PROSPECTS FOR THE USE OF BIOTAXONOMY IN CHARACTERISATION OF HOMOPTEROUS PESTS IN RELATION TO COST AND OTHER FACTORS AFFECTING TAXONOMIC OUTPUT

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BIOTAXONOMY — PRACTICABILITY OF USE

What is biotaxonomy ? — The assessment of natural affinity between organisms with the use of parameters associated with their vital activities. What can it do ? — Show similarity or difference between population-samples in respect of a parameter, and in conjunction with an adequate basis of reference, indicate the distribution of the observed state in an existing classification. Who needs it ? — The student of phylogeny, the taxonomist doubtful about the composition of population-samples that appear homogeneous by morphological criteria, and the field investigator who has found that a particular pest species is not behaving quite as described in the literature. Is it rapid and cheap ? — If investigation of the parameter to be measured calls for extensive assembly of material, or elaborate preliminary processing of samples, or involves team-work or experimentation — no; but if not, — possibly yes. Who decides what parameters most merit investigation ? Who supplies material appropriate for study ? Who does the technical work or makes the observations ? Who is responsible for assessing the taxonomic significance of the findings ? How, and how fast, can a basis of reference be built up ? Such are the questions, with their financial implications, that crop up when biotaxonomic studies are contemplated.

The laboratory procedures associated with biotaxonomy are potentially so diverse as to strain the resources of even a large agricultural research establishment, and on grounds of cost and speed are more likely to be used in specialised research projects than in the routine work of a classical taxonomist. In the field, on the other hand, there are behavioural characteristics of potential taxonomic value in different groups of insects that can readily be observed, and if not recorded by the collector remain unknown: feeding posture, feeding site on the host, locomotory behaviour, defense reaction, distribution and shapes of secretions, patterns of aggregation, relations with insects of other orders, association with habitat and choice of host are among the most obvious. Notes on such matters are scattered through the literature, but how traceable are they ? And how comprehensive a collection can be assembled under under any one topic ? In the Topical Index to the 8000 titles in the Bibliography of the Homoptera, only one entry appears under Behaviour. At present, it is often the taxonomist himself who collates such scraps of information as they incidentally come his way from different collectors. It can take so long to accumulate a meaningful data-base by this means that there would seem to be a case for working backwards, with the taxonomist suggesting how the meaning in terms of biology of particular parameters used in morphological comparisons can be ascertained by field observations or laboratory experiments. If we believe, for example, that the relatively short rostrum in such diverse plant-hopper species as Eumetopina flavipes Muir, Saccharosydne saccharivora (Westw.)(Delphacidae), Numicia graminivora Ghauri (Tropiduchidae) and Pyrilla perpusilla (Wlk.)(Lophopidae) is correlated

with their feeding on leaves of Gramineae, and the long rostrum in the bark-frequenting species of Laternaria (Fulgoridae), Myconus (Achilidae) and Toropa (Dictyopharidae) with their feeding on woody stems, is it reasonable to surmise that the exceptionally elongate rostrum of the endemic Malagasian Riancia longirostrum Sign. (Nogodinidae) is adapted for reaching vascular tissue of a native tree, bamboo or woody vine ? Or again, what is the biological significance of the lateral ocelli in Fulgoroidea ? Can their degree of development be used as a taxonomic parameter ? In some genera (Leialoha (Delphacidae)) they are present and apparently functional; in others (Durium (Tropiduchidae)), they are absent; in yet others, they are normal in some members of a species and reduced or even absent in others. They are apparently absent in all pre-adult forms of Fulgoroidea. As far as I have been able to observe, it is only Fulgoroidea with the ability to fly that have functional ocelli, and the latter are developed at full size only in macropterous individuals. The degree of development of the compound eyes in adults shows no such variation. It would seem not unlikely that information acquired by the insect through the lateral ocelli is concerned only with environmental factors of importance to it when flying. As a taxonomic parameter in the Fulgoroidea, the condition of the lateral ocelli cannot be used independently of the condition of the tegmina and wings.

BIOLOGY AND NOMENCLATURE IN ECONOMIC ENTOMOLOGY

In economic entomology, the properties of species are usually of more immediate interest than their phylogeny, and routine identification in Homoptera is normally limited to the determination of affinity at generic and specific levels. The biological predictability rendered possible by an identification depends on the range of biological variation within the group to which the species belongs: the more compact the group, the safer the prediction. This consideration indicates the practical importance of subgeneric, species-group and subspecific names. In large genera, such as Ormenis (Flatidae), the differences in biology and appearance of all the pre-adult stages between different groups of species may be striking, and the name of the species-group would be as informative as that of the genus. Many, and possibly all, species of Auchenorrhyncha vary from place to place cline-wise in particular morphological characters and more irregularly, or not at all, in bodily markings. Some can also extend their range of host-plants, according to circumstance. Where such a situation is known to exist, the subspecific name, if one is available, should be given in the identification. In Aeneolamia varia (F.)(Cercopidae) populations can be recognised on subspecific characters in conjunction with locality data, and not all of them as yet are known as pests of sugar-cane. Where a change of name has been relatively recent, it is helpful also to provide enquirers with the name of a long-used synonym to facilitate their search of literature.

BIOTAXONOMY AND FOOD-PLANTS

Knowledge of the food-plants of the better-known Fulgoroidea and Cercopoidea has accumulated sufficiently over the years to permit some generalisations regarding biology in relation to taxonomic status: ugyopine and alohine Delphacidae most commonly feed on woody or perennial dicotyledons, whereas delphacines are usually associated with grasses, sedges and reeds. A few genera are associated with a particular genus of host-plant, such as Dictyophorodelphax (Delphacidae) with Euphorbia and Chasmacephala (Tropiduchidae) with ferns, but the most general association is one between insect species and type of plant community, with the insect feeding on a number of hosts (either dicotyledonous or

monocotyledonous, but not both) within the community. In their natural habitat, even species known as pests elsewhere appear to cause little or no obvious damage to their host-plants. This is of particular interest in the case of Aeneolamia varia, as it shows that its saliva is not intrinsically very phytotoxic. The question whether feeding by this froghopper results in extensive leaf damage or not is one that is settled at the interface between the injected salivary enzymes of the insect and the "anabolic" enzymes of the host-plant flowing into the disrupted cells of the leaf. The most variable factor is the capacity of the plant to restrict injury to the spot where the initial damage occurred, and it is evidently governed by the level of general stress on the surrounding tissues. This in tropical crops largely depends on rate of moisture loss from the leaf, rate of nutrient inflow and the nutrient status of the solutes. A striking example of this relationship is not infrequently to be observed in Trinidad sugar-cane fields where extensive blighting from feeding-punctures made by A. varia has occurred on leaves of cane-stems that have been bored lower down by lepidopterous larvae, but not on leaves of stems that have not been bored, notwithstanding their having been attacked by froghopper. Prediction of the presence of A. varia or the delphacid Saccharosydne saccharivora (Westw.) in cane-fields at any time can safely be based on a knowledge of their biology, but prediction of the extent of damage to the crop in any year would primarily have to be based on soil-type, degree of xerophily of the variety grown and expected rainfall distribution (Fennah 1969).

The capability of acquiring and transmitting virus diseases of plants is chiefly associated with Homoptera at specific level, but its value as a taxonomic tool is limited by the fact that for a particular virus it may be possessed by several species of Homoptera in different degrees. The biological importance of these species in transmitting virus may depend on the closeness of their association with wild-plant reservoirs, and their economic importance on the proximity of a host-plant reservoir to an unaffected crop.

TAXONOMY AND COMMUNICATION

Taxonomic work in economic entomology involves identification of crop-associated insect species and elaboration of working tools (in the form of keys to known species, or of descriptions of new species) to accelerate future identification. The specialist coverage in taxonomic services is likely to remain skeletal, and even if the future work-load does not increase, the effect of all-round rising costs may have a bearing on how the taxonomist can cope with it in respect of the communication of findings. New taxa are being discovered by the use of more parameters for comparison, and to characterise them definitions are tending to become fuller, and if presented in the traditional manner, take up more space and so cost more to publish. Most papers are published in entomological or biological journals dependent on subscription income, and as their prices rise they need to increase their interest to each subscriber by increasing the number of topics per issue without increasing its size. This implies that the content of papers needs to be more succinctly presented. The onus of compression falls on both author and publisher. In papers involving much repetitive description, substantial savings in space can be achieved by presenting character-states for all species or genera discussed in tabular form, and such a table, if necessary, could be submitted camera-ready. It remains for editors actively to encourage use of this method. For their own part, they might usefully consider a more compact presentation of the data ancillary to the description itself.

There is a pressing need for greater rapidity in publication, particularly for short taxonomic papers expressly produced in response to an urgent request. Further outlets are needed that can be provided by the means currently to hand and methods designed to minimise costs of production.

The methods of communicating and retrieving information may change profoundly in the course of time, but they are not likely to do so uniformly throughout the world. Whatever the systems in use, their effectiveness will depend on their ability to trace recorded information. Biotaxonomy is interdisciplinary, and as far as Homoptera are concerned, where the aim of a biological study points in a non-taxonomic direction, the results are likely to appear in non-taxonomic or even non-entomological literature. If they are not reflected in the entries to an index or data-base accessible to and likely to be consulted by a taxonomist, significant information will be virtually lost. As a precaution against this happening, it could be advantageous to add the term "biotaxonomy" to the index-words given at the head of papers in which the text, irrespective of its main purpose, is thought to include data that may have a biotaxonomic application. Such action should at least ensure its inclusion in the data-bases of abstract journals.

REFERENCE

Fennah, R.G. (1969) Damage to sugar-cane by Fulgoroidea and related insects in relation to the metabolic state of the host plant. in Pests of Sugar Cane. Elsevier Publishing Company, Amsterdam, Netherlands, 367-389.