

## Kenneth Hedley Lewis Key 1911–2002

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Dr Kenneth Hedley Lewis Key was an extremely meticulous worker. He left copious notes and records covering all his studies including very detailed field notebooks of every collecting site he ever visited and records of every overseas type specimen he ever studied. Ken left nothing to chance. He wrote and left for posterity a detailed statement on which this memoir is based and to which some additions and a few corrections have been made.

Ken Key was born in Cape Town on 28 August 1911, the eldest son of South African-born parents of English extraction. In 1913 the family moved to Pretoria, where Ken was to spend his early boyhood. In this subtropical environment his interest was first aroused in the diverse and often showy insect fauna. By the age of seven, with encouragement from a grandmother, he had assembled a collection of pinned specimens and was making notes on their habits.

On returning to Cape Town in 1921 with his parents and a younger brother, Ken's formal education began in earnest at the leading State school, the Rondebosch Boys' High School, from which he matriculated in 1927 at the age of 16. During these years his interest in insects continued, but now it had to compete with a burgeoning preoccupation with the native plants of the Cape Peninsula. The richness of the flora of this small area is well known and is sufficiently well indicated by the abundance of species in the genus *Erica*, with more than 100 species, and the genus *Gladiolus* with more than 20, the latter including delicate, scented forms of rare beauty. In the family home Ken developed

a garden with plants collected in the surrounding mountains and heathlands and learned to know all the commoner species, with the help of the great old lady of South African botany, Mrs L. Bolus.

Curiously enough, in his matriculation examination Ken gained his best mark in mathematics, a subject in which he was always weak, and his lowest mark in science. However, as taught in the Cape Town schools at that time, 'science' did not include biology, so when in 1928 he enrolled at the University of Cape Town, it was for a BSc course, with his old and newer loves of zoology and botany as majors—entomology as such not being available. At the suggestion of his father, he had sought advice as to the career prospects likely to be opened up by such a course. His principal adviser had been the well-known South African educationist and naturalist S. H. Skaife, who reported that vacancies had just been advertised for nine entomologists to participate in investigations into the biological control of prickly pear in Australia. He foresaw an important future for work of this kind, and of applied entomology in general, in the coming years.

With this encouragement, Ken started his university career, and after a preparatory year of Physics, Chemistry, Latin and Economics, plunged into the zoology and botany courses. In zoology he found himself under an *enfant terrible* in the newly appointed Professor Lancelot T. Hogben, then in his late twenties and not yet world famous. Conservative Cape Town society could not adjust to Hogben—not even University society—



and after four years he returned to England to take up the chair of social biology at the London School of Economics. Among the many noteworthy events of his period in Cape Town was the time when he took a ‘coloured’ woman to a ball; only someone who has lived in South Africa can appreciate the horror with which that action would have been received in the late 1920s. Hogben believed in shock tactics, and these were not without their effect on our teenage student from a prim—indeed puritanical—home environment.

In the botany department Ken came under a very different kind of man, a shy and poorly articulate Englishman who had occupied the chair of botany at the University of Sydney a few years previously, R. S. Adamson. While Hogben had turned upside down all conventional ideas of a zoology course in those days and had his first-year students pithing frogs and perfusing the hearts of *Xenopus* with strange solutions of salts, Adamson, although himself an ecologist, was running a conventional botanical course. Ken managed to adjust to these different approaches and emerged with his BSc and the class medals for both subjects in both years. His entomological interests had not helped him in zoology, but in botany he had astonished Mrs M. R. Levyns, the second-year lecturer in ecology, with his knowledge of the plants encountered on the field outings. This same Mrs Levyns once gave a paper on the effect of moonlight on the growth of plants which Hogben, from the audience, ungallantly rubbished as ‘all moonshine’.

In 1931 the zoology department at Cape Town came under the marine biologist T. A. Stephenson, who carried out over the next few years quite epoch-making studies of the zonation of littoral animal communities along the South African coastline. Stephenson decided to redress the imbalance of the Hogben era by instituting traditional courses in comparative anatomy—vertebrates and invertebrates in alternating

years—for the MSc degree. As luck would have it, Ken was again cheated out of any formal training in entomology by landing in the vertebrate year. In spite of himself, he got quite a kick out of the evolution of the vertebrate skeleton and took his degree with first class honours at the end of the year. The only concession made to his interests was permission to choose as his research subject the topic ‘Acrididae of the Cape Peninsula’. His thesis on this subject, embodying observations on the distribution, behaviour and life-cycle of some thirty or forty local grasshopper species, won him the Purcell Memorial Prize awarded by the University, and probably assisted him towards the George Grey Memorial Scholarship that enabled him to proceed in the following year to the Imperial College of Science and Technology (University of London) to do a PhD in (at last) the Department of Entomology.

This interest in grasshoppers, which was to direct the whole of Ken’s subsequent career, had arisen quite fortuitously, again through the intervention of S. H. Skaife. Skaife had been asked by B. P. Uvarov, the great Russian authority on locusts and grasshoppers, then recently established on the staff of the Imperial Bureau of Entomology in London, if he could find someone in South Africa who would collect the local grasshoppers for him. He suggested to Ken that he might undertake this assignment and put him in touch with Uvarov. The contact was renewed when Ken moved to London in 1932, and led to his choice of *Locusta migratoria* as the subject of an experimental study on behaviour and related topics in that locust, which gained him the PhD in 1936. It also led to taxonomic work on grasshoppers, in which Uvarov was his mentor at the British Museum of Natural History.

The period in London was perhaps more significant in a general liberating sense than scientifically. Ken had chosen a

refractory problem and he received minimal guidance from his nominal supervisors, who at that time were desperately trying to find jobs for their graduates at the height of the Depression. In spite of the fact that his doctoral project yielded four published papers (2–5)\*, Ken was perhaps lucky to be awarded the degree.

His taxonomic studies at the British Museum were published in two papers on African genera of grasshoppers (6, 7). However, they were not Ken's first which had been published in 1930 (1), while he was still an undergraduate, in the *South African Journal of Science* (it was a lead-up to the MSc thesis that gained him the Purcell Prize).

During one of his sessions at the British Museum in 1935 Ken was visited by A. L. Tonnoir, a Belgian engineer and amateur entomologist who had been appointed to the then CSIR Division of Economic Entomology in Australia by R. J. Tillyard, its first Chief. Tonnoir was looking for a young man to fill a recently advertised vacancy for an Assistant Research Officer to carry out investigations on the 'grasshopper' (really locust) problem in Australia. Ken seemed to have just the kind of qualifications and interest required and he was encouraged to apply. In due course he was offered the job and arrived in Perth in May 1936.

Just before Tonnoir's intervention Ken had suffered a rejection without which his life would have taken a very different turn. A vacancy had occurred for an Orthopterist in the British Museum. Ken had several papers on Orthoptera in press, including two on taxonomy, as well as the slight quasi-taxonomic paper of 1930 and the thesis of 1931. He applied and was interviewed by a forbidding panel of British public servants and establishment entomologists, including N. D. Riley, then Keeper

of Entomology. In answer to questions Ken proudly described the revolutionary, and to his audience inappropriate, zoology course under Hogben. The questioners seemed to have odd interests. One wanted to know whether South Africa had produced a literature! Ken answered this with sturdy colonial bravado. He was not offered the job. He became an Australian, not a Britisher, but after a long stint as a locust ecologist, he turned to full-time taxonomy of the Australian grasshoppers and built up in Canberra a collection of Australian Orthoptera far superior to that in the British Museum and indeed at least equal to all other collections of Australian Orthoptera combined.

In Australia, still in his early twenties, Ken faced two sets of difficulties. His assigned problem was a broad ecological one, yet he was ignorant of climatology, of the Australian soils and vegetation, and of the economics, politics and technology of Australian rural production, with which the locust problem was intimately enmeshed. But in addition he had had no experience of doing research under direction, which was what he found was required of him as an Assistant Research Officer, and although he was only too conscious of his limitations in the unfamiliar environment, he also found that that direction was inadequately informed. In 1936 it was to be still a number of years before he would be able to be authoritatively advised on a matter of plant ecology or be referred to an adequate soil map of a critical area. He had to fill in the gaps as best he could by reading. He dug soil profiles in the Trangie area of New South Wales for correlation with locust life-cycle events and he did his own reconnaissance surveys of the vegetation of the outbreak areas of the Australian Plague Locust, *Chortoicetes terminifera*. In due course he achieved a more independent research status and began to feel that he was beginning to understand the locust problem.

\* Numbers in this form refer to the Bibliography at the end of the text.

That problem was essentially the question of where and how locust plagues originate. Its solution could be expected to lead to a more rational and radical strategy for locust control. The way to a solution had been indicated during the 1920s by B. P. Uvarov on the basis of evidence being accumulated on European and African locusts. Essentially Uvarov's theory of locust outbreaks was that for any given species there were special, often remote, areas (later called 'outbreak areas') in which the ecological conditions permitted both multiplication of the locusts and their active concentration in particular required habitats as a result of short-term fluctuations in the size of those habitats. It had been shown both in the field and experimentally that such concentration resulted in physiological changes leading to gregariousness and migration, with the consequent invasion of agricultural areas. These changes were signalled by changes in colour pattern and morphology and the whole phenomenon was designated 'phase change', the phases being the types of individual comprising respectively swarms and non-swarmling populations.

After some preliminary taxonomic clarification of the Australian pest species, Ken proceeded to test the Uvarov concept on *Chortoicetes*. Over a period of several years he was able to establish that the concept indeed applied to *Chortoicetes* in Australia, and he was able to map and characterize a number of outbreak areas ecologically. The results of this work were published in a series of four papers between 1938 and 1945 (8, 10–12).

In 1939 Ken was joined by L. R. Clark, who filled out some of the ecological detail from a base at Trangie, NSW, in one of the outbreak areas. This collaboration continued throughout the war years, with the approval of the manpower authorities who had classified it as a reserved occupation. Knowledge of the location and characteristics of the outbreak areas could have

practical implications of two kinds. On the one hand it could enable conventional control measures to be applied at an earlier stage of an outbreak and over a smaller area. And on the other hand, it seemed possible that certain changes could be made to the ecology of the areas that would prevent multiplication and swarm formation. Unfortunately, in retrospect, the urgency of the war situation led to efforts being directed into the second of these control options before sufficient knowledge had been gained of the insect's behaviour. Later work after the war, by D. P. Clark and his collaborators and later by R. A. Farrow, demonstrated why those efforts could not have succeeded.

Although Ken would not have claimed credit for the establishment of the Australian Plague Locust Commission, it was based on his work and that of his colleagues in New South Wales and Victoria. The idea of a commission had been mooted in the 1940s and 1950s but elicited no interest from the governments involved. But in 1972 there was a substantial outbreak and the Standing Committee of Agriculture agreed to the establishment of a commission, and this has continued to function effectively ever since. Now, based on Ken's early work and with seventy years of continuous research, more is known about the Australian Plague Locust than is known about any other locust species.

Ken's only real distraction from work on locusts and grasshoppers also occurred during the war, when he was called upon to organize an investigation into a massive infestation of strategic storages of baled wool by two species of clothes moth. A suitable insecticide treatment was devised (this was before the advent of the chlorinated hydrocarbons), but the most interesting finding biologically was the smashing of the infestation, in a store reserved from treatment, by immense numbers of spiders that built their webs between the stacked wool bales. These findings were reported

only in 1959 in a joint paper (25) with I. F. B. Common who, with K. R. Norris, had participated in the work.

Ken was awarded a DSc degree by the University of London in 1946 and another by the University of Cape Town in 1962.

After the war Ken turned to the writing up of his considerable data on the taxonomy of *Chortoicetes* and its nearer relatives in the genus *Austroicetes*, two of which are also minor pests. This work, which is still the basic reference in its field, was published as a small book (18) in 1954. However, as a preliminary, Ken undertook a close examination of aspects of Uvarov's 'Phase Theory' of locust outbreaks, with which he was dissatisfied and which had to be clarified for his proposed book. In 1950 he published a 'Critique' of the theory. This paper (14) was subsequently widely misquoted by close adherents of the theory, who in general failed to recognize that its main aim was logical clarification rather than dissent from well established biological facts.

At about this time Ken was making strenuous efforts to organize, through the State authorities of New South Wales and Victoria, a trial of a strategy of control that would follow the first of the control options mentioned above, namely the concentration of conventional measures in or near the outbreak areas in the early stages of an outbreak. Unfortunately, just when all human obstacles seemed to have been overcome, there was no outbreak for a couple of years. The momentum was gone, and when the locust situation again became ripe for action, attention was drawn away from the proposed trial by improvements that had been developed in the meantime in the technique of treating flying swarms with insecticide from the air. Not for the first time Ken was to reflect how much easier it was to work with insects than with humans.

During the second half of the 'fifties, Ken began to lose interest in *Chortoicetes*.

As we shall see, the final break did not come until 1959, but well before that he was devoting time to various side-line projects that were to yield publications of some interest: principally two papers (19, 20) (with M.F. Day) on a unique temperature-controlled physiological colour-change response in the alpine grasshopper, *Kosciuscola tristis*, and one (22) that recognized and studied for the first time Uvarovian phases (for which Ken coined the adjective 'kentromorphic') in the order Phasmatodea—the stick insects.

At this time also Ken began an association with the cytogeneticist M. J. D. White, seeking the solution of taxonomic and speciation problems in grasshoppers with the aid of features of the chromosome complement. The potential of this additional source of characters was spectacularly illustrated when White's examination of the karyotypes of the genus *Austroicetes*, monographed by Ken in 1954, showed that one of his 'races' of *A. pusilla* was in fact a completely different species, although the siblings can still not always be separated on any feature of their gross morphology. This led to a joint paper (21) published in 1957, the forerunner of a number of joint or parallel studies (31, 37) continuing beyond the retirement of both workers (Peacock and McCann 1994). However, a measure of disagreement developed between them on theoretical issues, particularly with White's concept of 'stasipatric' speciation. This was reflected in two papers by Ken in 1968 and 1981 (36, 66).

From 1958 onwards, Ken published some forty papers on the taxonomy of the Australian orthopteroid insects (two under joint authorship with M. J. D. White) and several others on theoretical and methodological issues of taxonomy. He contributed chapters to five books, including both editions of *The Insects of Australia* (39–43, 52–55).

Ken was a member of a number of expeditions to parts of Australia, some of

them quite remote at the time. They included Cooper's Creek (which he identified as a locust outbreak area), the Nullabor, and the Simpson's Desert and Alligator Rivers areas. His *modus operandi* was to travel selected routes and stop every 10 miles exactly, and to collect for half an hour. In this way he achieved a very thorough survey of many previously unsampled areas of the country. Ken's very large collection of Australian grasshoppers required intensive work which he felt unable to provide. He therefore asked James A. G. Rehn, curator of insects at the Philadelphia Academy of Sciences, to undertake taxonomic revisions of the Australian fauna. Three volumes were published between 1952 and 1957, by which time Rehn was clearly unable to continue the work. Ken was dissatisfied with the pace of the project. Also Rehn had no first-hand knowledge of Australia and its unique ecology. Rather than joining Rehn in the completion of the project, Ken decided to end it in 1963. Later, beginning in 1980, Ken re-examined much of Rehn's work and published a series of papers on most of the groups (63, 64, 67, 70–73).

In 1959 a combination of circumstances led to a final severing of the connection with *Chortoicetes*, and with ecology generally, and exclusive concentration on taxonomy and its organization within the CSIRO Division of Entomology. The polarization of theoretical ecology in Australia between the schools of A. J. Nicholson, then Chief of the Division of Entomology, and H. G. Andrewartha and L. C. Birch of the Universities of Adelaide and Sydney, was making it very difficult for a non-joiner in the Division to remain unaligned. Moreover, an inheritor of the field of locust ecology was waiting in the wings in the person of D. P. Clark, who already had a series of studies on the minor pest grasshopper *Phaulacridium vittatum* to his credit. The joint projects with M. J. D. White had extended to the remarkable endemic grass-

hopper subfamily Morabinae, of which more than one hundred undescribed species had already been collected and which was fantastically variable cytologically; a major cytotaxonomic study of this group was being planned. But the final determinants of the move into taxonomy came from a different direction.

Taxonomy in the Division of Entomology had grown in a haphazard fashion to meet increasing demands by workers on other projects. In the process, collections of great importance had been assembled in all the major insect orders and these were becoming better known to overseas taxonomists, who were sent material on loan for their studies. However, some of these overseas workers began to express concern at the lack of acknowledged institutional responsibility for these collections, especially when the lodgement of holotypes with the Division came to be considered. Pressure from overseas was reinforced by recommendations of a Committee of Review appointed to survey the work of the Division prior to the retirement of Nicholson as Chief. One of these was to the effect that a Curator should be appointed with authority to organize a unified system of curation. Nicholson accepted this recommendation and in 1959 appointed Ken as Curator. Ken took his role seriously, and it was not an easy one. He held extensive discussions with his independent-minded colleagues and secured acceptance of restraints and of standardized procedures that were not always welcomed by people who had been a law unto themselves. Moreover, this had to be done in the face, initially, of no more than luke-warm support from the administration.

In due course all this changed, and when in December 1970 Ken finally relinquished the Chief Curatorship in order to concentrate on his research, the Taxonomy group was a happy and united section of the Division that had gained the respect and understanding of the administration.

Ken produced a series of 'Museum Circulars' dealing with issues like storage facilities, loans policy, and a range of management procedures, all subsequently issued in book form. In 1962 the insect collections in the Division were placed on a more permanent footing when the Commonwealth Government officially gazetted them as the Australian National Insect Collection, 'a national heritage, which it is the responsibility of the Commonwealth to preserve for future study' (Upton, 1997).

Ken was elected a Fellow of the Australian Academy of Science in 1959. He served on the Sectional Committee for Biological Sciences and from 1975 to 1978 was a member of the Academy Council. He was not by nature a committee man, but could not avoid involvement in additional *ad hoc* or continuing committees of both CSIRO and the Academy. For a number of years he was a member of the Academy's Fauna Committee, and he did a stint on the Advisory Committee for the *Australian Journal of Zoology* (1964–1970). He served on the Board of *Pacific Insects*. He was foundation President of the Ecological Society of Australia and a foundation member of the Australian Entomological Society. He was appointed to the Interim Council of the Biological Resources Study set up in 1973, on which he served for the three years of its existence. Ken was also a member of both the Linnean Society of New South Wales and the Royal Entomological Society of London.

For nine years in the 'fifties and 'sixties he was an active member of the International Commission on Zoological Nomenclature based in London. He played a leading role in the discussions prior to the revision of the International Code of Zoological Nomenclature and for a period was a member of the Editorial Committee formed to produce a further revision in the 'seventies.

Ken's private life never intruded into his working environment. His political views

were towards the far left and for a time he was an active supporter of socialist ideologies. He held strong views on many topics including pets and gardening. When the hydatid problem was prevalent in the Canberra area, Ken was serious when he suggested that dogs and cats should not be permitted in the Australian Capital Territory. He had his own dog put down as an example. His strong socialist leanings led him to conclude that vegetables and fruits should not be grown in home gardens because to do so deprived growers and workers of employment. To his wife's amazement and disappointment, Ken removed plum and apple trees from his garden and did not permit vegetables there. He did approve a 1 square metre plot where his wife could grow medicinal herbs that were not available over-the-counter.

In August 1976, on his 65th birthday, Ken retired from CSIRO. After a short holiday in Europe he returned to the Division of Entomology as an Honorary Research Fellow, and continued his taxonomic studies on grasshoppers. He was still publishing taxonomic revisions and papers on theoretical taxonomy, taxonomic nomenclature, and grasshopper biology until December 1994, aged 83, when the onset of ill health forced his second retirement from the Division. He announced that he was suffering from the onset of Alzheimer's disease, although this was not until much later apparent to his colleagues.

He died on 11 January 2002.

Ken was married three times and is survived by a son and four daughters.

### Acknowledgments

Editing of Ken's chronicle has been greatly assisted by colleagues, especially Ted Edwards and also by John Balderson, who had been appointed as assistant to Ken. Mrs Dawn Waterhouse, who was an assistant in the locust group in the early years, greatly improved the manuscript.



Murray Upton, author of the definitive history of the Australian National Insect Collection, was of great assistance, and Dave Hunter, now Director of the Australian Plague Locust Commission, provided information about the commission. David Ride did the same for the International Commission for Zoological Nomenclature.

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