

PRESENT TRENDS IN SYSTEMATIC ENTOMOLOGY.¹
GENERAL DISCUSSION.

BY CHARLES T. BRUES,

Bussey Institution, Harvard University.

When I was asked recently to address a group of entomologists on the present activities in taxonomic entomology, I had grave doubts that the tendencies evident in the work of this large but frequently despised group of zoologists would be of any interest to students of insects in other fields, or even to the taxonomists themselves. The latter expectation seemed especially probable as systematists have become quite callous to derogatory remarks from biologists not versed in taxonomy, and have tended to lapse into a condition of *laissez faire* with reference to the relations of taxonomy to the other branches of zoology. Also I can by no means lay claim to that broad familiarity with insect taxonomy which should be expected of one who essays to outline its tendencies. Nevertheless there is some advantage in viewing such matters after frequent visits into other fields, for every return brings a new series of impressions which serve to throw into relief the changes that are gradually taking place.

Systematic entomology is growing old, and like a living organism it exhibits the usual signs of age in the development of fixed eccentricities of behavior. Fortunately for the ultimate progress of biology it has not persisted as a single entity, for it has produced during its long lifetime a series of distinguished, but not always harmonious offspring. These are now so vigorous and some of them so self-satisfied that they occasionally betray their disapproval of the motives and accomplishments of the other members of the family. At the present stage of our science their actions would seem to presage a lively future for entomology as

¹This and the paper that follows were presented as part of a symposium at the annual meeting of the Entomological Society of America in New York City, Dec. 27, 1928.

younger and less strongly inhibited generations come into being.

Like the poor old overworked phylogenetic tree of life, systematic entomology has developed many branches, each of which engages the attention of a series of zealous searchers for truth. Its growth has been purely spontaneous, and it has so far suffered few serious setbacks. For some millions of years Nature has pruned the phylogenetic tree until any second-rate gardener would shudder at its appearance. Decadent branches have been ruthlessly lopped off without respect to symmetry, age or prestige. Its twigs have developed millions of bud variations; it is enveloped in a tangled mass of parasitic vines and further beset with galls, excrescences, and tumors. If it were anything more than a convenient diagram for evolutionary progress, it must have needs long since crashed to the ground. Its more ancient aerial parts have literally crumbled to the earth for we now find bits of them preserved as fossil remnants. These are being slowly reclaimed and furnish the setting for an historical background. At the present time the primary basis of systematic entomology consists of the greater part of a thin horizontal section through this tree at its upper level—the living insect fauna. It appears as a hopelessly complicated mass of details; nevertheless we know that its ten million species form no haphazard assemblage, but that they exist as an integrated whole, so thoroughly integrated in fact, with reference to its component parts, to other living organisms and to physio-chemical conditions that we stand at present utterly helpless before it, unable to analyze the smallest part of its complicated structure.

As personalities tend to become similar after long association, entomologists might be expected to become so thoroughly integrated in their work that they could enter this biological maze with understanding. That would be the millennium. We may justly ask if systematic entomology as represented by its many adherents is entering upon a stage where it will pave the way, through an understanding of the taxonomic affinities of insects, for entomologists as a whole to fathom their biological interrelationships. In other words, are the present trends of systematic entomology leading to this goal which represents the biological Mecca?

I am fully aware that the present Mecca of many biologists lies in quite another direction—in the reduction of the phenomena of life to physics, chemistry and mathematics, but am not willing to concede that this will prove to be either the final goal, or the methodology which will lead to it.

This attitude has arisen through the more or less tacit assumption that biology will finally find its place among the exact or mathematical sciences. This is regarded by the systematic biologist as a wholly undesirable if not impossible attainment. They have already cast aside any substitution of numerical notation and symbols for binomial names and higher groups, as in no way simplifying the expression of taxonomic relationships. The reactions of organisms to light and heat, their growth and metabolism, the interactions of their genes in inheritance and many other phenomena which are due to similarities of their make-up are capable of mathematical expression as entities, so perhaps might be the combinations and permutations of these. Evolutionary change which is of primary importance to systematics and phylogenetics on account of its historical aspect is a process of differentiation, recombination or emergence, and to believe that this has proceeded upon uniform or predictable lines does not aid in organizing the mass of data which taxonomy has so far accumulated.

To observe the way in which one is viewed by his colleagues is generally a fair method of discovering one's shortcomings and it may sometimes even lead us to discover our virtues. In either case it aids in the development of the submissive spirit which is a formidable asset in approaching the altar of Nature. As taxonomy is the oldest branch of natural history we may regard the newer branches as younger brothers and sisters whose criticisms are tinged with juvenile jealousy and largely to be discounted. Of these younger branches morphology is the first child of taxonomy; indeed she is already becoming so Victorian in the eyes of the rising generation, that I hesitate to be seen smiling at her in public. Comparative morphology may be regarded either as the tool of taxonomy, or as a by-product of the latter; unfortunately it is sometimes pursued independently which greatly limits its field of usefulness. Many of the con-

tacts of systematic entomology with morphology relate to matters of nomenclature and these are perhaps the most unfortunate ones. The majority of morphologists hold the idea that the present instability in nomenclature as it relates to generic names is a disgrace which entomologists may be expected immediately to remedy. Most entomologists agree with them heartily and some have offered to supply remedies. As the affliction becomes chronic, many kind friends suggest new remedies and we are urged to learn by trial and error the benefits of each. At the present time we are powerless to stem the rising tide of names resurrected from oblivion by a few industrious searchers who follow this pursuit as a pastime or mental discipline during their leisure hours. By the rediscovery of some long-forgotten pamphlet it is possible with very little effort to cause an uproar whose echoes ring for many years. When a series of such commotions in rapid succession fails to drown out the small voice of the non-combatants who believe that the face of Nature is being changed too rapidly, deeply pitched cerebrations on the part of others bring forth new interpretations of previous literary researches, and so far as we can foresee, this process may go on forever. At the present time almost no branch of systematic entomology is free from this incubus and it is difficult to view with equanimity the future of entomological nomenclature, in spite of the protestations of those who insist that they are submerging their personalities for the good of science. There is of course some hope that the International Commission on Zoological Nomenclature may be able to restore order. They are struggling valiantly toward that end, but they need good honest support. I think that most of us are willing to give this, both actively and passively. The latter is particularly easy for it saves vast quantities of energy, breath and printer's ink, all of which find a ready market for other purposes. Perhaps no group of entomologists have suffered so long and painfully from nomenclatorial unrest as the lepidopterists¹ but their colleagues in other fields are facing the rapid approach of an equally distressing situation.

¹Dr. Forbes' discussion on a later page (p. 21) of the present issue of *Psyche* deals in an admirable way with this question.

Another criticism of systematic entomology that comes from the morphologists is that we do not take their work sufficiently into account as a basis of classification, and some have even gone so far as to elaborate new classifications of their own. Their contention does not seem to be well founded and a canvass of the present situation in this regard seems to justify the statement that never before have taxonomists (with a few notable exceptions) been so keen in their treatment of characters for the limitation of higher groups and in attempting to indicate phylogenetic relationships. Only those who have labored thus to bring order out of chaos appreciate (to borrow a very self-satisfying political expression) the "intricate complexity" of modern taxonomy, which by the way has the science of government skinned a mile when it comes to complexity. This very fact has developed another trend which is the continuous movement toward great specialization among taxonomists. Its necessity and advantages are obvious, but its drawbacks are very serious and unfortunately not always appreciated by the individual worker. There are at present really two types of specialists in taxonomy. One may be considered to include those who early acquired a general knowledge of insects and later settled upon some particular group to which they have devoted their energies. The other class includes those who have very early undertaken to specialize on a small group. The latter series is made up mainly of college students who have been assigned to taxonomic problem by some indulgent professor who hopes that he may rapidly impart to them the general familiarity with insects that he has acquired from long and tedious experience. Incidentally he knows that it will keep them busy. This method is not always entirely successful since it frequently develops such enthusiasm that all other fields of general value to taxonomists may be neglected. This class of workers has been rapidly augmented during recent years by the great urge to enter early into productive research, a condition which prevails in all departments of biology alike. It is fostered by marked changes which are occurring in our colleges and universities and particularly by the many luscious plums that are dangled before the noses of prospective research workers in the form of research endowments and fellowships. From the many temptations toward too early specialization systematic

entomology suffers more severely than the more recently developed branches since its literature has grown to be far more extensive and the details with which it deals are not only more varied but more complex as, they do not appear to be reducible to simplified expression or generalization. Can we say that we are honestly giving these problems the attention they require in the training of taxonomists?

The contributions of genetics are providing a great amount of material which is of broad importance to systematic entomology and this is gradually being utilized by taxonomists to broaden their ideas concerning specific relationships, variability, polymorphism, etc. Genetics sometimes complains that taxonomy should make wider use of its methods and discoveries. We can only reply that we hope to do so more fully in the future after we have again corralled all the insects that Noah let loose on Mount Ararat, together with any new species, hybrids and mutations that may have come into being since that time. Certainly the discoveries of genetics have already greatly modified the taxonomic treatment of species and intraspecific forms, but so far it has been impossible to utilize them to modify the current methods of comparative morphology in dealing with larger groups.

One present trend of systematic entomology is difficult to see in a clear light. Physiology, together with its child ecology, which is really a nursery of young children not yet quite capable of socializing their behavior, is a department of biology whose methods and outlook are rapidly changing. So far the contacts of physiology and ecology with taxonomic entomologists have been few and mainly confined to the utilization of the taxonomic laboratory as a workshop where trained mechanics could repair and get into understandable form certain lists of names representing the materials investigated by biologists to whom taxonomy and nomenclature is a totally unknown, thickly populated, but nevertheless utterly barren field. Fortunately, through the intervention of ecology it appears that physiology and taxonomy have come to regard each other with greater respect and there are indications that taxonomy may in the future greatly profit by the investigations of her co-workers in physiology, who in turn would not suffer any great degradation from a slight knowledge of systematics.

Taxonomy and phylogenetics are of course so inseparably united that it is impossible to deal with any aspect of one without considering the other. The structure of the phylogenetic tree is such that it brings into taxonomy a fourth dimension which is difficult to deal with nomenclatorially at least. This condition is by no means restricted to entomology, but as we shall see in a moment it promises to become more acute with insects than with other groups of animals. The development of insect paleontology has until quite recently been very slow and restricted to a small series of fossil forms, most of them comparatively recent and some of the others dating back to what appears to be the earlier pages of entomological history. Naturally most of these ancient forms are more or less annectant between modern orders, and have been grouped taxonomically as a very generalized extinct order, Palaeodictyoptera. The recent discovery of undoubted precursors of particular living orders or families and a vast series of genera and species before the mesozoic indicates that very soon we shall have numerous annectant forms between families and even orders that will form a number of taxonomic anomalies. Moreover many of the Persian fossil insects are so well preserved that their relationships may be very accurately determined. So far these fossil forms have generally been placed in separate orders, families and genera, but as these rapidly multiply and overlap one another they will produce an intolerable condition in the nomenclature of higher groups. This is more especially true as some groups have persisted over long geological periods while others have undergone a much more rapid evolution. It is also evident from studies of the beautifully preserved insects of early Tertiary age in Baltic amber that the same difficulty is arising here among the genera of the more recent groups of insects. Some entomologists still cling to the idea that fossil insects can be dealt with as a series apart. Naturally we can deal separately with a Permian and an Oligocene fauna but we cannot regard them taxonomically or nomenclatorially as any more independent than the present day faunas of New England and Italy.

An entirely different aspect of systematic entomology that has advanced by rapid strides during the last few years is our knowledge or the preparatory stages of insects. A

number of very successful attempts have been made to deal taxonomically with the larval stages of diverse groups; many Lepidoptera, Diptera, Hymenoptera, Coleoptera and Trichoptera have been studied with great care and if the human race persists long enough this task will increase until it becomes larger and undoubtedly more difficult than that presented by imaginal insects. So far it has corroborated many of the conclusions reached from taxonomic studies on adult insects and has served to give us faith in the principles of entomological classification. Considering, as we have said, the intricate complexity of the insect fauna, entomologists can point with pride to their accomplishments during the past 70 years of the post-Darwinian regime; and that is one very good reason why none of us wishes to return to the fundamentalist doctrine that we can never understand organic relationships. It must be admitted that some scandalous discrepancies as well as many minor errors of judgment have been exposed by this work on the preparatory stages, and these are proving a great aid toward clarifying systematics in various groups, especially those where characters of dubious validity have been widely used.

Throughout all the most recent work in systematic entomology there is a most pronounced tendency toward great specialization, and a growing worship of the species and the type specimen. The former is nurtured as we have said by the desire to enter very early into productive research, and the latter is fostered most assiduously by the modern museum curator. There is also evidence on every side that systematics is being systematized and standardized, just as business, teaching, manufacture and every other human activity has been mechanized at the hands of the efficiency expert. The last has been lately transmuted into the administrator or popularly as the modern executive. So far few entomologists have fallen under this spell, for most of them are more interested in their work than in aspirations to the mahogany desks, telephones and the other furnishings that are prerequisites of such a job. Some of them at least may be trusted to remain as free lances who are ready to drop an occasional fly or other specimen in the entomological cream as it emerges in a velvety stream from the systematic separator. It is only such behavior that will prevent a too great uniformity in our product.



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