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Research on butterflies at the British Museum (Natural History)

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The Department of Entomology at the British Museum (Natural History) houses one od the richest butterfly collections in the world. Estimated to contain approaching 3 000 000 specimens, and probably more than 90% of known species, it has been described as the butterfly collectors' Mecca. Built up mainly over the last 150 years, trough the efforts of hundreds of different people, it includes the huge Rothschild Collection, and parts of many others, such as those of Oberthür, Joicey, Fruhstorfer and Levick, most of which incorporated older collections. As a result, the BMNH collection is almost unrivalled in representation of the world's butterflies, and includes much type-material.

The collection continues to grow – but at a relatively diminished rate. Emphasis now falls on the organisation and use of this vast bulk of material for research purposes. Of course, an enormous amount of research has already been done *on* the collection in the past. But the desire now is to *use* the existing collection and library facilities to co-ordinate research projects in evolutionary and systematic biology. This is considered worthwhile because of the continuing interest in butterflies for physiological, genetical, coevolutionary and community ecology studies. The opportunities to underpin such work with thorough systematics are few: it is arguable that for butterflies the BMNH offers the most favourable conditions for this work in the world. With these objectives in mind, some of the research being done by the present staff (P.R. Ackery, R. Arora, J. Huxley, R.L. Smiles and R.I. Vane-Wright) is outlined below.

The biology and phylogeny of danaid butterflies

The danaids have received scientific attention out of all proportion to their number of 150 or so species. This is because their biology encompasses so many of the factors that make butterflies interesting and exciting. Their larvae are largely restricted to the poisonous Moraceae, Asclepiadaceae and Apocynaceae. The adults are aposematic, polytypic, somethimes polymorphic and sometimes migratory. They are included in a number of minicry rings, being major Müllerian models. Recent developments include the discorvery of male dependence on sex pheromone precursors gathered from various plants by the adults, the phenomenon of 'automimicry', and the incredible overwintering behaviour of *Danaus plexippus* in Mexico.

After discussions in 1974 with Professor Dietrich Schneider of the Max-Planck-Institute it was decided that a systematic review of the biology and a phylogenetic reconstruction for the danaid species would be of great value. Towards this end, Phillip Akkery has spent much of the last two years gathering and analysing data on early stages, host plants, making dissections, drawings, searching the literature and so on. The finished work will include keys to genera und species, a phylogenetic reconstruction based on a complete data matrix of all characters used, and a review of the known general and

specific biology. It ist hoped that this work, to be completed and published during 1978, will stimulate fresh work by posing key questions on the evolution and biology of this group.

The function of butterfly colour patterns and their role in speciation

Under this heading is included much of the research of J. Huxley and R. I. Vane-Wright. Butterfly wing patterns are used in two primary ways: as defence mechanismus, and as specific signalling systems. This, coupled with behaviour, has somehow produced the kaleidoscopic beauty and diversity of butterfly colour patterns, including such peculiar developments as female-limited polymorphism. These phenomena, argued over since the days of Darwin, can now be seen to be related to unresolved controversies concerning individual, kin, group and sexual selection.

Working with a world collection offers a unique viewpoint on this subject. Many previous generalisations can be seen to be wrong or inadequate. Work to date suggests that several major, interacting selective forces are concerned in producing the varied splendour of butterfly colours. Phylogenetic systematics provides an important method to help discover these factors. By searching varied groups of butterflies for sister-species (a pair of species arising from a common ancestor which has not given rise to any other living species), we can hopefully study the most recent or immediate products of speciations events. Comparison of a large number of sister-species pairs should shed light on the general modes, requirements, effects and reasons behind butterfly speciation. All this, of course, requires keeping up to date on advances in physiology, genetics and ecology, quite the most daunting aspect of the task!

At present the most important application of this approach is to the classic sex-limited mimic species, *Papilio dardanus*. This interest was triggered by the unexpected discovery that *dardanus* ist almost certainly the sister of a sympatric female-limited polymorph species, *Papilio phorcas*. A complete re-synthesis of the ideas on the origin of *dardanus* will be published by R. I. Vane-Wright in 1978. It is hoped that this work will formulate a number of field and laboratory experiments designed to choose between alternative theories.

John Huxley's work in this area is based, initially, on a very different approach. If butterfly colour and wing patterns are thought to be of specific use, what information is carried by them that the butterflies can respond to or differentiate? As structural colours are one of the most conspicuous elements in butterfly epigamic or intrasexual coloration, investigations have begun by endeavouring to elucidate the physiological basis of structural colour production in a wide range of species. To date a variety of '*Morpho*' and '*Urania*' type scales have been investigated, and news types, such as the '*Zalmoxis*' Tyndall-blue scales have been discovered. Other new types recognised are currently being worked on. This work has great value at the phylogenetic level alone, but the eventual goal is to design experiments to test predictions about the origin and function of specific isolating mechanisms. This will require good spectrophotometric knowledge of pigmentary as well as structural colours, and the elaboration of ideas on the perception processes employed by butterflies.

A catalogue of the butterflies of the Afrotropical (Ethiopian) region

While still at the former Coryndon Museum, Kenya, Dr. R. H. Carcasson did much basic work towards a catalogue od African butterflies. After moving to Canada some

years ago, he found it almost impossible to continue this huge task, because of lack of suitable facilities. Since then it has been agreed to complete this work, expected to run some 1000 printed pages, through collaboration with the BMNH staff.

The main part of the catalogue will include a brief description of the habitat and distribution of each species and subspecies recognised, together with the original references for all associated names, indicating their original status, combination and published type-locality. The references will form a bibliography of African butterfly literature. No literary synonymy or type-depository data will be given, but the work will be prefaced by descriptive sections on such topics as biogeography, bionomics, physiology, genetics, ecology – in fact, hopefully surveying the whole field of African butterfly biology.

Drafts of the following catalogue sections have been completed: Papilionidae, Satyrinae, Acraeinae, and Danainae. The Pieridae and Charaxidinae are in progress, the bulk of the work so far having been done by P.R. Ackery and R.L. Smiles, working from Carcasson's original. It is hoped to increase pace during 1978, and send the catalogue to the printers in 1979. Before this is done, however, copies of the various sections will be sent out to many other specialists, in the hope of receiving comment and correction.

In addition to the work described, many other projects are planned or in progress. These include research on the African swallowtails (Ramnik Arora & R.I. Vane-Wright), the old-world Charaxidinae (Robert Smiles), the application of x-ray techniques to the study of wing venation (R.L. Smiles), and a survey of the butterflies described by Linnaeus, Cramer and Fabricius (R.I. Vane-Wright).

Research also continues with many friends and visitors to the museum. Currently this includes work by Dr Gerado Lamas and Prof. K.S. Brown on the Dismorphiinae and Ithomiinae, John Eliot, Dr C.B. Cottrell and Don Sands on various lycaenids, Prof. Louis Marks on American Papilionidae, Lionel Higgins on *Phyciodes*, Dr M.J. Adams and I.G. Bernard on S. American satyrines, Michael Boppré on the structure of danaid scent organs, and the preparation of the multi-volume publication "Butterflies of the World" by Bernard D'Abrera.

A major area of concern to anyone interested in butterflies is conservation. In the opinion the writer, the main problems in butterfly conservation are politico-economic in origin: pollution and land usage. I believe the most useful contribution professional museum workers can make is to forge ahead as rapidly as possible with studies designed to increase our understanding of the origins and dynamics of organic diversity. This is because to the politician and economist our present ignorance is more suggestive of irrelevance and disinterest, than of natural resources in desperate need of preservation. For this reason the BMNH butterfly section welcomes the prospect of collaboration on any project aimed at increasing our knowledge of the evolution and ecology of butterflies. H.W. Bates was of the opinion that "the study of butterflies..... will some day be valued as one of the most important branches of Biological Science". We believe that day has arrived – but will it be long enough for us to find the answers?

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