PRESIDENTIAL ADDRESS TO THE THIRTEENTH ANNUAL MEETING OF THE LEPIDOPTERISTS' SOCIETY

LEPIDOPTERA AS SCIENTIFIC TOOLS.

Dear Fellow Members:

It is a fact that most of our knowledge of genetical mechanisms in living organisms has, up to now, been obtained by a study of *Drosophila.* This is because in these flies the comparative simplicity and large size of the chromosomes has made them particularly suitable material for laboratory investigation. Furthermore, they are easy to breed and usually disease-free. In *Drosophila* there are generally four or five sets of chromosomes containing 10-20,000 genes reacting each with the others, to express characters either behavioural, physiological or visual.

Where *Drosophila* has so miserably failed is that the survival value of visual character differences in the wild has, with few exceptions, been impossible to detect. So small are the flies that highly adaptive colour-patterning has not been divulged. Success or failure in nature must depend but little on their visual qualities. Even their life histories in the wild are little known, yet their early stages must also be subject to selection pressures.

In recent years the study of Ecological Genetics has made great advances. Using specially chosen species and particular techniques we are now able to assess population dynamics in the wild. The absence of distinctive colour and pattern in *Drosophila,* a whole dimension in nature, becomes apparent when, by contrast, we study birds, mammals and particularly the larger insects. Here they have been developed to the full by natural selection. To the student of Ecological Genetics the Lepidoptera must surely offer the very greatest advantages: on the one hand because of their highly developed patterns specialised to ensure survival by camouflage, mimicry, threat or warning coloration: on the other, because of their easy capture, easy marking and quick breeding. The colour and pattern of every lepidopteron is never fortuitous but always essential for the survival of the species.

Whenever there are two or more forms of a species flying together at the same time we can say that the species is polymorphic, and it is in such situations that we are today able to analyse some of the advantages of each form under different environmental conditions.

The Lepidoptera have in fact until recently been largely neglected for laboratory and field experiments. The reason for this is clear; namely that

in order to study them it is essential to have a knowledge of genetics, and also a more comprehensive one of the Lepidoptera species themselves, all of which differ in their life histories. This synthesis of two sciences in the same individual is but rarely found. The one is largely an academic subject learned comparatively late in life: the other is a spontaneous interest in Natural History, in particular in moths and butterflies, from earliest childhood. For this reason, amateur Lepidopterists in nearly every country, though earning their livings in different spheres, have played so important a part in recent advances in Ecological Genetics.

In Britain, the recent mapping of the frequencies of melanic forms of many species of moths, has been made possible by the voluntary help of over one hundred amateur collectors. In the Peppered Moth *Biston* (=*Amphydasis*) *betularia* alone they have provided over 20,000 records of melanic and typical forms throughout Britain. Many of these lepidopterists are not primarily interested in Science. They collect butterflies and moths for various reasons: for competition with other collectors, for æsthetic pleasure or even as a weekend escape from a nagging wife!

Since the advent of the highly efficient mercury vapour trap, first devised by HUGH ROBINSON and his brother, the competetive collecting of moths has in this country greatly diminished. The village idiot with his trap can now collect on equal terms with anyone. No longer is it necessary to have an intimate knowledge of species in order to obtain them. Nearly 150 years ago WILLIAM JOHN BURCHELL wrote this "To him who is satisfied with ammassing collections of curious objects simply for the pleasure of possessing them, such objects can afford, at best, but a childish gratification, faint and fleeting; while he who extends his view beyond the narrow field of nomenclature, beholds a boundless expanse, the exploring of which is worthy of the philosopher and the best talents of a reasonable being". However, the underlying reasons for collecting are today on a much wider plane and frequently have a more scientific interest.

Now how much have the Lepidoptera contributed so far to our knowledge of living things? For the teaching and demonstration of simple Mendelian inheritance, a number of Lepidoptera species with distinct forms showing clear-cut dominance are today regularly used in laboratories and schools. Sex-linkage was first demonstrated in *Abraxas grossulariata* f. "dohrnii" ("lacticolor") by DONCASTER. Geographical races, varying according to local conditions, geological and otherwise, have shown how intensely natural section must work. More recently we have been able to get more precise measurements of selective pressures by studying Industrial Melanism. We have shown that the black form

of *B. betularia,* the British Peppered Moth, has a 30 per cent. advantage over the light one in and around industrial centres. By this I mean that in each generation 130 of the melanic forms survive to 100 of the light ones. This was made possible by using modified marking techniques, first developed here by DOWDESWELL, FISHER and FORD, in which a dot of quick-drying cellulose colour paint is placed on the underside of a moth prior to release: four wings and say five colours, each changed according to the day, gives us twenty different markings. Subsequent recaptures may show a deficiency of one form or another.

In Britain, apart from work on Industrial Melanism this technique is being used to analyse a variety of situations: – in the Tiger Moth, *Panaxia dominula,* and its two forms, the frequencies of which have now been recorded each year by Dr. E. B. FORD for the last 26 years; in the frequency of spotting in the butterfly *Maniola jurtina;* on the forms of *Amathes glareosa* in Shetland; and in the Oak Eggar moth *Lasiocampa quercus* subspecies *callunae* in Yorkshire.

Recently I have developed a method of "marking" larvæ by feeding them on plants previously grown in water culture with radioactive isotopes. This method is the only one available for larvæ today, because of their frequent ecdyses which exclude colour marking. A known number of radioactive larvæ of *Panaxia dominula* were returned to the colony from which they had been extracted, and a proportion of radioactive imagines were subsequently recaptured. An estimate of the total imaginal population was conducted at the same time. This enabled us to say that the late-larval and pupal mortality-rate in the wild is approximately 85-95 per cent. A study of wild populations of Lepidoptera by improved marking techniques will no doubt in the next few years enable us to appreciate the fine balance of conflicting advantages and disadvantages which contribute to the survival of each form. But pattern and colour amongst the Lepidoptera, unlike *Drosophila,* must play an all-important part in their survival.

In North America the investigations of Dr. CHARLES REMINGTON and his co-workers on mimetic butterflies, on diapause, and on chromosomal counts have laid the foundations for future advances in many directions. Drs. LINCOLN and JANE BROWER *have shown* by carefully devised laboratory and field experiments that mimetic Lepdioptera gain advantage by copying distasteful species. Until this proof was forthcoming, many entomologists, particularly in France, did not believe that any such advantage could be conferred by mimicry. Dr. W. HOVANITZ has produced evidence that a sex-limited dominant gene, responsible for a colour phase difference in *Colias* species at the same time changes its behaviour pattern in nature.

In other fields the Lepidoptera have recently been responsible for advances in the knowledge – the hormonal control of growth and ecdysis by Dr. CARROLL WILLIAMS and others; the discovery that the vestibulum, present in some species of moths, may be a highly specialized organ for recognising the near-presence of bats by Dr. ASHER TREAT.

In the laboratory, by large-scale breeding experiments, work by Dr. C. A. CLARKE and Dr. PHILLIP SHEPPARD has divulged the genetic mechanisms responsible for the mimetic morphs of *Papilio dardanus,* the existence of a super-gene and the selection of a particular gene-complex (the total complement of genes present) to suit each morph according to the area of Africa its model inhabits. JOHN TURNER of Oxford is at present unravelling the series of mimetic forms in the South American species *Heliconius melpomene* and *erato,* which is likely to prove even more complex than in *Papilio dardanus* in Africa.

The biochemical knowledge of Lepidoptera is growing apace. In Britain the analysis of wing pigments is at present being studied by many: Dr. PETER BRUNET and Mr. JOHN DAVIES at Oxford; by Dr. THOMSON and others at Aberdeen and Mr. HAMSEN at Cambridge. Using gas chromatography techniques, Dr. PAUL FEENY has developed a method of analysing the chemistry of female assembling scents of several species of moths. Using different methods from those of HALLER and POTTS in their pioneer work on the scent of the Gypsy Moth, *Lymantria dispar,* we have been able to collect scent by passing the air from flasks containing assembling virgin female moths through liquid oxygen. The essence, sealed in tubes in nitrogen, has (in certain samples only) attracted males in the wild on breaking the tubes twelve weeks later.

These then are but a few of the exciting problems to which Lepidoptera, the common interest of all of us here, are contributing. There are many other lepidopterists who are contributing to science, the majority of whom have not been mentioned. If any of you feel ignored, let me assure you that this is not so. Let me tell you a true story to convince you that it is the recording of small apparently insignificant facts which is responsible for the final major conclusions.

At the beginning of the last war I had a patient who, unknown to me at the time, was a Senior Officer in Counter Espionage. In the course of conversation I told him how, before the war I had been interested in a particular moth, The Northern Arches, *Apamea exulis,* subspecies *assimilis,* which is rare and only found in Scotland. I had recently had a telephone conversation with a man I did not know who told me that he had caught two specimens in Scotland. He wished me to see them for correct identification but he regretted (and he hoped

I would not mind) that he could not possibly give me particulars of where and how he had caught them. I drove over to his home, and the first words both he and his wife said were "I do hope you understand that we cannot give you details of the locality". During tea I heard his wife tell mine, firstly that they had been married the previous year, secondly that their honeymoon had been in July at a certain remote place in Scotland, and thirdly that they never walked further than a quarter of a mile from their hotel. He showed me his collection, in which were a few specimens of the beautiful white form (f. "hospita") of *Parasemia plantaginis*. "Yes", he said, "I caught these on my honeymoon". They were boldly labelled "Loch Maree Hotel". I shall never forget his farewell remark: "Terribly sorry old man, but I cannot give you any clues, but you understand why". During our short meeting I had in fact learned the date and the year of capture, the locality within a quarter of a mile and actually even his method of capture. I had told this story to my patient, who was in Counter Espionage. I met him again after the war. He informed me that he had frequently lectured the troops by telling them this story, in order to demonstrate that it is a collection of minor apparently unrelated incidents which add up to the final realization of truth. It is the same in espionage, counter-espionage or our own spying into the private lives of Lepidoptera. Small, apparently unimportant and disconnected observations may result in an important discovery. From this each of us must learn the importance of putting on record original observations, however trifling they may seem: they may be most important to others.

In my Address today the emphasis has been on the scientific contributions of the Lepidoptera. The very title of this address specifies this. I am proud to have been your President at a moment in time when the Lepidoptera are helping to teach us so much about the fundamentals of life. Allow me, though, to make one further point. There are many Lepidopterists today to whom science is anathema; they are dismayed that their hobby is becoming more and more a tool of science. To them I would say this. "Heaven help the scientist who, using butterflies for science alone, fails to appreciate their beauty and to take advantage of the wonderful places into which they lead us. You probably get more enjoyment from these than do such men in science". In this sense I think it is wrong to divorce aesthetic pleasure from scientific fact.

The Lepidoptera, Thank God, can give satisfaction to all of us.

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