# Foreword

Those of us who are interested in any aspect of the Zygaenidae will greet this volume with joy – it is exactly what we have been waiting for, the sort of field guide every entomologist engaged in the study of a particular group of Lepidoptera needs and dreams of acquiring. It gives us a sound foundation for the general biology, morphology, ecology and distribution of these moths, but in addition provides essential details of life-cycles, food plants and breeding, and also brief notes concerning past students of the Burnets and Foresters. The lists of parasitoids (primary and secondary) are extremely useful and so is the table showing the distribution of the mutant colour forms in the western Palaearctic species. It is a fine *Überblick* which does not discourage a young student by the weight of knowledge already accumulated and, on the contrary, ingeniously arouses our curiosity and opens unknown doors.

The Burnets are a most unusual and peculiar group of diurnal moths. As a beginner I found them somewhat sinister and I still think their crude aposematic characteristics disseminate a subtle sense of *Angst,* difficult to define. I have experienced the same sensation watching numerous roosting Monarch butterflies settling down in the bushes for the night. Do they both produce a warning pheromone of which our central nervous system is only just aware?

One of the most striking features of *Zygaena* noted in the field guide is their extensive and 'individual' variation. Is there some hitherto unrecognised connection between this striking variability and their equally striking toxicity? Certain other unrelated poisonous moths such as *Arctia caja* (Linnaeus, 1758) (Garden Tiger Moth) and *Abraxas grossulariata* (Linnaeus, 1758) (Magpie Moth) produce many varieties highly prized by amateur collectors. The Magpie Moth stores a cyanoglucoside, sarmentosin, also recorded from a certain Japanese Zygaenid, *Pryeria sinica* (Moore, 1877). The late E. B. Ford, to whom I put the question, thought the 'exceptional' variation was in the eye of the beholder and that innocuous cryptic species were really just as variable but in a subdued manner. However, reading Naumann, Tarmann & Tremewan one's curiosity is again aroused. Is there some link, some cause and effect, between the dazzling variable patterns, the toxic deterrents and the evolution of the aposematic life-style?

The authors also provide a stimulating description of the complicated diapause of the Zygaenids – a daunting project and a revelation to those of us who have undertaken little, if any, breeding of these moths and have had no experience of their cold-hardiness, decreased metabolic rates, changes in colour and various structural and physiological adaptations which are mentioned. I recall the shock of surprise I experienced on opening a closed tin box and finding several tiny straw-coloured larvae of *Zygaena* which had been overlooked two years and nine months previously and were now alive and well! The field guide records diapause lasting five years or more.

The great charm of the Zygaenids lies not only in their beautiful colour scheme and that agreeable addiction for sitting still on mauve flower heads, but in the unique beauty of the habitat of their choice. Graceful grasses waving gently in June sunshine, bespangled with wild flowers in full bloom, sudden clearings on the precipitous slopes of the Alps, rolling downlands or hayfields, filled with the nostalgic scents and sounds of high summer.

One of the most attractive features of their close association with flowers is the male Burnet's appropriation of one of the ingredients of the scent of scabious blooms. This volatile element (trimethylpentadecanon) is transferred onto the male's brush-like coremata and disseminated as an alluring stimulus to courtship and pairing.

The habit of sitting immobile in numbers on the same flower heads is associated with a remarkable example of Mullerian mimicry between Zygaenids and Syntomids. Mutual self-exposure has probably played an important role in the development of this extreme case of superficial resemblance between unrelated toxic moths. So far there is no experimental evidence to prove a similarity between their chemical defenses, except for a bitter taste and the same pyrazine alerting signal. It would be interesting to investigate this question in the Chalcosiine *Agalope glacialis* (Moore, 1872) which is a brilliant mimic of the Magpie moth *Abraxas paucinotata* (Warren, 1894). One would expect to find cyanoglucosides in both species.

The book contains an excellent section on conservation. The authors are absolutely right in placing the greatest importance on the preservation of the habitat rather than the Zygaenids themselves, despite their dangerous exhibitionism which makes collecting too simple. However, it is not enough to protect and preserve the terrain where they are found; such an area must be *managed* by well-informed personnel. Semi-natural meadows are extremely vulnerable to encroachment by scrub, modern agricultural methods including the switch from hay to silage, drainage, uncontrolled grazing, and pollution by chemicals, deliberate or accidental. Today, more Burnets and Foresters are being destroyed by mismanagement and neglect of the habitat than by development and overcollecting.

The toxicity of the Zygaenids is perhaps their most fascinating characteristic, and one of the best examples among Lepidoptera of the 'stock-piling' of deterrents from their dazzling coloration and buzzing flight to chemical alerting signals and toxins.

Naumann, Tarmann & Tremewan first mention the lethal protein described and named zygénine by Rocci (which can render a mouse unconscious within seconds if injected via the peritoneal route, thus acting faster than any known neurological toxin), and then pass on to a paragraph on cyanide (HCN) which is found in the tissues of all stages of the life-cycle of *Zygaena.*

In 1962 a lecture was given at the Royal Entomological Society where it was prophesised that in time insects would be found which not only sequestered deterrents from their foodplants, but would eventually turn over to synthesizing the toxins themselves. 'This is something', the lecturer added, 'to ponder when caught up in traffic jams'. About 15 years later Davis & Nahrstedt revealed a dual pathway in *Zygaena* larvae, which sequester and store the HCN precursors linamarin and lotaustralin from their foodplants, but synthesize both these cyanogenic glucosides if feeding on foliage which lacks them. This is somewhat similar to the case of the Trinidad subspecies of *Danaus plexippus* (Linnaeus, 1758) which synthesizes pyrazines (the alerting substance, shared with *Zygaena)* if absent from its foodplant, although the majority of Monarch butterflies from elsewhere sequester their pyrazines from Milkweeds *(Asclepias).* It will come as no surprise if we find that the versatile Zygaenids will likewise synthesize pyrazines, since they are lacking in some of their most favoured foodplants.

The authors point out that it was Karl Jordan who, 90 years ago, first gave resistance to cyanide as a family character of the Zygaenidae, and Witthohn & Naumann have now shown that this is owing to a special detoxification system for HCN, namely ß-cyano-L-alanine synthetase. My only regret is that we are not given more information about the meshing of the two separate systems, the resistance to HCN and its sequestration, storage and release against predators. Reading this field guide one always wishes for more.

All naturalists who study and collect these ravishing insects will surely find that this is both a scientific and practical, yet romantic publication – an absolute *must* both for their library and the rucksack. It is somehow appropriate that it forms one side of a triangle – the book, with its affection for the Zygaenids on every page, the moth with HCN improbably circulating in the haemolymph and the amazing discovery of that small but powerful molecule spinning among the stars in outer space.

January 1998

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