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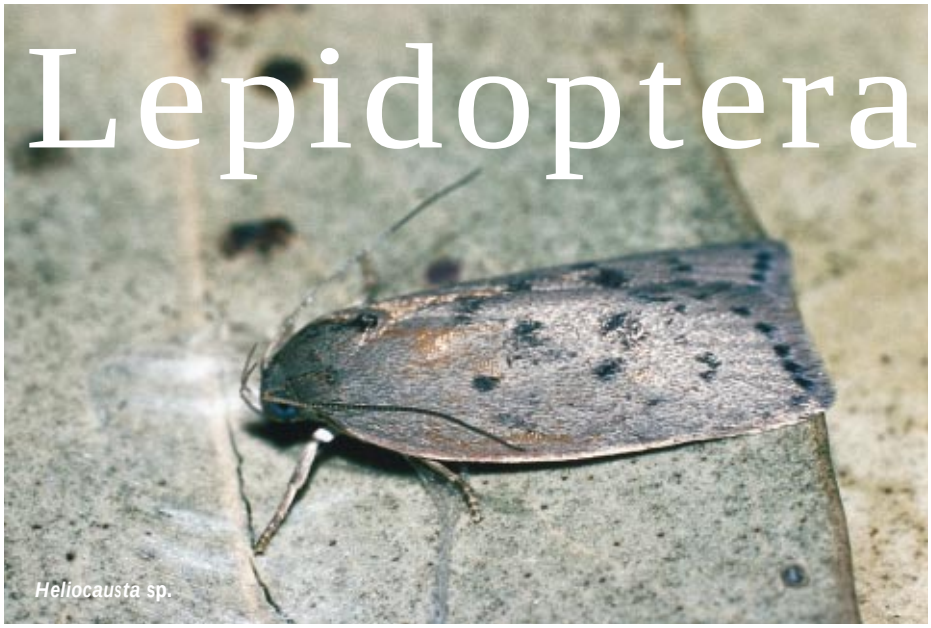
Shedding light on Lepidoptera


Heliocausta sp.

Ian Common has been deciphering Australia's insect biodiversity since long before the term existed.

Anna van Dugteren outlines his amazing legacy.

In the summer of 1950, Dr Ian Common began making weekly forays from his Canberra office to the granite boulders of the Brindabella Ranges, seeking clues to mass movement, ecology and lifecycle of the bogong moth.

Back then, science had little to say about the bogong. Aborigines in the high country were known to have feasted on them in summer, Sydney was occasionally invaded by them, and masses of dead bogongs were seen washed up on New Zealand's beaches.

Common, a junior scientist with CSIRO Entomology, was intrigued by the moth, and set about unfolding its story.

Day and night he observed the moths along their migratory path. He counted their swarms in motion and at rest. He trapped and bred them. He dissected them to determine their sexual maturity, weight, diet and body fat. He analysed their excrement, predators and parasites. He measured changes in how they occupied their shelters, and he travelled across eastern Australia gathering specimens of their larvae: a species of cutworm known to be a minor pest of agriculture.

In 1954, Common revealed the bogong moth as one of the Earth's great migratory insect species. His paper in the *Australian Journal of Zoology*, confirmed that the bogongs' larvae and breeding grounds spread from inland southern Queensland and northern New South Wales, right down to the Hay plains.

He established finally that the moths migrated to the Australian alps in spring, often hitchhiking on cold fronts, to escape the summer heat of their breeding grounds, and had been doing so for millennia. There they rested, living on fat reserves accumulated as caterpillars and feeding on the nectar of flowering gums on their long journey. And at the end of summer and through autumn, they returned to their breeding grounds to reproduce.

This was exciting stuff. An insect – often with a wingspan no more than four centimetres – that did a return trip of many hundreds of kilometres before reproducing. The North American monarch butterfly was the only other lepidopteran known at that time to undertake a two-way migration, between Canada and Mexico.

It was also exciting for what it revealed about Australia's biological diversity.

There are estimated to be 40 000 species of moths and butterflies in the world, with 22 000 species thought to occur in Australia, most of them endemic. They range from thousands of different types of microlepidoptera (tiny moths) that fill all sorts of ecological niches, to the largest moth in the world – the Hercules moth – found in the north Queensland rainforests. About 400 of the 22 000 species are butterflies.

Only about half of Australia's moth species have been named, with many still undocumented or even unknown to science. Accurately describing and naming more insect species is the key to protecting them and their ecosystems, and to developing environmentally safe ways of controlling insect pests without destroying beneficial insects. Ian Common, now considered one of the world's most eminent lepidopterists (moth and butterfly experts), has made an enormous contribution to this process.


Wingia lambertella


Zonopetala divisella

Above and below: Ian Common's research has revealed much about the distribution, biology and larval food plants of the mallee moths, the largest group of moths in Australia. The moths are thought to have a gut flora which helps them to digest dead leaf material. In this way they help to recycle nutrients in Australia's forests.


Philobota sp.

The chronicles of a great recycler

ALMOST 50 years after unfolding the story of the bogong moth, Dr Ian Common has completed the final volume of what some might call his magnum opus: *The Oecophorine Genera of Australia*.

The three-volume set of monographs presents all that is known about the sub-family Oecophoridae or mallee moths, and is rapidly becoming known as the 'bible' on this extraordinary insect group.

For Common, it represents a lifetime of discovery. There is the species he first caught as a child, the species he worked on while at university and then as a junior entomologist in Queensland, the species he trapped on Black Mountain behind CSIRO and around Canberra, and the many new species he captured on insect-collecting trips across Australia.

Dr Ian Common and Leane Regan who was employed by the Australian Biological Resources Study to provide technical assistance during the six-year Taxonomy of the Australian Oecophorinae project.

More than 5000 species, or some 20% of the continent's moth fauna, are mallee moths, making it by far the largest moth group in Australia. An estimated 3500 species are represented in the Australian National Insect Collection (ANIC), many of them undescribed. The whole of Europe, by comparison, has just over 100 species.

Common believes the great diversity of Australia's mallee moths is a product of their unique taste for myrtaceaus species, in particular the eucalypts.'The evolution and speciation of the eucalypts after the Australian continent split from Gondwana opened a window of opportunity for the parallel evolution of mallee moths,' he says.

'Mature and dead eucalypt leaves are tough and leathery, have low nutritive value and are rich in phenolic compounds, including tannins, which makes them unpalatable to many organisms. Here was a developing food source that wasn't seriously exploited by other insects.'

Through his research at CSIRO Entomology, Common discovered that mallee moths larvae could digest mature and dead eucalypt leaves. He and his colleague Dr Marianne Horak have since found that some mallee moths species even consume the faeces of animals that dine on eucalypt leaves, such as koalas and possums.

The findings have helped to explain the amazing proliferation of mallee moths alongside eucalypts in many different habitats, from high-rainfall areas of northern Queensland to arid inland locations and temperate, sub-alpine and alpine environments.

While the mallee moths depend on eucalypts, ecologists are now realising that eucalypts in turn depend on the moth to break down leaves and recycle nutrients back into Australia's poor soils. But Common believes the moths' crucial role in nutrient recycling is under threat from controlled burning practices which circumvent this natural breakdown by releasing nitrogen to the atmosphere.

He points to the controlled burning of Jarrah forests of south-western Western Australia. 'Way back in the early days of insect collecting, the Jarrah forests were rich in mallee moths,' he says. 'In more recent years when I have collected insects in these forests I have had an extremely small yield as the leaf litter and the mallee moths have been depleted.'

Anna van Dugteren and Robin Taylor

He has described and sometimes discovered one new suborder of moths, one new superfamily, two new families, one new subfamily, one new tribe, 124 new genera and 80 new moth species. He has published 100 scientific papers on Australian Lepidoptera and six books, including the landmark *Insects of Australia*, first published in 1970, *Butterflies of Australia* with DF Waterhouse, and *Moths of Australia*.

The work has helped to lay out the evolutionary history of moths and butterflies and other insects both on this continent and elsewhere in the world. It has also shed light on how Australia's peculiar and difficult environments have evolved.

Common's fascination with insects began at an early age. Born in 1917, he grew up in Toowoomba an avid collector of birds' eggs, lizards, spiders, fungi, and insects. By 1946 he had been awarded a Master of Arts from the University of Queensland and later a Doctorate in Agricultural Science based on his published research on insects.

He joined CSIRO in 1947 after a wartime stint with the Queensland Department of Agriculture and began working mainly on pasture and cereal crop caterpillars, fitting in important taxonomic revisions of various pests groups and work on the bogong moths.

He remembers one of many occasions when he and his colleagues were called upon to identify a species of pest insect and its close relatives. 'In the 1960s, the international pest, cotton boll worm was a problem in the Northern Territory and cotton from the Territory was quarantined and couldn't be processed in Queensland,' he says. 'Quarantine officials believed that the international cotton boll worm had already entered Queensland and they approached me to confirm this, so they could lift the quarantine on Territory cotton.

'But back in the 1920s, a Queensland entomologist discovered what he had called the pink boll worm of cotton. Similar to the

Garrha sp.

Right: The *Wingia* group of mallee moths genera contains more than 700 species in Australia and is well represented in all states and territories.

Below: Larvae of the mallee moth *Trisyntopa scatophaga* live in nests of the golden-shouldered parrot in Cape York Peninsula and the hooded parrot in the Northern Territory which excavate their nest chambers from termite mounds.


Trisyntopa scatophaga


Wingia aurata

international cotton boll worm, it isn't a pest, but lives off native hibiscuses (a plant in the same family as cotton) up and down the Queensland coast. The problem lay with ignorance over the two similar species of boll worm.'

To answer the quarantine question, Common went back to basics, collecting, breeding, taxonomically describing, observing, trawling through collections and sorting out the relationships between the various species of boll worm. He confirmed the existence of the pink boll worm of cotton and found that the international pest species hadn't entered Queensland. On his advice, the quarantine remained in place, preventing the pest from spreading east.

From 1960 until his retirement in 1982, Common's career was tied to the development and growth of the Australian National Insect Collection which was formally established in 1962 by an Act of Parliament. Boxes, cabinets and suitcases full of insects, formerly scattered in private collections and in offices and labs throughout the division, were brought together in a new dedicated building, catalogued and mounted to ensure their preservation, usefulness and accessibility to researchers.

The collection was quickly swelled with specimens from across Australia. Common and his colleagues journeyed to places such as Arnhem Land, northern Queensland, Thursday Island and the Kimberleys, often returning with 5000–10 000 insects. 'So many of the insects we collected were new to us, they hadn't been described in the scientific literature and we couldn't put a name to them,' he says.

Common has a passion for a particular family of moths: the Oecophoridae or mallee moths. Working from his home in Toowoomba as an honorary research fellow for CSIRO's Australian National Insect Collection, he has completed the final volume of the three volume set Oecophorine Genera of Australia (see story opposite).

As with all his previous work, it is a wonderful gift to an evolving nation on the cusp of celebrating its first one hundred years. By naming, describing, explaining and illustrating the rich mallee moth fauna of Australia, Common has provided some of the ecological guideposts for managing this country's rich and complex biodiversity next century.

But he can't help worrying about the moths still to be discovered in the leaf litter, the rock crevices, under the bark and in the forest canopies of Australia.


Telanepsia stockeri

Far left: Mallee moths usually lay their eggs in narrow crevices or between living or dead leaves, often in large groups or masses. This helps to protect the eggs and larvae from temperature extremes and predators. Some species construct portable cases from leaf fragments, enabling them to move to the most favourable leaves for food.

Left: Some species of mallee moths feed in the droppings of native animals such as koalas and possums which contain organic materials derived from eucalypt leaves. The caterpillars of most of these species complete their development in a single dung pellet in which they spin their cocoons, later emerging as adult moths. One of the koala scat feeding species was named in honour of Australia's chief scientist, Dr John Stocker, as *Telanepsia stockeri*.