JOURNAL OF
THE LEPIDOPTERISTS' SOCIETY

Volume 30 1976 Number 4

PRESIDENTIAL ADDRESS 1976—WHAT INSECTS CAN WE IDENTIFY?

RONALD W. HODGES
Systematic Entomology Laboratory, IIBIII, Agr. Res. Serv., USDA[1]

I work for an organization, the Systematic Entomology Laboratory of the U.S. Department of Agriculture, which is vitally concerned with recognition and differentiation of insect species. Although the numbers fluctuate from year to year, the 28 scientists in the laboratory identify approximately 250–300 thousand specimens each year. I realize that many of you must wonder as you hear me give these figures why is it that when you send specimens to be identified we do not respond immediately to a request for identification. Much of the very large number of specimens with which we deal comes from agricultural sources such as the plant quarantine stations of Animal and Plant Health Inspection Service, the Agricultural Research Service, the Forest Service, state agencies, international ports of entry, and museums. Our major resources for making these identifications are the National Collection of Insects (approximately 24 million specimens), the combined libraries of the Smithsonian Institution, the Library of Congress, and the National Agricultural Library, and the numerous files of host plants, catalogues, cards, and separates built up by the scientists working with the collection over the last 90 years.

When we talk or think about numbers of insects, we usually refer to the large number of undescribed species. The general estimate is that about 1 million names have been proposed for insects to date and that there may be 1–10 million species to be described. These figures are impressive by any standard and are often cited as one of the major problems in making identifications. But, what about the names in the

[1] Mail address: c/o U.S. National Museum, Washington, D.C. 20560.

TABLE 1. Percent of specimens associable with described species by museum workers for a series of faunas.

	N. America		Palearctic		Neotropical		Exotic	
	%	Described Species	%	Described Species	%	Described Species	%	Described Species
Diptera								
Culicidae	95	250					50	3500
Mycetophilidae	5	612					8	
Cecidomyiidae	5	1200					1	
Ceratopogonidae	75	400					25	4000
Tipulidae	95	1500					80	14000
Syrphidae	40	1000					25	6000
Muscidae	90	622					40	
Sarcophagidae	95	327					60	
Calliphoridae	95	78					65	
Tachinidae	82	1281			28	2864		
Coleoptera								
Curculionidae	75	2600	50–60		0–5		0–5	
Scarabaeidae	90	1400	90	500	50	2000	5–10	
Coccinelidae	99	400	95	200	50	600	25	
Bruchidae	100	100			90		40–50	900
Buprestidae	80	660					25	11400
Colydiidae	95	110					25	1375
Dermestidae	95	130					40	877
Histeridae	50	360					5	3500
Heteroptera	75		60		50		25–50	
Homoptera								
Aphidae	60	1500					45–50	2000
Aleyrodidae	90	500						
Coccoidea	80	1500	80+	1500	20	1000	40–50	2000+
Cicadellidae (♂ ♂)	80	3500					12	20000
Hymenoptera								
Symphyta	75	1000	60	2500	25	1000	40	2500
Formicidae								
workers	80	650	30	2000	15	2700	10	3000
♀ ♀	15		5		1		1	
♂ ♂	10		5		1		1	
Ichneumonidae	50	2850					15	15000
Chalcidoidea	50–60		50–60				5–15	
Braconidae	65	2000					10	10000
Isoptera								
soldiers	90	45			15	1000	15	1500
alates	90				15		15	
workers	5				5		1	
Lepidoptera								
Lycaenidae	95	300	98+		70		80–85	
Noctuoidea	50	3100					30	50000
Geometridae	90	1200+			50		10–15	10000
Gelechiidae	80	750					10–15	4000

literature? What do they mean as far as an identification is concerned? When you peruse the McDunnough check list or parts of the *Lepidopterorum Catalogus*, what do the names mean to you or to anyone? The answer is that they represent various states of knowledge. In some rare instances the names can be associated with biological entities in contemporary terms. A higher percentage can be associated with morphotypes and identified as such. A yet larger percentage of the names represent nearly nothing to an individual trying to make identifications.

When a field worker in ecology or biological control, or someone making an environmental impact statement, wants to have specimens determined, he normally sends them to one place, usually where systematists are willing or obligated to make determinations. In the United States the Systematic Entomology Laboratory is a major source of determinations on a broad level. In Canada scientists of the Biosystematics Research Institute make determinations. And, there are several regional identification centers such as the California Department of Agriculture, the Florida Department of Agriculture, the Illinois Natural History Survey, the New York State Science Survey, as well as individual systematists at numerous universities.

Because I have access to information about the National Collection and workers associated with it, I asked the following question of our scientists: On the basis of the collection and the literature available to you, what percent of the names in the literature can you associate with specimens for a series of faunas with a fair degree of certainty? The answers were couched with various degrees of uncertainty and were not for a consistent series of zoogeographic areas. For North America north of Mexico I have listed data for each family group. For areas other than this I have data for different associations of areas. Some of the responses are as follows (Table 1):

The numbers become monotonous, but they serve to emphasize the point that we can identify relatively well the described North American fauna and very poorly the fauna from other parts of the world. Also, these figures are for adults. When the comparison is made for taxa for which larvae are known, the contrast is striking (Table 2).

What do these figures mean in practical terms? Currently, we cannot identify with certainty a relatively large percentage of the described world fauna.

Without question there is a need to know what these insects are. When an insect is intercepted at a port of entry, the question arises, "Is it of economic importance or potentially of economic importance?" If it is, certain measures will be taken. If it is not, and the only way

TABLE 2. Percent comparison of larval and adult specimens associable with described species.

	N. America		Palearctic		Neotropical		Exotic	
	%	Described Species	%	Described Species	%	Described Species	%	Described Species
Symphyta								
adults	75	1000	60	2500	25	1000	40	2500
immatures	10		10		1		1	
Formicidae								
workers	80	650	30	2000	15	2700	10	3000
immatures	1		0		0		0	

one can say that it is not is to know what it is, then the commodity can enter the country directly.

A generic or family level determination is not adequate for sampling work. Much of the time and money spent on numerous surveys has been and continues to be wasted for lack of specific determinations. Meaningful comparisons for most purposes can be made only at the specific level. The main reason for stopping short of this level is lack of available expertise and/or cost of determinations. Use of parasitic insects as biological control agents requires specific determinations. The pendulum is swinging back insofar as needing to know exactly what an insect is for control programs in agriculture. No longer can all insecticides be used indiscriminately for pests. Each target insect must be identified on the label, and the insecticide must be used where needed—not ubiquitously. The Systematic Entomology Laboratory was started when there was a need to know insects for agricultural purposes. With the advent of DDT and successors, many entomologists thought that all the crop problems caused by insects would be solved by their use. We know better now. Control or suppression—not eradication—is a major goal in agricultural research today.

Unfortunately, for economic and social reasons, it apparently is not justifiable to spend a research career on basic taxonomic work in most educational institutions. I strongly argue this concept. As long as there is a need to know what animals are, then we must continue the process of making known what has been described, refining our means of recognizing species, genera, and higher categories, and integrating the undescribed species into a system.

Within the Lepidoptera the families are in varying stages of knowledge. The butterflies are probably the best known with the papilionids

at the top of the list. For the large superfamilies, Noctuoidea, Geometroidea, Pyraloidea, Tortricoidea, Gelechioidea, Yponomeutoidea, and Tineoidea, many problems are extant in determining what a name represents or with which genus a new species should be associated. In many instances specimens in collections have been identified by comparison with colored illustrations, by direct visual comparison of specimens with the holotype, by comparison of specimens with other determined specimens (often at the British Museum (Natural History)), by comparison with written descriptions, and rarely by direct comparison with the holotype of several character systems. Most of the major papers written before 1940 have been done without examination of type-specimens, including some that appear useful such as Heinrich's revision of the North American Olethreutidae, or without study of the male and female genitalia. With much of the literature nearly worthless except to validate scientific names and with many specimens in the collection questionably determined, I contend that the base of our science is very weak.

Someone must accumulate a large amount of material for each group in need of revision, draw together the available names (sometimes names are "hiding" in other families or superfamilies), study the type-specimen for each name, and associate each name with one or more specimens in the accumulated material. For a group as large as the Noctuidae with more than 5,300 generic names and 60,000 specific names the initial stages require an immense amount of time and dedication. Variation among specimens must be assessed. To my knowledge species vary in nearly all characters, and for this reason the male or female genitalia sometimes are no more final for specific determination than the shading of the color pattern, wing length, or other characters. Also, reliance on single characters for specific or generic distinction undoubtedly produces untenable classifications. Many of the species and particularly many of the genera are more widely distributed than our predecessors recognized, and often names proposed for specimens from other zoogeographic regions will prove to be senior synonyms of names proposed for specimens from North America. Conversely, many names have been applied too broadly in the past. These factors indicate that the studies should be done on as broad a base as possible, particularly at the generic level. Also, working with large numbers of species and genera gives the student a better perspective for his treatment of all categories.

Special problems that Lepidoptera give to workers are their relatively large size, obvious color pattern, and scale covering. These have enabled many to work without recourse to study of other characters. Or, for wing venation, specimens have not been properly prepared for study.

Many wings have been studied by temporary clearing of a part of the wing with volatile solvents rather than removing the wing, clearing, staining, and mounting it on a slide so that all veins could be studied properly. Many workers didn't use microscopes. Edward Meyrick, who described more than 15,000 species of Lepidoptera, refused to use a microscope until his later years, and he refused to acknowledge that genital characters were worthwhile. He based much of his classification on the venation as seen through a hand lens. Meyrick died in 1938. If Lepidoptera were smaller, then workers would have been forced to study them at greater magnification initially and perhaps done a better job of comparative work.

Lepidoptera, in general are very poorly collected. Although there are series of butterflies from several localities, this is not the case for the moths. There are many instances in which only the holotype is known or the extant specimens are less than 5. Before we can understand the species and their relationships, we must have much better representation of each species from numerous localities throughout its geographic range. This part of the cycle is going to be very difficult to fill because one of the major sources of material is amateur collectors who find it very unrewarding to collect specimens and not be able to identify them. At the moment systematists cannot provide names for many species, or the number of systematists relative to those who would like to have names for specimens is so small that were they to do nothing but name specimens they would have no time for revisionary study.

As we progress in our knowledge of the Lepidoptera, it will become necessary for those who want or need names for specimens to submit them properly prepared, with wings spread, in as good condition as possible, and with the genitalia prepared for study. It is not reasonable to expect the systematist to spend 1–2 hours preparing a specimen, so that he can begin to make a determination unless the correspondent wants to spend $30–40 for an identified specimen.

One can ask, "Where do we go from here?" At the present rate of study the answer is "not very far." With the current small number of systematists doing revisionary work, the likelihood that the world fauna will be known in a comprehensive manner is very low. The described, world fauna of Lepidoptera is more than 140,000 species, and if projections are correct, the total may be as high as 280,000–1,400,000 species for the world. The demands on systematists' time are such that to be able to revise 60–100 species within a year often is not possible. Also, the first needs are for general studies covering the higher categories through the generic level for the world. If done for smaller zoogeographic

areas, the revisions must take into account the genera of the world. From this point others can revise genera or groups of genera for the world or smaller areas. We also need general manuals for use by a broad spectrum of persons from the amateur to specialist. However, under current administrative requisites for job evaluation large projects are not favored. Many, short publications are preferred over few substantial ones. Unless these attitudes change, I do not see how we can accomplish the work that needs doing. At the same time I feel that a broad audience should be made aware of the poor foundation of systematic entomology.