

three joints of equal length; first joint pale yellowish-white, swollen in the middle and tapering towards each end; second and third joints very slender, cylindrical, dark brownish-yellow, with a black band at the base; in the middle of the front of the head is a black, heavily chitinized tubercle (fig. 2 c) which is divided into four sharp points at the apex, the larger points below; on each side of the center is a very slender, small, cylindrical, yellow tube-like projection with a fine bristle at the apex; the head and all the thoracic parts are dark yellowish-brown; leg capsules are paler towards the apex. Abdomen is composed of nine segments, the apical one is very small; abdomen is a pale, whitish-yellow and tapers nearly to a point at the apex; on segments two to eight there is a transverse dorsal row of brownish-yellow, sharp-pointed, bristle-like spines; this row is slightly above the middle of each segment and the spines in the middle of the row are a little longer than those at the ends.

Length, 4 mm., diameter (at thorax) 1.5 mm.

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## THE ROLE OF THE TAXONOMIST IN PRESENT DAY ENTOMOLOGY.<sup>1</sup>

BY A. B. GAHAN.

My first inclination was to entitle this screed "The Tax on Taxonomists," but lest some might interpret this title as pre-saging the advocacy of some new and radical form of revenue production, or still worse as a wail from a disgruntled systematist anent his own hard lot, rather than the cheerful ebullition of one thoroughly contented with his job, and who revels in the difficulty of it, the less dangerous but somewhat more inclusive title of the "Role of the Taxonomist in Present Day Entomology" was substituted.

It is not an easy matter for one working in a purely taxonomic field, and that a strictly limited one, to choose a subject for an address which will be of interest to the general membership of this society. Inured though I know it to be to varied brands of verbal bombardment, I have no desire to go down in the annals of the Society as the one who added the proverbial last straw. Bearing in mind this hazard it was not without considerable trepidation that I chose as my subject for this occasion the theme indicated by the title. If what I am about to say does not come up to expectations, I beg of you to place the blame upon the precedent which makes it necessary for a retiring president to deliver an address rather than upon the unlucky individual who happens to be the chief victim of that precedent.

### A Bit of Speculation.

An entomologist may be defined as one who is interested in the study of insects.

It seems reasonable to suppose that man's first interest in

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<sup>1</sup>Annual Address of the President.

insects probably came about through the bodily discomfort occasioned by their ravages upon his person rather than upon his sources of food supply. Anthropologists tell us that earliest man was a creature much given to the simple life, and prone to seek his sustenance in the chase and by foraging, rather than through the arts of husbandry. It therefore follows that he probably was little impressed by Arthropods except as their bites or their perambulating propensities irritated him by day or disturbed his slumbers by night.

It might well be that the first entomologist was contemporaneous with the first flea, or at least with the first establishment of mutual acquaintanceship between the genus *Homo* and the genus *Pulex*. One can readily imagine the quick interest that must have been engendered in our shaggy ancestor when the first of these six-legged tormentors landed perhaps upon the exact spot which could not be conveniently reached, and began to "bore in." Also his further surprise and aroused curiosity after the intruding *Pulex* had finally been dislodged and chased into the open, to find that when he would crush it with a hairy thumb or fore-finger, he but bruised his digit, while the elusive visitor hopped merrily away. At such a time what more natural than that there should arise in his mind the question "What is it?" And, behold! We have the genesis of the modern entomological taxonomist, for it is exactly that question which the taxonomist is eternally trying to answer.

Whether to *Pulex*, or to some one of several other insects belongs the distinction of thus having implanted the idea which developed the modern taxonomist, is not essential to the point. The fierce stab of *Culex* the mosquito, the annoying familiarity of *Pediculus* the cootie, the stealthy nocturnal foraging of *Cimex* the bed-bug, or the murderous attack of *Vespa* the hornet, would any one of them probably have produced the same reaction.

As the struggle for existence became more keen, and man was gradually driven to take up the art of husbandry, his interest in insects must have received a powerful added impetus. When by the sweat of his brow and at the expense of blistered hands and a lame back, he had brought his small garden patch to the point of anticipated fruition, only to see it devastated and wiped out by a horde of hungry grasshoppers (or locusts if you belong to that school), he no doubt often became discouraged and wondered, as sometimes does his modern successor, whether it was worth while after all. One can readily picture him returning from an unsuccessful hunt to find that in his absence the plague had descended upon his little clearing and that his one remaining hope of a means of appeasing his appetite was rapidly disappearing. In his rage he possibly seized the first weapon at hand and began threshing about among his plants with the idea of revenging himself upon the despoilers. At the

sudden commotion the "hoppers" probably hid themselves away a short distance out of danger and faced about to see what was happening, as modern "hoppers" have a habit of doing. If this particular ancestor chanced to be of a wide awake and original turn of mind, an idea may have popped into his head at this point. This idea would have been something on this order, "If they (the hoppers) are afraid of me and fly before me, why not drive them out of my garden." Here perhaps was the genesis of the economic entomologist. As illustrative of the value of a really good original idea, it may be stated without prejudice to the economists, that the method is still in use, as witness the measures employed to-day in the battle against grasshopper outbreaks in South Africa and elsewhere.

So far I have dealt mostly with pre-historical facts or fancies, whichever you choose to call them. In thus permitting my imagination this slight indulgence, I trust I have not wandered too far from fact, nor transgressed too greatly the accepted rules which prescribe that scientific discussion must be dignified. If unhappily I have done so, I shall hope to make partial amends in what follows.

Having established a possible pre-historic beginning for taxonomy, as well as the economic phase of entomological research, we will next consider briefly and in a very general way its progress in the light of recorded history.

#### Early History of Taxonomy.

Dr. C. L. Marlatt in a presidential address before this society in February, 1897,<sup>1</sup> gave an extremely interesting historical survey of the literature of the science of entomology. He points out that while figures and sculptures of insects occur upon the monuments of ancient Egypt, and while incidental references in the writings of Moses and the early Chinese scholars are common, the first study of insects to which any importance can be attached began with Aristotle, more than three hundred years before the beginning of the Christian Era. Dr. Marlatt traces the history of the development of the science in more or less detail through the succeeding centuries down to the beginning of the present century. It is not necessary therefore, even if my limited knowledge of the subject would so permit, for me to attempt to go into a detailed review of this ancient literature. Suffice it to say, that the period of approximately 2100 years which elapsed between the time of Aristotle and the time of Linnaeus, was productive of much necessary work on the metamorphosis, anatomy and physiology of insects, as well as several scarcely successful attempts at classification. This pioneer work, forming as it undoubtedly did, a foundation for

<sup>1</sup>Proc. Ent. Soc. Wash., vol. IV, 1897, pp. 83-120.

the work of Linnaeus and those who follow him, was of great importance, and represented no small advance since the time of Aristotle.

The most interesting and important development during the period, from the standpoint of the present discussion, was the attempt by Swammerdam in his "Biblia naturae" or "Bibel der Natur," published in 1737-8, at a classification of insects, using metamorphosis as the basis for primary divisions, and characters taken from the adults as the basis for smaller groups. This work was very imperfect and incomplete, but represented a considerable step forward, and undoubtedly exerted a more or less profound influence upon the work of those who followed. That the science was still in a very primitive condition, however, is apparent. The theory of spontaneous generation had not yet been entirely discarded; the number of recognized genera and species of insects was surprisingly small; no satisfactory or workable classification had yet been evolved, and in lieu of a system of nomenclature the cumbersome descriptive paragraph was still in use. Economic practice during the period seems largely to have taken the form of prayers to the Almighty for deliverance from outbreaks, and of appeals to the courts for judgments against insects. The latter practice was so general during the Middle Ages, that special rules and highly imposing legal forms and ceremonies were developed by the courts for the handling of suits against insects, as has been entertainingly described by Dr. L. O. Howard, in an address before the Association of Economic Entomologists in 1894.<sup>1</sup>

#### Modern Status of Taxonomy.

In spite of the interest attached to the pre-Linnaean evolutionary period, it is nevertheless apparent to every student of entomology that for all practical purposes the real history of the science dates from the publication of the 10th edition of Linnaeus. For centuries the study had been floundering about like a rudderless ship on an uncharted sea, occasionally making a little progress in one direction or another, but for the most part, getting nowhere. Under the guiding and steadying influence of the binomial system of nomenclature, and with a workable classification serving as a chart, the good ship immediately took up a straight course and has made continuous progress ever since.

Following publication of the various editions of Linnaeus came a period in which taxonomic investigation monopolized practically the whole field of entomology. Fabricius with his

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<sup>1</sup>Insect Life, vol. VII, 1894, pp. 55-108.

classification based almost wholly upon the mouthparts, came and went. Latreille, to whom is due the credit for first properly limiting the Class Insecta, as well as for harmonizing and welding into a natural system based on a combination of metamorphosis, wings, and mouthparts the conflicting systems of Swammerdam, Linné and Fabricius, also accomplished his purpose and passed on. Thunberg, Olivier, Illiger, Schrank, Panzer, Kirby and Spence, Meigen, Fallén, Cuvier, DeJean, Spinola, Klug, Say, Gravenhorst and many other illustrious names are associated with the period.

This was the formative period in entomology; the period when the foundation started by Linnaeus was expanded and strengthened to carry the great superstructure which was to be erected upon it; the period in which collections were acquired and facts accumulated, sifted and associated; in which classifications were laboriously built up, picked to pieces and wholly or in part discarded. Out of it all came a rational and workable classification which forms the basis for all our knowledge, both systematic and economic, to-day. What has been done since has simply amplified and extended the original structure started by Linnaeus and his immediate successors.

A thought which I particularly want to impress is this: that the ground work, the foundation of the whole immense entomological structure of to-day is essentially taxonomic. Prof. Raymond Pearl of Johns Hopkins University in a recent address,<sup>1</sup> makes this significant statement, "The first step toward a proper knowledge of the phenomenal world is obviously to get the phenomena classified in an orderly scheme. In biology this takes the practical form of getting the different kinds of plants and animals described, named and classified." The truth of this statement can not be gainsaid. Objects without names can not well be talked of or written about; without descriptions they can not be identified, and such knowledge as may have accumulated regarding them is sealed; unclassified their relationships are unknown and the possibilities of deduction are destroyed. In short, without the fundamental work of the taxonomist the great mine of entomological literature would not exist, and the accumulation of knowledge would be largely limited to what one could personally observe and remember.

Linnaeus was able to classify all of the known animals and plants of his time. It is difficult to imagine any one so intrepid as to attempt the same thing to-day. In the field of entomology alone, the task would be too vast to be accomplished in the span of one lifetime. The mere task of consulting the literature would preclude the possibility of doing anything else. Marlatt

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<sup>1</sup>Science, vol. LVI, 1922, pp. 581-592.

in 1897 estimated the number of published volumes on entomology of 500 pages each at between twelve and fifteen thousand with an annual accretion, exclusive of economic matter, estimated at 75 volumes. I believe this estimate of the annual accretions to be too conservative to apply to the present. In fact it seems to me probable that the present-day output of America and her possession alone must be very close to that figure. With a dozen or more journals devoted entirely to entomology and each publishing a yearly volume of greater or less extent; with numerous museums maintaining entomological departments and publishing articles in one form or another; with practically all of the forty-eight states as well as several of the insular possessions maintaining corps of entomologists in their experiment stations or agricultural colleges, and frequently in their universities as well; with the Federal Bureau of Entomology turning out bulletins and papers at a prodigious rate, it seems fairly certain that the total annual output from all of these sources can not fall far short of Marlatt's estimate for the whole world in 1898.

Be that as it may, the fact is apparent that no one could hope to compass the whole field of entomology to-day; hence, the specialist. The tendency to specialize manifested itself even among the pupils and immediate successors of Linnaeus, as we find Meigen, Fallén, Weidemann and Zetterstedt devoting themselves mostly to Diptera; Lepelletier, Gravenhorst and Klug to Hymenoptera; Hübner and Esper to Lepidoptera, etc. At first specialization seems to have been by orders. As the field expanded, as more genera and species became known, as more men and women were drawn into the study of the subject, as the literature became more and more extensive and complicated, the tendency to narrower and narrower specialization has kept pace. A few present-day specialists of unusual capacity and enthusiasm still manage to cover a whole order (as witness my good friend A. N. Caudell), but for the most part, specialization in the larger orders like Diptera, Hymenoptera, Lepidoptera and Coleoptera is by subdivisions of the order, not infrequently by families or sub-families.

This tendency to specialize in a narrow field is frequently the subject of disapproval or even condemnation by certain writers. No doubt it is to be regretted, but it is nevertheless the outgrowth of perfectly natural causes, and causes for which there appears to be no remedy. Just as in the field of mechanics no man is now expected to know all there is to know about the various lines of engineering, so in entomology the human capacity is limited, and if one would accomplish anything in his natural lifetime, he must forego the pleasure of knowing the whole subject, and specialize, and that along comparatively narrow lines. A good illustration of the growth of the science,

as well as an excellent illustration of why in this day it is necessary to specialize, is to be found in the fact that Linnaeus knew but 74 genera of insects, while the recent compilation of a genotype list of the Chalcidoidea reveals the occurrence of over 1900 generic names in that Hymenopterous superfamily alone.

Having shown that the science is founded on the work of taxonomists, let us for a few moments study the relation of the taxonomist of the present day to his subject. Early systematic workers took up the study either as a pleasant recreation and relief from less interesting duties, or as an adjunct to some other line of philosophical investigation. The professional entomologist was unknown. Since he was under no obligation to any one so far as his entomological studies were concerned, the early worker presumably could follow whatever line of investigation pleased his fancy.

The systematic worker of to-day is in quite a different position. More often than not he is on a bread and butter basis, i. e., earning his livelihood through his entomological endeavors. In most cases it is probable that he was drawn into the work by the same influences which attracted the earliest workers to it, viz., the interest and fascination inherent in the study itself. Probably it is true also, that the particular group upon which he specialized was more or less of his own choice. But once established as a systematist in a particular group and having associated himself with some institution of learning upon which he is dependent for a salary, he is very apt to find that he is no longer free to follow untrammelled his own inclination in the matter of the lines which his investigations will follow. In entomology, as in all other sciences, economic considerations now largely influence and often determine the direction of pure research. Not only is the systematic worker apt to find himself unable to follow his own inclination regarding the particular group or groups he will investigate, but he is very fortunate if he does not find himself so swamped with demands for determinations and other information that he is unable to do any real research work at all. The tremendous world wide interest in economic entomology has resulted in swelling the number of economic workers to a veritable army, while the number of systematists has apparently not kept pace. As a concrete example I may state that in the whole world to-day there are probably not over a dozen individuals actively engaged in the taxonomic study of Chalcid-flies, notwithstanding the fact that the interest in parasitic insects is greater than ever before, and this group is probably the most numerous of all the parasitic forms. In most cases these systematists are not pretending to cover the whole super-family, but specializing upon one or more large families. The consequence is that the determination and classification of the specimens in a certain family for all the economic workers

of the world may fall upon two or three individuals. This would be an ideal state of affairs, perhaps, if the specimens and individuals sending them in were not quite so numerous, since it would give the systematist a world-wide view of his subject. But with the present demand for information what it is, the actual result is the swamping of the systematist with determination work, with resultant dissatisfaction to both him and the one sending the specimens.

In the address of Prof. Pearl from which I have already quoted I find this: "One forms the opinion that perhaps four-fifths of the Ph. D's turned out in zoology at the present time, not only never have, but probably never will for themselves identify an animal strange to them, and as for deciding whether the unknown creature has been previously described, or placing it in proper taxonomic relation to its nearest relatives, such a problem would be as far beyond their powers as it is beyond their desires." Prof. Pearl is in a position to know whereof he speaks. The entomological portion of this same four-fifths of the Ph. D's presumably goes into the universities and colleges to teach, or into the Experiment Stations or the U. S. Dept. of Agriculture to engage in investigational work along economic lines. Having neither power nor desire, or if they have these, usually lacking the facilities to find out for themselves what a particular insect constituting their problem may be, they must seek help. And who but the systematist can help them? Given the name, if the insect happens to be one with a history and they are at all familiar with bibliographic work, which they frequently are not, they have the key which unlocks all that is known about it. Without its name they are helpless.

But all of the demands for names and information does not come from these Ph. D's who have become professional entomologists. The postgraduate student or embryo Ph. D's demand the help of the systematist in completing their theses. The undergraduates and high school students must have names for their specimens in order to get credits. Then there is the private collector who maintains a collection but often does not know enough about his hobby to name his specimens himself and sends them to the specialist, frequently with the stipulation that they must all be returned with a statement as to their position in the classification, their habits, importance, etc. Among them all, the systematist does not lack for something to do. In fact, he frequently finds work piled up ahead sufficient to keep him occupied for months or even years. The resulting delay is aggravating to the worker who waits for his names, and it is equally discouraging to the systematist who sees himself hopelessly cut off from doing any of the necessary constructive classification work which he had planned to do.

And this brings me to a consideration of the possibility of



relief. The one and perfect remedy would be an immediate and substantial increase in the number of working systematists. Unfortunately this is a remedy which can not be applied immediately. Taxonomy does not carry the same appeal to the popular mind as does the economic phase of entomology, for the reason that its results are less tangible and its importance is not appreciated because not understood. It is very doubtful therefor whether federal, state, or private funds would be forthcoming for the employment of any considerable number of additional taxonomists even if trained individuals were available, which they are not. It is probable that the universities and colleges would be glad to train young men and women in taxonomy were there a real demand for their services; but notwithstanding the very apparent need for more taxonomic work, there is manifested by institutions no disposition or desire to take on more taxonomists and consequently there is very little incentive for universities and colleges to turn them out. This is to be regretted for several reasons. First, because until such time as the supply of trained and working systematists is brought up to the point where they are sufficient to handle with reasonable promptness the work expected of them, the economic side of the work must suffer delay. Second under present conditions the taxonomic worker is prevented from doing the careful work which the situation demands and which would be a credit to him. Third, when the present crop of systematists passes on as they inevitably must, there are in many instances no younger understudies who can step into their places. A crying need of the hour then, it seems to me, is a realization that the dearth of taxonomists is seriously handicapping and retarding the progress of the science as a whole and will continue to do so to an increasing extent unless steps are taken to make up the deficiency.

It will not be amiss to point out that in the meantime it is possible to afford some partial relief. Many times the motive which prompts a field worker to send specimens to a specialist for determination is idle curiosity. Idle curiosity is commendable enough so long as it does not impose a hardship upon some one else. In fact much of the progress of the world was no doubt brought about through idle curiosity. But if the aforesaid field worker will simply pause long enough to consider whether or not the determination of certain specimens is of any importance to him, whether he actually needs a name for them or not, many times he will decide that a name is not necessary and will send them to the specialist with the stipulation that they are for the collection and not for immediate determination. By such a method material would be accumulated which would be invaluable in case revision of a particular group were undertaken, while the specialist would be relieved, in part at least, of

the bugbear of miscellaneous determination and description and could devote more time to the revisionary work which is so necessary.

Another way in which the field workers and students could aid the specialist materially is by seeing that their specimens are properly mounted and labelled. There are few things which ruffle a systematist's nerves more than to have a lot of improperly mounted, broken or dirty specimens, or specimens unaccompanied by requisite data handed to him for definite determination. Prof. T. D. A. Cockerell in an unpublished letter once estimated that on the average it took the specialist at least four times as long to name a specimen as it did for the collector to collect it. This estimate is probably much too small when applied to some of the less well known groups. If the specialist was only familiar enough with his group to be able to name on sight anything which came into his hands, the problem would be simple enough. But unfortunately this is seldom the case. The genera and species are far too numerous for one mind to retain them all. The published classifications are in many cases several years out of date and consequently do not include many of the new genera and species. The determination of a single specimen therefore is often a matter of hours or even days of searching through literature before the particular description covering the specimen at hand is found, or before the possibility of a published description is eliminated and one can proceed to describe it. In view of these facts the systematist should not be too severely criticised if sometimes the determination of a given specimen is not returned as promptly as anticipated. Neither should he be considered a crank and a crab if he sometimes grumbles at receiving a consignment of specimens so mounted as to be unfit for examination, or as frequently happens, a lot which he must himself mount before he can study.

#### Conclusion.

In conclusion I wish to quote once more from the address of Prof. Pearl as follows: "It is the systematist who has furnished the bricks with which the whole structure of biological knowledge has been reared. Without his labors the fact of organic evolution could scarcely have been perceived and it is he who to-day really sets the basic problems for the geneticist and the student of experimental evolution." If I, in this address, have to some slight degree succeeded in impressing my hearers with the truth of these words of Prof. Pearl as applied to the science of entomology, and if at the same time I have given the economic workers among you some slight insight into the difficulties which surround the work of a present-day systematist, I have succeeded beyond my expectations and am satisfied.

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