epitomized by European collectors who buy specimens from

Tropical Regions at auction for large sums. (Others of us buy them discretely from Welling or Plaumann.) Many collectors seem to derive a lot of their satisfaction and pleasure from the appearance of a neatly curated collection. They actually like spreading and preparing specimens, I guess. This aspect of the affliction provides continuing challenges in time and effort of preparation of specimens, in attempting to obtain perfect specimens to replace less aesthetically pleasing ones (if this is the main goal), and in keeping up with costs of equipment and space for storage (less a challenge with micros than with saturniids, of course).

Hunter instinct. Quite aside from the resultant collection, there is considerable satisfaction derived from the challenge of the hunt—planning the quest, searching for the appropriate habitats, predicting the timing of visits and so on. The anticipation is half the fun (often more). Also satisfying is the skill required in stalking and catching the prey, particularly for rare species and especially for those not seen before. As we all know, those are the hardest ones to catch. This seems to be the leading source of satisfaction for some collectors, to hear them boast. It certainly must be more important than preparation and curating for many collectors, to judge from the amount of papered material that accumulates.

For many of us, I think, it is the lure of adventure that is a strong factor. To see the open road ahead, leading to new and potentially exciting areas (particularly if other lepidopterists have not visited them), is the seduction, coupled with the anticipation that something new may be discovered. The adventure: to collect in exotic areas is the need—the specimens are secondary. Most lepidopterists, if given the choice, obey Powell's Law (Munroe, E. G. 1969, Proc. Entomol. Soc. Ontario 99:43), which can be paraphrased as, "No biologist willingly collects within 1,000 miles of his home base." Thus, lepidopterists living in California go to Mexico to collect, or to Costa Rica if we have a grant; our host at the Carnegie leaves Pennsylvania to collect in Ecuador and Taiwan; people in Kentucky and northward all go to Florida every spring, while those in Florida are gone to Trinidad or Hispaniola (that is not 1000 miles unless you are from Gainesville, but that's OK because it's an island); people in Washington spend summers in Colorado and Utah, except for Don Davis who collects everywhere else in the world; everybody collects in southern Arizona except Arizonans, who go to Mexico.

Doug Ferguson is the exception; they say he collects in his yard in Maryland. Incidentally, Ferguson, our immediate past president, wrote me and said he would not be able to attend the Executive Council meeting here—he is collecting in British Columbia.

Simply the enjoyment of getting out to natural areas, away from

phones, freeways, smog, commuting, demands of the job and responsibilities at home has to be a big factor, for amateurs and professionals alike. After all, collecting is a lot more fun than committee meetings, preparing lectures or budget reports, etc.

Acclaim from peers. For some, there is pride in exhibiting accomplishments; presumably these often are the same people who get the most satisfaction out of the collection itself. Competitiveness is a factor, certainly more so for some people than others.

Most lepidopterists would not believe that fame is much of a factor in why we collect (notoriety is a better descriptor), yet I wonder how many of us would maintain enthusiasm if we thought *absolutely* nobody else cared (as opposed to hardly anybody else)? Even though we go collecting mainly for the enjoyment, challenge, and satisfaction in obtaining the specimens, can you really say that often you don't think "wait till so and so hears about *this*!"?

I know one of the things I really enjoy is discovering things for other researchers, and I think this is a prevalent feeling among many collectors, amateur or professional (of course it is particularly enjoyable if it is a species I think they have overlooked in areas they have or could have worked).

The lure of patronyms should be mentioned. Some collectors are unabashed in their admitted desire for this form of immortality; others do not admit it, yet they look coyly away, suppressing a smile of delight, if you mention it. Possibly some hardened professionals don't care at all, but you would be tempted to question their honesty. The indignant condemnation of the increasing use of patronyms voiced by Dimock (1984, J. Res. Lepid. 23:94–101) was misguided and pathetic—misguided because he did not list the two most useful roles patronyms fulfill, to acknowledge collectors' efforts and to avoid secondary homonymy, and pathetic because it will be ignored.

Satisfactory in discovery. Beyond the fun of collecting and the pleasure in curating the collection, for biologists there is the added feeling of accomplishment in discovering new information, finding out things that nobody has known before. I see this as a bonus to the lure of collecting, one that you would not derive from collecting stamps or baseball cards.

For sheer joy of accomplishment, I don't think the discovery of facts "new to science" is surpassed by any other aspect of collecting. Who among us is not pleased by finding a new population or state record of even a well-known species?

For specialists in microlepidoptera, finding a new species in a museum collection is not very exciting; it means more dissections and descriptive

work—Ron Hodges has how many new *Chionodes*, 150? But finding a new species that you recognize in the field—ah! that is another matter. Then you feel you are the discoverer, not just a processor filling in another space in the stamp album.

For me, there are two kinds of discoveries from which I derive the most satisfaction. First, there is the finding of a "lost" species, one collected and described long ago and perhaps known only from one or a few specimens. For example, the rediscovery in Chihuahua of *Apodemia phyciodoides* a few years ago must have been a great thrill to Richard Holland (although no doubt he showed no outward display of excitement). Second, even more enjoyable to me, is the discovery of the key to an insect's biology, particularly a species that has been known for a long time to lots of collectors.

It is this last, of course, that I wish to emphasize today—a satisfaction that is available to everybody without obeying Powell's Law, if you spend some time watching the animals instead of taking the pinch-first-and-ask-questions-later approach. I can share a couple of experiences of these kinds of discoveries:

1) Rediscovery of *Ethmia minuta*. I began a study of *Ethmia* while still a student. One day on a visit to the San Diego Natural History Museum, I found specimens of this elegant little species—at the time the smallest known member of the genus and the only one with marked sexual dimorphism in wing color—the kind of thing that, as a specialist, you say immediately: "that's new." But these had been collected by W. S. Wright in 1916 and labelled "San Diego." During the interim, San Diego had grown from a village of several thousand people to a city with a population of ¾ million and huge urban sprawl, so there seemed little hope of recovering the species. I will never forget the thrill then, when a couple of years later in the foothills back of the city I found adults of this "lost" (for 45 years) species at flowers of *Cryptantha*, which proved to be the key to its interesting biology, with the female ovipositor greatly modified to penetrate the densely hirsute floral buds.

2) The surprising biology of *Ethmia scylla*. I collected the first specimen of this nondescript species at Mt. Diablo near my home in 1959. John Burns and I went out the following spring and collected a nice series, which was gratifying; but 10 years were to pass before I discovered its biology. This involved repeated trips early each spring, misguided in the belief that some borage or hydrophyll must be the host plant because most ethmiids depend upon those plants. Finally I caged females with unlikely (to me) plants from the habitat, and in one day the females chose what they wanted for oviposition. The larvae feed

in the flowers of *Collinsia*; *Ethmia scylla* is the only species in this worldwide genus known to use Scrophulariaceae. It was a satisfying find but also taught me a lesson about making assumptions.

WHAT KINDS OF BIOLOGICAL STUDIES ARE NEEDED?

In the remaining time, I will briefly summarize some examples of biological studies of the kinds any of you can carry out with minimal equipment in your local area.

Larval Foods and Habits

The most obvious biological characters to most lepidopterists are the food plants. You might think that this aspect is pretty well documented, but even for North American butterflies much remains to be discovered. One of the most famous for his untiring efforts in this field is Roy Kendall in Texas. In response to my inquiry he estimates that he has reared more than 750 species of Lepidoptera, including about 330 species of butterflies. About 40% of these are thought to have been previously unknown. He has more than 2000 vials of preserved larvae. I would like to quote from a letter:

"I can't recall anytime during the past 30+ years when there was no livestock in my lab, and there is no end in sight [at age 76]. Although many lepidopterists consider certain species 'trash,' I find them very interesting and often rear these as well as 'goodies' numerous times from different localities." He also says, "Incidentally, I am an amateur in every sense of the word. The only formal training received was a 3-hour high school course in zoology." Yet Kendall probably has contributed more to our knowledge of larval biology of North American Lepidoptera than any other single person. Publications by Kendall or others with whom he readily shares unpublished data have recorded host plants or other information on about 500 species.

While it often is a lot of work, compared to merely collecting and killing adult Lepidoptera, I cannot overemphasize the need for this kind of work: the repeated study of biologies of different populations of the same species, in order to confirm existing records and to discover and document geographical and seasonal variation in biological characteristics. Just because a butterfly book states that a certain plant is the host of a species does not mean that its biology is known. You should question all such statements; errors are perpetuated by repeating from such books, and, even if correct, the statement may be based on a single record or apply only to a portion of the insect's range. Moreover, when one of the beautiful adults emerges, it is a lot more satisfying than going to some locality listed in the Season Summary to recollect adults.

Important kinds of rearing studies that need to be carried out include

emphasizing diverse larval niches, not just external foliage feeding caterpillars. Many species feed in leaf litter or as borers within roots or stems, in seeds, galls, or leaf mines. Backyard studies, such as that reported here yesterday by Bill Miller on sibling species of gall moths, await the attention of lepidopterists in every part of North America. Few places have been well surveyed for leaf mining species, yet the various genera have highly characteristic forms of mines by which you can learn to identify them, and they often live for long periods in this stage, so that the precise timing of search needed for the adults is not so critical. Wagonloads of food plant and a pitchfork are not needed as when you rear saturniids; just hold the leaf in a vial for a few days and often a beautiful (and frequently undescribed) moth comes out.

Such studies are best carried out on a local basis, where you can repeatedly visit a habitat. Any place in the Western Hemisphere will have literally hundreds of species that have never been reared before, or have only been studied in another region. John De Benedictis has carried out a several-year survey at San Bruno Mountain near San Francisco and to date has reared about 150 species of microlepidoptera; still, each visit recovers larvae that he, and often anyone else, has never seen before. Patience and painstaking search of the different ecological horizons (roots, stems, flowers, fruit, mines, etc.) of all available potential host plants are the requisites.

Before leaving this topic, I'll make a pitch for preserving larvae. It is easy to obtain good specimens by simply immersing in boiling water for a few seconds or minutes and then preserving in drugstore rubbing alcohol. Far more species have been reared than the number for which we have material useful for larval studies, even in butterflies. Much of the emphasis in the past has been to obtain perfect specimens of the adults. Photographs of the larvae are not adequate for identification of most moths, and our knowledge of larval taxonomy lags far behind that of the adults for nearly all families.

Adult Behavior, Longevity

Mark-release-recapture studies of individuals, while time-consuming, are fun to do. They yield information on dispersal, differential movements of males and females, lifespan, feeding habits and so on, and they have been carried out for rather few North American Lepidoptera. These studies do not have to be very sophisticated to produce new information. All you really need is a felt-tipped pen with permanent ink, a notebook, and a net. For example, Smith (1982, J. Lepid. Soc. 35:172) marked and released common butterflies in his backyard in Sacramento and learned from recaptures that individuals of *Pieris rapae* and *Papilio rutulus* live up to 39 days, *Battus philenor* up to 44 days.

We lack this kind of information for almost all Nearctic butterflies and moths.

My backyard was the exotic locality where I studied mating behavior of *Incisalia iroides* (1968, J. N.Y. Entomol. Soc. 76:47). The whole study, which I think still records the most data on mating of any North American thecline, took place at a small lemon tree that the males liked to use as a perch. Mating occurred in late afternoon and extended into evening, so I could easily handle the mated pairs, mark individuals, and return them undisturbed to their perch. I suspect that mating habits of theclines generally have been overlooked because the butterfly people tend to keep bankers' hours.

Waldbauer and Sternberg (1982, J. Lepid. Soc. 36:154–155) released marked *Hyalophora* in Illinois and recorded recaptures of 18 males 6.8 miles away, using virgin females as bait; and, in a similar study, Toliver and Jeffords (1981, J. Lepid. Soc. 35:76) recorded *Callosamia* movements 14 and 36.5 miles from their release points. But for the vast majority of Lepidoptera we have no data on dispersal capabilities.

Mark-release-recapture studies of skippers have been few and not wholly successful. Handling most species evidently disturbs the individuals more so than is true of other butterflies. After releasing about 50 marked *Paratrytone* and never seeing one return, I developed a method of marking them without capture. Using a brush made from a feather, I found that males could be marked as they perched, with a mixture of ink and paint. Residency and competition for perches could then be monitored.

Studies of adult feeding also are needed. Paul Opler recorded floral visitations of butterflies in Virginia and found their choices to be a correlation of tongue length and corolla depth (Opler, P. A. & G. O. Krizek, 1984, Butterflies east of the Great Plains, Johns Hopkins Univ. Press, Baltimore, Maryland, 294 pp.), rather than just by color, or by plant taxon, as butterfly enthusiasts often assume.

One of the most remarkable studies on feeding is that of Bill Miller, who carried all his equipment to the stage when he reported the study to us at Berkeley last year: a dixie cup, a water vial, and a wick. He demonstrated increased fecundity in the spruce budworm when females imbibe nutrients (1987, Environ. Entomol. 16:1291–1295). This may not seem profound to you, but a recent bibliography recorded more than 4000 references to this insect, easily the most intensively studied species of Nearctic Lepidoptera, yet nobody had done this kind of study previously.

"Mud puddling" has received some attention, but there are many unanswered questions. Only one extensive study, that of Adler, has been carried out (1982, J. Lepid. Soc. 36:161–173). He recorded 93 species

of moths at mud in New York; 99% were males. However, 80% of one geomtrid visited flowers instead. Why don't females do this, and why is it so rare in California? Why do some species have this habit while others do not?

Predation is another phase of biology that everybody seems to take for granted but nobody does much about documenting. The observations by Paul and Anne Ehrlich on lizard predation of tropical butterflies a few years ago is an example of how data can be recorded with a little patience (1982, J. Lepid. Soc. 36:148–152).

Seasonal Abundance

This is another field wide open for investigation. The classic study is Ehrlich's team research on *Euphydryas editha* over a 25-year period (1975, Science 188:221–228, *et seq.*). But such sophistication and funding are not necessary. The counts by Sidney Hessel of *Catocala* attracted to mercury vapor lamps at one site in Connecticut during a 12-year span, summarized in Sargent's book (1975, Legion of night, Univ. Massachusetts Press, Amherst, 222 pp.), are almost without parallel. Indications of increase or decline seen during a five- or six-year period were misleading when longer term fluctuations were observed. Smith (1984, J. Lepid. Soc. 37:275–280) also did this by counting butterflies for two-hour periods in his backyard for 12 years. There were large year-to-year fluctuations but no general trends, such as are often alleged.

This is a reason that the annual counts of butterflies sponsored by the Xerces Society are useful. We had 87 counts reported in 1987 [99 in 1988]; if we can obtain 150 or 200 that are reported on a continuing basis, general trends in abundance, as well as migrations and other comparative data, will be enhanced. A 15-mile diameter circle is selected and all the butterflies seen in one day counted. The object is to compare abundances from year to year at about the same date at each site. Obviously a place like Berkeley is not going to have the species richness of a site in southern Arizona or the Rocky Mountains, but after 14 years we have a good basis for predicting and explaining increases and decreases in abundance from one year to another in our circle.

Diapause

For most species we have little information on diapause development. The study by Sims of *Papilio zelicaon* (1983, J. Lepid. Soc. 37:29–37) is a good example of what can be done. He showed that populations on native umbells were univoltine, and modification of the diapause pattern enabled adventive populations to colonize urban areas on sweet fennel throughout the season. Incidentally, outdated terms such as "breaking" and "triggering" should be dropped from your vocabulary;

the process is a dynamic one that takes place over many weeks or months. Treatments such as constant temperature chilling that results in development in one instance may not do so for all populations of a species or even all individuals of a population.

A special interest of mine has been prolonged diapause, the maintenance of dormancy for more than one year. I published a summary of knowledge for Lepidoptera last year (1987, J. Res. Lepid. 25:83–109). In yucca moths under optimum winter environments, all or nearly all larvae complete development, while in adverse conditions, all or nearly all maintain diapause. Adults emerge over several years, even though neighbors in the same plant have completed development in a prior season. I have emergences now up to 19 years [20 years in 1989] after collection of the fully fed, prepupal larvae, so they are prepared to wait out the adversity and the lepidopterists' patience. One advantage of such studies is that they are not very labor intensive.

In conclusion, the take-home message is that I think the anticipation and realization of discovering something new is a major factor in the attraction of collecting Lepidoptera. This part of the enjoyment and satisfaction can be fulfilled in your local area if part of your effort is devoted to study of biological or behavioral aspects of butterfly and moth populations, rather than continuing an emphasis on subspecies and county records.

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