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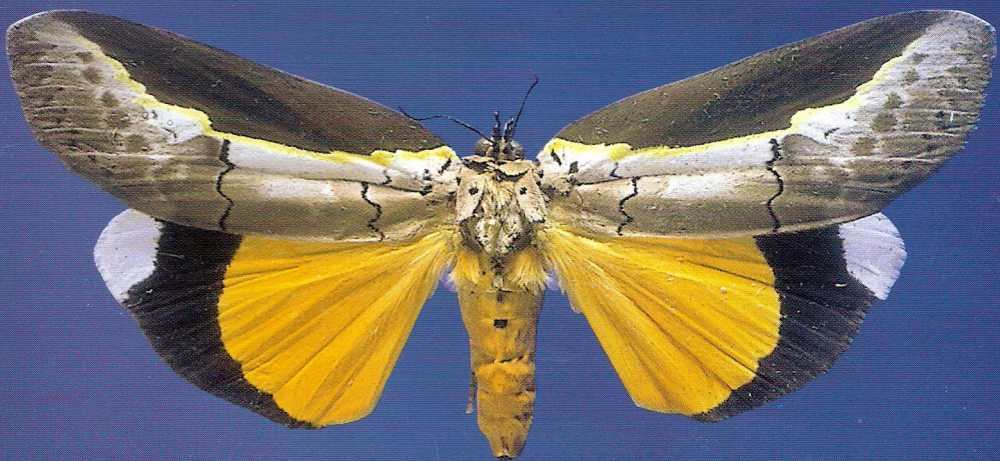

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EDITORIAL

MEMBERSHIP

The aims of the Lepidopterists' Society of Africa are to promote the scientific study and the conservation of Lepidoptera in Africa, and to provide a communication forum for all people who are interested in African Lepidoptera.
Metamorphosis, which is the official journal of the Society, publishes original scientific papers as well as articles of a less technical nature. Fees indicated below refer to surface postage, but if airmail is required, notify the Treasurer and - per issue – add R32.00 for Africa or US $6.00 if Overseas.
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CONTENTS

Front cover – Noctuid moth – *Eligma hypsoides.* Photograph by Ingo Lehmann
Back cover – *Charaxes acuminatus* upper- and underside. Photgraph by Ingo Lehmann

Editorial

What is a species? Definitions abound, ranging from requirements such as the ability to breed and propagate, to the application of macroscopic or microscopic criteria as defined by the classifier. An excellent overview by several eminent authorities and their opinions can be found in *Species and Speciation:* Edited by E.S. Vrba, 1985. The epithets applied provide identifying handles. And depending on the system or criteria used the terms utilised for binomial classification are likely to be revised and changed from time to time. Such changes are not always popular or universally accepted, but if based on well considered scientific criteria they cannot be ignored. The advent of molecular biology, chromosome analysis and other disciplines has necessitated a reappraisal of the numerous species and subspecies of Lepidoptera.

The leading article in this *Metamorphosis* by Alan Heath addresses these issues in revised classification of the huge genus *Chrysoritis.* In keeping with the recommendations of the International Zoological Nomenclature Codes certain gender corrections to original spellings have been applied by a suitably qualified taxonomist and referee.

The beautifully coloured, day-flying noctuid moth on the front cover has been provided by courtesy of Ingo Lehmann. This is one of a small group of large forest Sarrothripinae with a range from West Africa to Japan and with representatives in Southern Africa and Malawi. He also provided the photographs of a specimen of *Charaxes acuminatus* subsp. cf. *shimbanus* on the back cover. This interesting specimen was found at an elevation well below 300m. The Shimba Hills where it normally flies are higher. It has been assimilated into the collection of the Natural History Museum, London.

Graham Henning presents a *pot-pourri* of notes about the biology of threatened butterflies in South Africa. Several topics he raises are very important and he has highlighted these with examples relevant to South Africa. Nolan Owen-Johnston revisits Malawi with another exciting story-this time about *Acraea pentapolis epidica.* To add grist to the mill it has recently been chronicled that the Acraeini now classify as a tribe of the Heliconiinae - the well-known South American butterflies. For a fun article turn to Andre Coetzer's recent experience on the Roof of Africa in Lesotho.

At the Annual General Meeting of September, one of the presentations was of a totally different kind. J.E. Terblanche's Lepidoptera and literature is reproduced in its entirety with his permission.

The prolonged sabbatical leave of our acting secretary-Alan Heath-has created a vacancy both on the National Council and also in the Western Cape branch. Fortunately Anthony Brinkman was willing to fill the latter vacancy. Our Chairman is looking to filling the important Secretary post. If you have a suggestion who may be able and willing, please contact Hermann Staude with this information. Hermann will also be highlighting other aspects of the functioning of the Society.

We were all very pleased to have welcomed Jon Ball who came up especially from Cape Town to present an overview of the activities of the Western Cape Branch. It brings closer together these two branches with similar philosophies, yet separated by such a great distance geographically that members seldom have the opportunity to interact. It is discouraging to note that that branch is also suffering from "collecting blues", literally and figuratively.

Council comments

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The weekend of 8-9 September saw the society having its l8th annual general meeting and conference. As usual aurelians from near and far a-field descended on Onderstepoort, South Africa, to kindle old friendships and to see what everyone else was up to.

Unfortunately we did not see as many faces from far a-field as we would like to. Perhaps soaring travel costs and an ever increasingly busy world, in which everyone seems to have less and less time for the things they really enjoy, is taking its toll. We were, therefore, happy to see Ivan Bampton from Tanzania, Ray Murphy from Malawi, Chuck Saunders from Swaziland and members from the Western Cape, the Northern Cape, the Free-state, KwaZulu-Natal and Gauteng Provinces of South Africa attending the conference. We were particularly glad to see Rudi Mijburg up and about chatting to everyone. At the same time we were sad that Bill Henning was not well enough to make it. As always it proved to be a wonderfully enriching experience and I am sure that every member who attended went home enthused and ready to tackle the coming season with renewed vigour.

The one hour allotted to the AGM proved to be far too little time for our active councillors to properly report back to our members. Those councillors who were on the conference programme used the opportunity to inform members of what they were doing and others were given the opportunity during the course of the conference.

The Chairmen of the society, that is Steve Woodhall, Jonathan Ball and myself decided that it is high time that people who achieve in Lepidoptera receive some recognition for their work. We decided to kick things off by awarding two Chairman's Awards at the conference. The first is an award for the most influential publication on African Lepidoptera for the year 2000/2001 and the recipient is Martin Kruger for his long awaited monograph on the Macariine moths of the region entitled: *A revision of the tribe Macariini (Lepidoptera: Geometridae:Ennominae) of Africa, Madagascar and Arabia.* Martin in his usual soft-spoken unassuming manner remarked afterwards that this was not necessary because this is his job. We can assure you however that this publication goes way beyond the call of duty and we have not seen a publication of this calibre on African Lepidoptera for a long time. The second award was for the most outstanding work contributing to the conservation of African Lepidoptera for the year 200/200 l and the recipients were Graham Henning, Peter Roos and Reinier Terblanche for their work on the Heidelberg Copper, *Chrysoritis aureus.* These gentlemen showed us all what you can do with just one species and we are sure that their efforts in collaboration with Marianne Forsyth of Gauteng Nature Conservation will go a long way toward ensuring the survival of this threatened butterfly. We envisage that awards in these two categories as well as in other categories will be awarded annually and invite members to pass comment and offer suggestions. The principle, however, of recognising our achievers is one that is here to stay.

Our councillor charged with data processing, Bennie Coetzer, formally launched LEPIBASE and LEPIDOPS. LEPIBASE is the data-base that the society runs, which will attempt to ultimately hold as much as possible distributional data on Afrotropical Lepidoptera. It is to this database that every member of the society can and must make significant contributions. Every member has at least some new records that will only be of real value once they have been incorporated into LEPIBASE. Accumulating these

records centrally as a society will give us the necessary clout to ensure the continuation of our hobby and ultimately the continued survival of Africa's Lepidiversity. LEPIDOPS is the computer software programme that Bennie developed, which you use to capture the data for LEPIBASE. This programme does far more than just allow you to capture the data for LEPIBASE it also provides you with all the tools needed to properly manage your collection. In addition it contains lots of information on Afrotropical Lepidoptera and you can add new information software as it becomes available. If you are a member of the society and you are willing to contribute to LEPIBASE then you can purchase this software at the greatly reduced price of only R80.00 plus postage. This is the one society project that we can all participate in, so purchase your CD from Bennie today and let's start getting the data in. When as youngsters we started collecting, it was drilled into the heads of most of us that a specimen is worthless unless it has a locality label stuck on to the pin. Later we were told that this label is worthless if the locality was not precisely defined, preferably with a grid reference. Today I am telling you that it is all worthless if that record does not find its way into LEPIBASE.

From the reports of Jonathan Ball and Steve Woodhall it is clear that the branches are functioning well. Regular branch meetings are held and branch members are getting involved in educational and youth projects as well as conservation matters and regular outings to exciting places. Thanks must go to Gauteng branch for organising the conference so well. If you live in an area of Africa that does not have a formal branch, why not get together with the other members in your area and get organised. Those members that participate in branch activities will tell you that it is a rewarding experience. Reinier Terblanche is getting things going in the North West Province and the Northern Cape. I am sure we will see a formal branch coming out of this area soon. Then there are rumours of the imminent formation of a branch in KwaZulu-Natal. This is all exciting and very necessary if we wish to withstand the threats to our hobby that we are currently facing.

Hermann Staude

NEW SYNONYMIES AND TAXONOMIC NOTES ON THE GENUS *CHRYSORITIS* BUTLER (LEPIDOPTERA: LYCAENIDAE)

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Abstract: A phylogeny implied from morphological and molecular evidence is followed in the rearrangement of the species and species groups of *Chrysoritis* Butler. Fifteen taxa are synonymized and four are reduced in rank to subspecies based on their morphology and life history. *Chrysoritis lycia* (Riley) is synonymized with *C. chrysaor* (Trimen); *C. kaplani* (Henning), *C. stepheni* (Dickson) and *C. beaufortius charlesi* (Dickson) are synonymized with *C. beaufortius* (Dickson); *C. atlanticus* (Dickson), *C. henningi* (Bampton), *C. lysander* (Pennington) [with its two subspecies *lysander* and *hantamsbergae*] and *C. williami* Heath are synonymized with *C. pan* (Pennington); *C. coetzeri* (Dickson) is synonymized with *C. zonarius* (Riley); *C. cottrelli* (Dickson) is synonymized with *C. zeuxo* (Linnaeus); *C. wykehami* (Dickson) is synonymized with *C. turneri* (Riley); *C. hyperion* (Dickson) is synonymized with *C. swanepoeli* (Dickson); *C. balli* (Dickson & Henning) is synonymized with *C. pyramus* (Pennington); *C. whitei* (Dickson), C. *mithras* (Pringle), *C. bamptoni* (Dickson), *C. lyndseyae* (Henning) and *C. psyche* (Pennington) are reduced in rank to subspecies of *C. thysbe* (Linnaeus). The validity of seven more taxa is questioned but left for further research. Inter-specific variability is discussed in relation to microclimate.

Key Words: Phylogeny, *Chrysoritis,* Lycaenidae, South Africa, new synonymies.

INTRODUCTION

A provisional arrangement of the genus *Chrysoritis* Butler was included in a revision of the tribe Aphnaeini by Heath (1997). In this revision, the genera *Bowkeria* Quickelberge, *Oxychaeta* Tite & Dickson and *Poecilmitis* Tite & Dickson were synonymized with *Chrysoritis* on morphological grounds. The specific status of many South African lycaenids was questioned, in particular, the genera *Aloeides* Butler and *Chrysoritis* were considered to contain many synonymies. Subsequently, Rand *et al*. (2000) reconstructed the phylogeny of the genus inferred from mitochondrial DNA sequences of 19 species of *Chrysoritis* and compared these with the arrangement of the complete set of 59 species made by Heath (1997). In general, this latter arrangement of *Chrysoritis* was well supported by the molecular phylogeny. It was also considered by Rand *et al.* (2000) that two of the *Chrysoritis* clades most likely contained synonymies, namely the *thysbe* group and the group containing *zeuxo, cottrelli, zonarius,* and *coetzeri.*

The purpose of this paper is to revise the systematic arrangement of *Chrysoritis* in the light of the above two papers. It is also opportune to identify species which are of doubtful validity and to synonymize those whose status cannot be supported. These synonymies have long been known to exist but it was hoped that the molecular work at Harvard would continue to cover all the *Chrysoritis* and infer a phylogeny for the entire genus. Unfortunately this has not happened, nor does it seem likely in the near future; however, due largely to rearing experiments carried out over several years and a sufficiently large reference collection, the synonymies proposed are considered well-supported.

MATERIALS & METHODS

The conclusions reached in this paper rely in part on the findings of Heath (1997) and Rand *et al.* (2000), also on a reference collection of 2 430 *Chrysoritis* specimens accumulated over the past 16 years and from the 458 specimens reared during this period. Table I lists the general localities of collected material indicating how many adult specimens were reared from each locality. Additional reference was made to the collection held by the South African Museum, Cape Town. The methods employed in rearing specimens and in studying their life history are described by Heath & Claassens (2000). In many cases, photographic slides were taken of eggs and each larval stage. References to foodplant and ant associates are taken from Heath (1997) and Kroon (1999). In preparation for an earlier paper (Heath, 1997) genitalia dissections of males of all known *Chrysoritis* species were made and in most cases at least three slide preparations were made. In some instances, scanning electron microscopy was employed to examine the cornuti of the male aedeagus. Female genitalia were not dissected for on all species since they did not provide any useful character.

RESULTS

Although substantially confirming the results in Heath (1997), the molecular study subsequently showed *C. dicksoni* (Gabriel) to form a clade with *C. oreas* (Trimen). This is also supported by the facies, there being nothing else closer to either species in this respect. A further clarification occurred in the *areas* group *sensu* Heath (1997) where the molecular phylogeny implies that *C. chrysantas* (Trimen) is an unresolved basal member of the genus.

INTER-SPECIFIC VARIATION.

Rearing *Chrysoritis* over the years from egg to adult and from caterpillars collected in the field from various localities, has demonstrated the extent to which the environment can, during the larval stage, affect adult wing shape, size and the markings of both wing surfaces. In some instances, when rearing from eggs in captivity, the adult offspring were similarly marked to their parents, whilst in many other instances they were quite different.

It was further found that the undersides of hind wings do not provide reliable specific characters. For example, the adults obtained from rearing *C. chrysaor* (Trimen) in a bathroom, from eggs laid by females from Leipoldtville had very much darker undersides than their parents, the uppersides also being more heavily marked with black. As a general rule, undersides are more clearly and heavily marked at higher altitudes and in cooler and higher rainfall areas. Adults of *C. t. psyche* (Pennington) taken from the slopes of Kobee Mountain near Vanrhynsdorp had undersides similar to *C. t. thysbe* (Linnaeus) from the south coast, whilst those taken 87km further north-west at Nuwerus were very much paler and less distinctly marked. The underside hind wings of *C. beaufortius* (Dickson) and *C. violescens* (Dickson) from the Roggeveld and Hantamsberg Mts. (1 300--1 600m) have a distinctive appearance; however this same montane underside sometimes occurs in other *Chrysoritis* species at sea level normally having a typical *thysbe* underside pattern. Both underside patterns have been encountered among *C. turneri turneri* (Riley) from the above mountains. At Mamre, specimens of *C. thysbe thysbe* with typical f. *osbecki* undersides fly together with intermediates and those having typical *thysbe* undersides.

Another variable character is the extent of blue on the forewing of males. For example, bred specimens of *C. pan* (Pennington) from Leipoldtville (and type locality of *atlanticus* Dickson) have their forewing blue extending well beyond the cell spot, a feature not seen in the wild adult population from the same locality. The various

populations of *C. thysbe* along the west coast vary in the extent of blue and black on their uppersides, the blue being more extensive in more northerly material, but considerable variation occurs within populations also. Some of these variations in facies appear to be caused by the particular microclimate prevailing for each insect, and possibly influenced by cold sea mists along that broad coastal strip. The *thysbe* material from 20km or so inland from the coast are even more heavily marked with black, some examples from Wallekraal and Redelinghuys north of Piketberg have almost black forewings. A similar tendency can be seen in some inland *thysbe* specimens from just north of Clanwilliam and from Moorreesburg. Some of this variability is also affected by seasonal conditions, the undersides of specimens emerging in winter months being noticeably darker.

SYSTEMATICS

SYNONYMIES

The following changes in taxonomy are introduced, based largely on a lack of constant distinguishing features and life history traits:

C. lycia (Riley, 1938) is synonymized with *C. chrysaor* (Trimen, 1864). At Leipoldtville, caterpillars of this species feed on *Tylecodon* (Crassulaceae) infested with the host ant *Crematogaster liengmei.* Those near Cape Town generally feed on *Rhus* (Anacardiaceae) and *Cotyledon* (Crassulaceae). Breeding experiments done several years ago showed that specimens bred in captivity from the two populations resulted in identical specimens. Results from breeding in captivity show clearly the effect that the environment can have, particularly in the lightness or darkness of both wing surfaces and the intensity of the coppery upperside. It would be reasonable to consider *lycia* as an extreme, more yellowish form of *chrysaor*. Both forms and intermediates fly at Yzerfontein. The ant associate for both forms is *Crematogaster liengmei*. Specimens examined - 118 of which 44 were bred in captivity.

C. kaplani (Henning, 1979), *C. stepheni* (Dickson, 1978) and *C. beaufortius charlesi* (Dickson, 1970) are synonymized with *C. beaufortius* (Dickson, 1966). The forewing blue in typical males from the Sutherland district is marginally more extensive than in specimens from the northern populations at Calvinia and Garies. This difference is very small, and does not warrant subspecific status. Considerable intergrading variation occurs within populations from the greater Sutherland area, from specimens lacking almost any black to those with totally black forewings. It might be appropriate for the heavily marked forms of *beaufortius* such as some of those from Quaggafontein to be regarded as f. *charlesi* and the intermediate form from Garies and Calvinia as f. *stepheni.* The natural foodplants of *beaufortius* are species of *Osteospermum* and *Dimorphotheca* (Asteraceae). The ant associate is obligate and in all cases *Crematogaster peringueyi.* There is no detectable difference in either genitalia or early stages. Specimens examined - 120 of which eight were bred in captivity.

Table I. Areas represented in the reference collection, indicating the number of specimens bred.

***CHRYSAOR* SPECIES GROUP**						
C. chrysaor	1	Melkbosch	12	Yzerfontein	26	Leipoldtville
	5	Oudtshoom	0	E. Cape		
C. natalensis	0	Not collected				
C. midas	0	Sutherland	0	Middleburg		
C. aureus	4	Heidelberg	2	Greylingstad		
C. aethon	1	Graskop				
C. lyncurium	0	Stutterheim	0	Underberg		
C. lycegenes	9	Howick				
C. phosphor	0	Not collected				
***CHRYSANTAS* SPECIES GROUP**						
C. chrysantas	0	Wallekraal	0	Steinkopf		
***OREAS* SPECIES GROUP**						
C. oreas	0	Bulwer				
C. dicksoni	2	Vermaaklikheid	3	Mamre		
***ZEUXO* SPECIES GROUP**						
C. zeuxo	1	Bredasdorp	0	Cape Town	0	Uniondale
	0	Oudtshoom	0	Avontuur		
C. zonarius	1	Melkbosch	0	Clanwilliam	1	Nieuwoudtville
***PYROEIS* SPECIES GROUP**						
C. felthami	4	Melkbosch	0	Sutherland	0	Soutfontein
	0	Riversdale	0	Lambert's Bay	0	Worcester
C. pyroeis	0	Melkbosch	4	Lambert's Bay	1	Hondeklip Bay
	0	Paarl	1	Groenrivier	0	Riversdale
***THYSBE* SPECIES GROUP**						
C. palmus	3	Paarl	0	Knysna		
C. aridus	0	Garies				
C. turneri	3	Calvinia	2	Calitzdorp	0	Sutherland
	0	Matjiesfontein				
C. blencathrae	0	Worcester				
C. endymion	24	Franschhoek	0	Wellington		
C. swanepoeli	4	Oudtshoom	3	Ladismith	0	Prince Albert
	0	Calitzdorp	0	Matjiesrivier		
C. violescens	2	Sutherland				
C. daphne	0	Uniondale		Vanrhynsdorp	0	Franschhoek
C. uranus	1	Ceres	3			
	1	Paarl				
C. adonis	1	Ceres	0	Ladismith		

C. brooksi	10	Mamre	5	Riversdale	0	Worcester
C. nigricans	13	Mamre	2	Bredasdorp	2	Oudtshoom
	1	Vermaaklikheid	0	Uniondale		
	1	Piketberg				
C. irene	0	Paarl				
C. beulah	0	Cookhouse				
C. perseus	60	Groenrivier	2	Hondeklip Bay	2	Lambert's Bay
	6	Wallekraal	0	Soutfontein		
C. azurius	3	Sutherland				
C. rileyi	19	Worcester				
C. thysbe	4	Mamre	10	Cape Peninsula	2	Wallekraal
	10	Melkbosch	3	Mossel Bay	14	Lambert's Bay
	5	Moorreesburg	4	Nuwerus	1	Port Elizabeth
	0	Vanrhynsdorp	0	Witsand	13	Bredasdorp
	5	N. of Clanwilliam	1	Hondeklip Bay	28	Soutfontein
	0	Riversdale				
C. pyramus	11	Oudtshoom	4	Uniondale	0	De Rust
C. beaufortius	2	Sutherland	4	Calvinia	2	Garies
C. plutus	2	Uniondale	1	Oudtshoom		
C. pan	6	Cape Town	14	Leipoldtville	5	Nieuwoudtville
	4	Port Nolloth	14	Oudtshoom	0	Wallekraal
	1	Groenrivier	9	Soutfontein	0	Kamieskroon
	0	Calvinia	0	Vanrhynsdorp	4	Yzerfontein
	0	Calitzdorp	0	Ladismith	1	Hondeklip Bay
C. trimeni	1	Port Nolloth				
C. penningtoni	0	Hogsback				
C. pelion	0	Lesotho				
C. orientalis	7	Underberg, KZN				
C. braueri	0	E. Cape				
Note that place names represent the district or general area in which collection took place.						

C. atlanticus (Dickson, 1966), *C. henningi* (Bampton, 1981), *C. lysander* (Pennington, 1963) and *C. williami* Heath, 1997 are synonymized with *C. pan* (Pennington, 1963). As with *C. thysbe* from the western coastal belt this insect is also highly variable. Populations up to 180km north of Cape Town answer to the description of typical *pan* with the margins of both wings plain black and the underside markings indistinct. Specimens vary in size between different populations; inland populations often being larger. In the Lambert's Bay coastal area the insect's cilia are sometimes interrupted by

small pale flecks and the underside markings are slightly more distinct. Further north, the underside hind wings of specimens (formerly *williami)* are sometimes very dark, especially in winter forms. The late summer and autumn broods produce very small specimens. In some localities above 600m in early spring, the insects are larger and exhibit considerably more forewing blue. The interesting spring form *hantamsbergae* occurs at Nieuwoudtville, on the Bokkeveld and on the higher points of the Hantamsberg at Calvinia. In later broods from these areas, the extent of forewing blue is reduced and the insects are smaller. Interestingly, eggs laid by females from Leipoldtville near Lambert's Bay and bred through to adults were quite unlike their parents *(atlanticus)* in their markings but instead, they answered to form *hantamsbergae.* In more arid areas the undersides are paler and less distinctly marked, especially during the summer and autumn broods. The late summer specimens in the arid Karoo and Namaqualand have pale undersides; this also applies to those (formerly *henningi)* from the "Little Karoo" south of the Swartberg range and which more closely resemble the topotypical form beneath. There are no geographically isolated forms of *pan,* they fly to the north and south of the Swartberg Mountain range from Willowmore to Anysberg and Montague and from Cape Town to Port Nolloth and Calvinia. Intermediate forms are common, which mediates against their retention as subspecies. The taxon *hantamsbergae* is treated here as a local seasonal form rather than a subspecies and so it too must sink along with *lysander.* Note that *pan* takes page precedence over *lysander* in Pennington (1962). The genitalia are constant in all known populations and they all associate with the ant *Crematogaster liengmei.* Recorded larval foodplants are *Chrysanthemoides incana* (Asteraceae) and species of *Zygophyllum* (Zygophyllaceae). Pennington (1962: 273) recorded *C. monilifera,* probably in error since it only grows along the southern coastal belt. Specimens examined - 361 of which 72 were bred in captivity.

C. coetzeri (Dickson & Wykeham, 1994) is synonymized with *C. zonarius* (Riley, 1938). Their facies do not show specific differences other than specimens from Nieuwoudtville on average being smaller than those from Cape Town, whilst specimens from Het Kruis are a little larger than average. There are individuals from both populations that vary in size. Specimens taken from populations between Clanwilliam and Klawer also vary in size. Specimens have been bred through to adult from egg from both Cape Town and Nieuwoudtville and the early stages do not differ. The life history of both taxa has been studied, the foodplant being *Chrysanthemoides incana* (Asteraceae). The *incana* shrubs from the more northerly areas from Clanwilliam to Nieuwoudtville are of a slightly different form to those from the more southerly and coastal areas in having very small leaves on longer trailing stems. The ant associate is *Crematogaster peringueyi.* Specimens examined- 67 of which three were bred in captivity.

C. cottrelli (Dickson, 1975) is synonymized with C. *zeuxo* (Linnaeus, 1764). Specimens from the extreme east of its range at Buffelsnek north of Knysna tend to have the forewing apex and hind wing tornus more pointed than those from Cape Town. At best *cottrelli* could be considered an extreme form of *zeuxo,* although many close intermediates occur in the intervening populations, notably on the Kammanassie Mountains. The foodplant is *Chrysanthemoides monilifera* (Asteraceae) and the ant associate is *Crematogaster liengmei.* Specimens examined - 61 of which two were bred in captivity.

C. wykehami (Dickson, 1980) is synonymized with *C. turneri turneri* (Riley, 1938). The Calvinia populations are more heavily marked on the underside than those from the south. The upperside on average is also more heavily marked with black in many

specimens. Having bred specimens from caterpillars and from eggs from the Calvinia population it is clear that such differences are environmentally caused and certainly do not warrant specific status. The populations at Sutherland show some intermediate tendencies, those taken at higher altitude being closer to the Calvinia population. The undersides of specimens from Calvinia appear to be closer to *C. turneri amatola* (Dickson & McMaster, 1967), however the upper side maculation on the hind wing is less pronounced in the former, conforming more to specimens from the southern populations. Specimens from the mountains above the Huis River Pass near Calitzdorp and above Prince Albert are also more heavily marked on the underside than those from the more arid areas around Matjiesfontein. Each population has its own characteristic underside pattern-contrast, associated with the local microclimate, the basic pattern remaining unchanged. The foodplants recorded are species of *Osteospermum, Dimorphotheca* (Asteraceae) and *Zygophyllum* (Zygophyllaceae). The ant associate is a *Crematogaster* species near *liengmei.* Specimens examined - 52 of which seven were bred in captivity.

C. hyperion (Dickson, 1975) is synonymized with *C. swanepoeli* (Dickson, 1965). Some years ago Dickson (pers. comm.) expressed doubts about the true status of *hyperion.* Intermediates have since been recorded from many localities including the Huis River Pass, Calitzdorp and particularly above Seweweekspoort, Ladismith. At the former locality a heavily marked female was captured in copula with a male of the typical form (pers. obs.). The more heavily marked male specimens are found in cool well-watered gullies such as those at the top of the southern face of the Swartberg range whilst the paler specimens fly in the drier gullies. This seems to be another example where the extent of black on the wings is affected by the microclimate. The foodplant is usually a species of *Thesium* (Santalaceae) and the ant associate is a species near *Crematogaster liengmei.* Presumably the darker specimens of C. *swanepoeli* from the higher points of the Swartberg Pass could be referred to as form *hyperion.* The populations at lower altitudes have two main broods whilst those at higher altitudes appear to manage only one in most seasons. Specimens examined- 90 of which seven were bred in captivity.

C. balli (Dickson & Henning, 1980) is synonymized with *C. pyramus* (Pennington, 1953). The more lightly marked specimens of *pyramus* from the slopes above the Swartberg Pass are very similar to specimens found in the populations from the Kammanassie Mountains and Blesberg above Meiringspoort; intermediates are also not uncommon on the Swartberg. The two forms of *pyramus* share a similar morphology, as do their early stages and they both associate with *Crematogaster peringueyi.* The main foodplants of these populations are species of *Osteospermum* and *Dimorphotheca* (Asteraceae). Specimens examined - 86 of which 15 were bred in captivity.

C. whitei (Dickson, 1994), *C. mithras* (Pringle, 1995), *C. bamptoni* (Dickson, 1976), and *C. psyche* (Pennington, 1967) are reduced in rank to subspecies of *C. thysbe* (Linnaeus, 1764). *C. lyndseyae* (Henning, 1979) flies sympatrically with *bamptoni* and intergrades occur, hence it cannot be considered a subspecies; it is synonymized with *thysbe bamptoni.* None of these taxa exhibit any constant morphological differences, and all appear to share the same life history as other forms of *thysbe.* The foodplants are species of *Chrysanthemoides* (Asteraceae), *Thesium* (Santalaceae), *Zygophyllum* (Zygophyllaceae) and *Osteospermum* (Asteraceae), and the ant associate is *Crematogaster peringueyi.* All of these taxa should properly be regarded as forming a cline, hence their subspecific status is given provisionally, pending a molecular study of these and other closely related taxa including *C. thysbe schloszae* (Dickson, 1994) and

C. thysbe f. *osbecki* (Aurivillius, 1882). There are many other interesting forms of this insect, particularly in the inland area between Malmesbury and Vanrhynsdorp. The blue on both wings tends to become more extensive as the cline is traced northward, close to the coast. The wing shape also varies, but this occurs often within populations of *thysbe.* The undersides vary considerably between populations but this is caused by the microclimate (discussed above). Specimens examined - 420 of which 1O1 were bred in captivity.

POSSIBLE SYNONOMIES

The following taxa are suspected of being synonyms but insufficient life history information currently exists to confirm this. It is hoped that molecular and life history studies will help to clarify the relationships.

Some specimens of *C. thysbe* from between Riversdale and Stilbaai are almost identical to specimens of *C. pyramus* from the Kammanassie Mountains (formerly *balli),* which suggests that *thysbe* and *pyramus* may be conspecific. It is not unreasonable to expect *thysbe* to be found inland from the south coast just as far as it is from the west coast. They share the same morphology, both insects associate with the same species of ant *(Crematogaster peringueyi)* and they share *Osteospermum* species (Asteraceae) as one of the larval foodplants (cf. Heath, 1997).

Chrysoritis lycegenes (Trimen) could perhaps be regarded as a subspecies of *C. lyncurium* (Trimen); however, despite the early stages of the former being well documented (Henning, 1987), those of the latter are unknown. The latter species was not included in the molecular study and so cannot provide any support either way; however, material suitable for molecular analysis is retained in the MCZ Laboratory [Museum of Comparative Zoology] at Harvard University. A small intermediate population has also been recorded from Bushman's Nek, KwaZulu-Natal. One of the foodplants of *lycegenes* is a species of *Diospyros* (Ebenaceae) and the ant associate is *Crematogaster liengmei.*

The relationship between the populations of C. *aureus* and C. *aethon* is also in need of thorough research, including breeding experiments and possibly molecular analysis. The normal foodplant for C. *aureus* (van Son) from Heidelberg is *Clutia galpinii* (Euphorbiaceae), but in 2000, three adults were bred through from eggs laid by a female from Heidelberg on *Diospyros lycioides* (Ebenaceae). The population from Morgenzon also feeds on *Diospyros* (Owen-Johnston, 1991). The foodplant recorded for *aethon* is a species of *Rhus* (Anacardiaceae) (Owen-Johnston, 1991) but at Kowyns Pass, Heath (pers. obs.) discovered a caterpillar feeding on a species of *Crassula* (Crassulaceae) abutting a bush of *Rhus.* It eventually producing a perfect adult *aethon.* These observations indicate that the choice of larval foodplant is not a major issue within a species group and hence should not be used as a specific characteristic. The ant associate for both species is *Crematogaster liengmei.* Material suitable for molecular analysis of these two taxa is retained in the MCZ Laboratory at Harvard University.

There are considerable similarities between *C. pelion* (Pennington) and *C. orientalis* (Swanepoel) suggesting they could be conspecific hence it is recommended that breeding experiments for these two taxa be conducted to determine their true relationship and status. Material suitable for molecular analysis of these two taxa is retained in the MCZ Laboratory at Harvard University.

The relationships between *C. chrysaor, C. natalensis* and *C. midas* (Pennington) are in need of further detailed study. The degree of black maculation of the upperside is a highly variable feature in *chrysaor.* Also the tails, which are a feature of *natalensis* are not an uncommon feature of inland specimens of *chrysaor* in both the Western and Eastern Cape Provinces. Material suitable for molecular analysis of *chrysaor* and *midas* is retained in the MCZ Laboratory at Harvard University; however, material has not yet been obtained for *natalensis,* nor has its ant associate been determined.

The habitat of *C. swanepoeli* from above Seweweekspoort and on the Swartberg Pass has much in common with that where *C. daphne* flies on the Kammanassie Mts. The facies are very similar, the ants are the same. It is quite probable that these are also the same species. Material suitable for molecular analysis of these two taxa is retained in the MCZ Laboratory at Harvard University.

Some specimens of *C. pan* from a population 8km east of Port Nolloth resemble the larger *C. trimeni* (Riley), which flies close to the coast near Port Nolloth at McDougall Bay. Bred specimens of the former differ from their parents in being typical of northern populations of *pan.* The ant *Crematogaster peringueyi* is very common in the *trimeni* habitat but early larval stages have not so far been found together with their ant associate. Pringle (pers. comm.) collected a similar *Chrysoritis* species close to both *pan* and *trimeni* from near Kleinsee, south of Port Nolloth. Further research, especially on the ant association, is needed to clarify their unresolved life histories and relationships since *pan* is only known to associate with the ant *Crematogaster liengmei.*

Arrangement of the genus *Chrysoritis.*

In view of the phylogeny inferred from both molecular and morphological evidence, and taking account of the synonymies above, the following revised arrangement of the genus *Chrysoritis* is proposed:

CHRYSORITIS Butler, 1898, type species *Zeritis areas* Trimen, 1891.
Forty-two species: [Bulleted items on list below refer to synonyms]

CHRYSAOR SPECIES GROUP

C. chrysaor (Trimen, 1864). *Zeritis chrysaor* Trimen, 1864. Type locality: Cape Colony, British Kaffraria & Kaffraria.

- *C. lycia* (Riley, 1938) syn. nov. *Poecilmitis lycia* Riley, 1938. Type locality: Matjiesfontein.

C. natalensis (van Son, 1966). *Poecilmitis natalensis* van Son, 1966. Type locality: Howick, Natal.

C. midas (Pennington, 1962). *Poecilmitis midas* Pennington, 1962. Type locality: Oukloof Poort, Nieuwveld Mts.

C. aethon (Trimen, 1887). *Zeritis aethon* Trimen, 1887. Type locality: Lydenburg District.

C. aureus (van Son, 1966). *Poecilmitis aureus* van Son, 1966. Type locality: Heidelberg.

C. lyncurium (Trimen, 1868). *Zeritis lyncurium* Trimen, 1868. Type locality: Nr Tsomo River.

C. lycegenes (Trimen, 1874). *Zeritis lycegenes* Trimen, 1874. Type locality: Natal.

C. phosphor phosphor (Trimen, 1866). *Zeritis phosphor* Trimen, 1866. Type locality: Bashee River, Kaffraria.

C. phosphor borealis (Quickelberge, 1972). *Bowkeria phosphor borealis* Quickelberge, 1972. Type locality: Yellowwoods, [Balgowan] Natal.

CHRYSANTAS SPECIES GROUP

C. chrysantas (Trimen, 1868). *Zeritis chrysantas* Trimen, 1868. Type locality: Murraysburg.

OREAS SPECIES GROUP

C. oreas (Trimen, 1891). *Zeritis oreas* Trimen, 189 1. Type locality: Natal Drakensberg.

C. dicksoni (Gabriel, 1947). *Phasis dicksoni* Gabriel, 1947. Type locality: Nr Melkbosch Strand.

ZEUXO SPECIES GROUP

C. zeuxo (Linnaeus, 1764). *Papilio zeuxo* Linnaeus, 1764. Type locality: Cap. b. Spei. [Cape Peninsula].

- C. *cottrelli* (Dickson, 1975), syn. nov. *Poecilmitis (Chrysoritis) cottrelli* Dickson, 1975, Type locality: Buffelsnek Forestry, N. of Knysna.

C. zonarius (Riley, 1938). *Phasis zeuxo zonarius* Riley, 1938. Type locality: Nr Melkbosch Strand.

- C. *coetzeri* Dickson & Wykeham, 1994, syn. nov. Type locality: Nieuwoudtville.

PYROEIS SPECIES GROUP

C. felthami felthami (Trimen, 1904). *Zeritis felthami* Trimen, 1904. Type locality: Muizenburg Vlei.

C. felthami dukei (Dickson, 1967). *Poecilmitis felthami dukei* Dickson, 1967. Type locality: Roodeberg nr Vink, Robertson Karoo.

C. pyroeis pyroeis (Trimen, 1864). *Zeritis pyroeis* Trimen, 1864. Type locality: Cape Province.

C. pyroeis hersaleki (Dickson, 1970). *Poecilmitis pyroeis hersaleki* Dickson, 1970. Type locality: Lady's Slipper, Witteklip Mts.

THYSBE SPECIES GROUP

C. palmus palmus (Stoll, 178 1). *Papilio palmus* Stoll , 1781. Type locality: Kaap de Goede Hoop [Cape Peninsula].

C. palmus margueritae (Dickson, 1982). *Poecilmitis palmus margueritae* Dickson, 1982. Type locality: 6 miles [10km] E. of Knysna.

C. aridus (Pennington, 1953). *Poecilmitis aridus* Pennington, 1953. Type locality: Kamiesberg Mts., Namaqualand.

C. turneri turneri (Riley, 1938). *Poecilmitis turneri* Riley, 1938. Type locality: Matjiesfontein.

- *C. wykehami* (Dickson, 1980), syn. nov. *Poecilmitis wykehami* Dickson, 1980. Type locality: Hantamsberg, Calvinia.

C. turneri amatola (Dickson & McMaster, 1967). *Poecilmitis turneri amatola* Dickson & McMaster, 1967. Type locality: Mt Kubusie, Eastern Cape.

C. blencathrae (Heath & Ball, 1992). *Poecilmitis blencathra[e]* Heath & Ball, 1992. Type locality: Waaihoek Mt., Ceres.

C. endymion (Pennington, 1962). *Poecilmitis endymion* Pennington, 1962. Type locality: Du Toit's Kop, Franschhoek.

C. swanepoeli (Dickson, 1965). *Poecilmitis swanepoeli* Dickson, 1965. Type locality: Prince Albert.

- C. *hyperion* (Dickson, 1975), syn. nov. *Poecilmitis hyperion* Dickson, 1975. Type locality: Zwartberg Pass.

C. violescens (Dickson, 1971). *Poecilmitis violescens* Dickson, 1971. Type locality: Komsberg Pass, nr Sutherland.

C. daphne (Dickson, 1975). *Poecilmitis (Poecilmitis) daphne* Dickson, 1975. Type locality: Kammanassie Mts.

C. uranus uranus (Pennington, 1963). *Poecilmitis uranus* Pennington, 1963. Type locality: Gydo Mt., Ceres.

C. uranus schoemani (Heath, 1994). *Poecilmitis uranus schoemani* Heath, 1994. Type locality: Gifberg Mt., Vanrhynsdorp.

C. adonis (Pennington, 1962). *Poecilmitis adonis* Pennington, 1962. Type locality: Gydo Mt., Ceres.

C. brooksi brooksi (Riley, 1938). *Poecilmitis thysbe brooksi* Riley, 1938. Type locality: Nr Philadelphia, Cape Prov.

C. brooksi tearei (Dickson, 1966). *Poecilmitis brooksi tearei* Dickson, 1966. Type locality: East of Riversdale.

C. nigricans nigricans (Aurivillius, 1924). *Phasis thysbe* var. *nigricans* Aurivillius, 1924. Type locality: Muizen Mts.

C. nigricans zwartbergae (Dickson, 1982). *Poecilmitis nigricans zwartbergae* Dickson, 1982. Type locality: Zwartberg Mts.

C. irene (Pennington, 1968). *Poecilmitis irene* Pennington, 1968. Type locality: Du Toit's Kloof Pass.

C. beulah (Quickelberge, 1966). *Poecilmitis beulah* Quickelberge, 1966. Type locality: Nr Steytlerville.

C. perseus (Henning, 1977). *Poecilmitis perseus*, Henning, 1977. Type locality: 18km E. of Hondeklip Bay.

C. azurius (Swanepoel, 1975). *Poecilmitis azurius* Swanepoel, 1975. Type locality: Roggeveld Mts.

C. rileyi (Dickson, 1966). *Poecilmitis rileyi* Dickson, 1966. Type locality: Brand Vlei, Worcester.

C. thysbe thysbe (Linnaeus, 1764). *Papilio thysbe* Linnaeus, 1764. Type locality: Cap. b. Spei. [Cape Peninsula].

C. thysbe schloszae (Dickson, 1994). *Poecilmitis thysbe schloszae* Dickson, 1994. Type locality: Nr Moorreesburg.

C. thysbe psyche (Pennington, 1967), stat. nov. *Poecilmitis psyche* Pennington, 1967. Type locality: Bitterfontein.

C. thysbe mithras (Pringle, 1995), stat. nov. *Poecilmitis mithras* Pringle, 1995. Type locality: Brenton-on-Sea, Nr Knysna.

C. thysbe whitei (Dickson, 1994), stat. nov. *Poecilmitis whitei* Dickson, 1994. Type locality: Nr Port Elizabeth.

C. thysbe bamptoni (Dickson, 1976), stat. nov. *Poecilmitis bamptoni* Dickson, 1976. Type locality: Hondeklip Bay.

- C. *lyndseyae* (Henning, 1979), syn. nov. *Poecilmitis lyndseyi* (sic) Henning, 1979. Type locality: 10km N. of Wallekraal, Namaqualand.

C. pyramus (Pennington, 1953). *Poecilmitis pyramus* Pennington, 1953. Type locality: Zwartberg Pass.

- C. *balli* (Dickson & Henning, 1980), syn. nov. *Poecilmitis balli* Dickson & Henning, 1980. Type locality: Kammanassie Mts., Uniondale.

C. beaufortius (Dickson, 1966). *Poecilmitis beaufortius* Dickson, 1966. Type locality: Nieuwveld Mts.

- C. *beaufortius charlesi* (Dickson, 1970), syn. nov. *Poecilmitis beaufortius charlesi* Dickson, 1970. Type locality: Quagga Fontein, 25 miles N.W of Sutherland.
- C. *kaplani* (Henning, 1979), syn. nov. *Poecilmitis kaplani* Henning, 1979. Type locality: Wolfhok, Nr Garies, Namaqualand.
- C. *stepheni* (Dickson, 1978), syn. nov. *Poecilmitis stepheni* Dickson, 1978. Type locality: Hantamsberg, Calvinia.

C. plutus **(**Pennington, 1967). *Poecilmitis plutus* Pennington, 1967. Type locality: Seweweekspoort, Zwartberg Mts.

C. pan (Pennington, 1963). *Poecilmitis pan* Pennington, 1963. Type locality: Platrug Farm, Malmesbury Distr.

- *C. lysander lysander* (Pennington, 1963), syn. nov. *Poecilmitis lysander* Pennington, 1963. Type locality: Kamieskroon, Namaqualand Distr.
- *C. lysander hantamsbergae* (Dickson, I 978), syn. nov. *Poecilmitis lysander hantamsbergae* Dickson, 1978, Type locality: Hantamsberg, Calvinia.
- *C. henningi* (Bampton, 1981), syn. nov. *Poecilmitis henningi* Bampton, 1981. Type locality: Huis Riv. Pass, nr Calitzdorp.
- C. *williami* Heath, 1997, syn. nov. (= *Poecilmitis dicksoni* Henning, 1977) (preoccupied). Type locality: 18km E. of Hondeklip Bay.
- *C. atlanticus* (Dickson, 1966), syn. nov. *Poecilmitis atlanticus* Dickson, 1966. Type locality: Leipoldtville, nr Lambert's Bay.

C. trimeni (Riley, 1938). *Poecilmitis thysbe trimeni* Riley, 1938. Type Locality: Port Nolloth.

C. penningtoni (Riley, 1938). *Poecilmitis penningtoni* Riley, 1938. Type locality: Gaika's Kop.

C. pelion (Pennington, 1953). *Poecilmitis pelion* Pennington, 1953. Type locality: Basutoland [now Lesotho].

C. orientalis (Swanepoel, 1976). *Poecilmitis orientalis* Swanepoel, 1976. Type locality: Boesmansnek, Nr Underberg.

C. braueri (Pennington, 1967). *Poecilmitis braueri* Pennington, 1967. Type locality: Madeira Hill, Queenstown Dist.

CONCLUSION

In the systematics of the genus *Chrysoritis*, foodplants appear to be of lesser importance compared to the ant associates: however, the possibility that the ant species are themselves composed of species groups should not be overlooked. In this context a further point should be considered, which is that the food of the ant may also form a component part of the oviposition cue for the adult butterfly (cf. Heath & Brinkman, 1995). Despite the above observation, *C. zeuxo* and *C. zonarius* have been observed to rely only on their particular foodplant, the adults of both sexes seldom wandering far from their respective species of *Chrysanthemoides*, provided that the ants are present.

Experience in breeding *Chrysoritis* over many years has shown that females seldom oviposit unless the correct ant is present. However, exceptions do occur and it is occasionally possible to stimulate oviposition in the presence of the 'wrong' ant. *C. perseus* (Henning) is recorded as associating with the ant *Crematogaster melanogaster* by Heath (1997) but on a few occasions caterpillars have been found close to a *perseus* population, attended by a different species of *Crematogaster* ant, and when bred out, could answer to either *C. perseus* or *C. thysbe bamptoni* (this study). This too is an area for further research.

The phenetic variability between populations of some of these species e.g. *thysbe* and *pan*, has in the past influenced experienced authors to describe many of them as species. It is only recently that more material, additional populations and intermediates have been discovered and this, together with breeding experiments, has thrown a different light on the matter. The various forms appear to be partly induced by the local micro-habitat of each population aided by the seasonal changes which occur. Baylis & Pierce (1991) showed how the nutritional quality of a single species of foodplant can affect both the survival rate of caterpillars and the oviposition rates of females. It seems probable that differing species and variable quality of larval foodplants could also affect the size and facies of an adult butterfly. Altitude is already known to play a part in affecting the wing pattern of some butterflies (cf. Melling, 1987; Brunton *et al.*, 1991). It seems to play a significant role in the facies and brood frequency of *Chrysoritis* species, probably by affecting the microclimate, especially at higher elevations through the differing temperatures, wind exposure and precipitation rates. In western coastal areas the prevalence of sea mists also has a similar effect on wing markings. Although gene flow almost certainly takes place over time between the various populations of *Chrysoritis*, their patchy distribution and non-migratory behaviour would limit this to a certain extent and allow local forms to develop. There is no doubt that there are very many factors at work which can and do affect the size, wing pattern and behaviour of a species.

Recent comparative work on ant-associated lycaenids on a global basis (Pierce *et al.* in press) has highlighted the need for our species names to represent only what is really there. Having said that, only the more obvious synonymies have been discussed here, and it is probable that several more still exist among the remaining 42 species of this genus.

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REFERENCES

BAYLIS, M. & PIERCE, N.E. 1991. The effect of host-plant quality on the survival of larvae and oviposition by adults of an ant-tended lycaenid butterfly, *Jalmenus evagoras. Ecological Entomology* **16:** 1-9.

BRUNTON, C.F.A., BAXTER, J.D., QUARTSON, J.A.S. & PANCHEN, A.L. 1991. Altitude dependent variation in wing pattern in the Corsican butterfly *Coenonympha corinna* Hübner (Satyridae) *Biological Journal of the Linnean Society* **42:** 367- 378.

HEATH, A & BRINKMAN, A.K. 1995. Aspects of the life history, distribution and population fluctuations of *Oxychaeta dicksoni* (Gabriel). *Metamorphosis* **6**: 117-127.

HEATH, A. & CLAASSENS, A.J.M. 2000. New observations of ant associations and life history adaptations (Lepidoptera: Lycaenidae) in South Africa. *Metamorphosis* **11:** 3- 19.

HEATH, A. 1997. A review of African genera of the tribe Aphnaeini (Lepidoptera: Lycaenidae). *Metamorphosis* Suppl. **2**: 1-60.

HENNING, S.F. 1987. Myrmecophily in Lycaenid butterflies (Lycaenidae: Lepidoptera). *Entomologist's Record and Journal of Variation* **99**: 261 -267.

KROON, D.M. 1999. *Lepidoptera of Southern Africa, host-plants & other associations, a catalogue.* Lepidopterists' Society of Africa. pp 160.

MELLING, T.M. 1987. *The ecology and population structure of a butterfly cline.* Unpublished Ph.D. Thesis, University of Newcastle-upon-Tyne.

OWEN-JOHNSTON, N.K. 1991. Thoughts and observations on the genus *Poecilmitis* Butler (Lepidoptera: Lycaenidae) in the Transvaal. *Metamorphosis* **2**: 49-50.

PENNINGTON, K.M. 1962. Descriptions of a new *Neptis,* new Lycaenidae, and records of rare species and additions to the list of Southern African Rhopalocera (Lepidoptera). *Journal of the Entomological Society of Southern Africa* **25:** 266- 286.

PIERCE, N.E., BRABY, M.F., HEATH, A., LOHMAN, D.J., MATHEW, J., RAND, D.B. & TRAVASSOS, M.A. (in press). The ecology and evolution of ant association in the Lycaenidae (Lepidoptera). *Annual Review of Entomology.*

RAND, D.B., HEATH, A., SUDERMAN, T. & PIERCE, N.E. 2000. Phylogeny and Life History Evolution of the Genus *Chrysoritis* within the Aphnaeini (Lepidoptera: Lycaenidae), Inferred from Mitochondrial *cytochrome oxidase I* Sequences. *Molecular Phylogenetics and Evolution* **17:** 85- 96.

Lesotho, January 2001

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South Africa

Getting up at two o'clock in the morning has never been easy but as I am a lepidopterist, I have to get used to it. On Saturday, the 27th January we had to get up early to pick up other fellow lepidopterists and set off for Lesotho. We eventually left Steve Woodhall's house in Edenvale at 4:00am together with Steve and Nolan Owen-Johnston, all stuffed into our car. The trip to Lesotho seemed very short to me and when I woke up, we were almost at Fouriesburg, close to the border. We stopped at a garage to fill up before we entered foreign territory. As we got out to stretch, a mint male *Aeropetes tulbaghia* flopped past us. I have caught many *Aeropetes* in my life, but I have never managed to pick up a nice male until recently at Mariepskop in the northern Transvaal. In any case, we still needed some nice males from other areas. Steve Woodhall saw it when it settled on a gutter of the toilets. I only managed to get out my net with a handle of 30cm. Since I did not see it settle, I asked Steve to catch it. He crept up around the wall and with one magnificent catch managed to bag it. Well, that was the beginning of a very successful trip to the roof of Africa!

We entered Lesotho through the Caledonspoort border post and for the first time in a very, very long time, there were NO clouds. The sky was a bright blue and the roadsides were dotted with flame red Pokers. We left the border and drove on to a spot just before Oxbow. On the right side of the road was a marsh where Steve told us we could get some *Pseudonympha varii.* We caught some *varii's* the previous time we went to Lesotho, but Steve wanted some so we decided to take a look around. We all got off and Steve, my father and I started walking to the marsh. The first thing we saw were little brown dots flopping over the moist grass. My father took the first swipe and missed. That little flopping brown dot was soon transformed into a little brown rocket and then zoomed away. Fortunately there were plenty so we all got nice series of *varii.* On the way back to the car, Nolan showed us a spot for a *Harpendyreus* species (I think it is *H. tsomo*) underneath the bridge. We also got a nice series of them. We decided that since this was Lesotho, and there were still no clouds in sight, we should make for the *Chrysoritis pelion* spot. We did not know how long the weather was going to hold. As soon as we passed the next ridge, we saw all doom – a few tiny white spots on the horizon. Little white spots can only do one thing. They can't rain, they can't cover the sun and they can't bring bad weather. They can only grow. We decided to quickly get some *Pseudonympha penningtoni.* We stopped at the quarry on the Tlaeeng Pass, which is the highest road in Africa at 3 251 m above sea level. This time the browns were a lot more common. Since we also got *Pseudonympha penningtoni* last time we came, I decided to try and photograph them. Little browns settle very often and they settle for long periods, except when you try to photograph them. Then you can only get to about 70cm from them before they take off and settle about three metres away. The times when I did manage to get close, they were not impressed. They would sit there with their wings closed and creep around the blade of grass so that I couldn't get any photo whatsoever. My father called me and showed me his little *penningtoni.* A normal little butterfly except that the brown patch on the forewing upperside was yellow. I knew that it was our second aberration. As we got in the car again, we again noticed the few little white clouds. They were now covering the landscape. Again we decided to get to the *Chrysoritis* spot quickly. We eventually arrived at the Motete River and Steve showed us the "hill" on which they all caught them.

The sky was already covered in massive, dark clouds and we knew we only had a few minutes before we were going to be soaked. Fortunately, our luck held up a bit and when we started climbing, the sun broke through a few clouds. The first butterflies to show their faces were some *Pseudonympha gaika*. I caught one but decided that *Chrysoritis pelion* was more important and I joined Steve as he was climbing the hill. As soon as we reached the first ridge, a *pelion* darted past us and dived down into a gully. I was just getting a little bit upset, when Steve told me that it would come up again. I don't think he finished his sentence when it turned up again. I ran up a little bit higher right into the path of a fiery rocket. It tried dodging but my primary school cricket shots paid off. I got it. I got my first *Chrysoritis* with blue on the upperside!!! Lesotho was a success. Steve told me that we should split up and try to get some more. He told me that they prefer gullies or the edges of ridges. He decided to go up to the next ridge and had a go at them there where I was. I stayed on the lower ridge and on the first edge another one turned up. I captured it with no problems at all. We all then climbed higher up. I ventured out to the left and my father and Steve took off to the right. If you go up to the 5th ridge and continue going left, you will come across an enormous patch of long grass - the same type you find at all the *Pseudonympha gaika* spots. That spot is the perfect spot for *gaikas.* I picked up many mint males but only one mint female. Though I am not complaining. The underside of a freshly emerged *Pseudonympha gaika* male is gorgeous. All the other *Pseudonymphas* were also common in that area. According to the signpost at the river, the road is about 2 995m above sea level. I assume that if you climbed the mountain, you were higher than 3000m above sea level and that explains why we also got *Pseudonympha penningtoni.* While we were on top, the clouds silently crept up on us and then hit us with force! Fortunately my father and I were close to the car but nobody else was in sight. As we got in the car it started to rain hard. We took the binoculars to try and spot someone on the hill but we didn't see a soul. At last the rain cleared up a bit and just then a soaking wet Steve appeared on the mountain in front of us. Nolan was nowhere to be seen. We hooted and shouted but he was gone. We decided to go and search for him with the car and just when we got on the road we saw him strolling towards us. Funnily enough, he did not even have a single drop of water on him. As we set off for Sani Pass, he told us that he took shelter underneath a rock next to the road. The road to Sani Pass was a long rainy road. The one advantage of a rainy day on the road is that you don't worry much about the butterflies you are passing. We filled up at the little garage in Mokhotlong and then we hit the road towards Sani Pass. We stopped at the spot where Alf Curle and Graham Henning caught *Torynesis pringlei* a week earlier. Unfortunately it was still cloudy so I decided to take a shot at the trout in the little stream down below. One trout came for the lure, missed it and that was it. After that we drove straight to the Sani Pass Hotel where we met up with Clive Quickelberge and Alan Plowes. After dinner I finished my setting work and went to bed. I later found out that Steve and Clive stayed in the bar with a few drinks and some of the stories became very interesting but unfortunately I didn't hear them. The next morning began early and cold, but as soon as the sun starts baking you on the side of a massive mountain, you begin to heat up and wait anxiously for the elusive *Torynesis pringlei*. Well, the day started off quietly, but we soon found some *Orachrysops nasutus.* I am not sure which subspecies it is, but Steve Woodhall told me that it is a different subspecies from the one we found at Stutterheim. Up to that point in the trip, we only managed to pick up one *Aeropetes tulbaghia*. They were quite scarce at the other places we stopped at and they are really difficult to catch if they only fly past. Well, at this particular spot there is a famous red spot, an area filled with red hot pokers. As described in all the books, *Aeropetes tulbaghia* loves red objects. Whether it is a red car, a red bag or a red hot

poker, they will always go to inspect it. At this particular spot, they were extremely plentiful and you could almost handpick them. They were also common further up the mountain where they would dart past you and settle in full glory on a rock. Since there are very few *Acraeas* in Lesotho, there are no mimicking butterflies, whether it be Batesian, Müllerian or false mimicry. There is, however, a butterfly that forms part of the group 'collectorian' mimicry. They do not resemble other butterflies for protection against birds or other natural predators, they resemble butterflies for their commonness. The main devil in this category is of course *Torynesis*. Even though you can distinguish between them in a tray, it is not so easy to distinguish between them and the common *Dingana bowkeri* in the field. I am pretty sure we would have gotten millions of *Torynesis* if we only collected all the *Dinganas* that were flying about. Well, I decided to take another shot at the trout in the stream down below. This time I tried a nice little Rapala and it worked. A fish grabbed it and was hooked. I was standing on a rock about 2m above the pool so I had to lift the fish up. As I lifted it, it came off, fell on rock and slid back into the water! The fishing proved as unsuccessful as the butterfly collecting. I was quite excited about that close call so I decided to go and tell my dad. Little did I know that my father changed the trip around by chasing up a little black bug. That little bug flopped around him, settled and that was the end of that little black bug. A mint male *Lepidochrysops loewensteini*! By the time I got up there, everybody in the Maloti mountains knew that and I totally forgot to tell my father about the fish. I decided to go down to the road but I was again stopped. A little bigger black *Dingana* came up from the road. Somehow I just knew it was a *Torynesis* and with a calm swipe I zapped it. Steve Woodhall was standing about twenty meters from me. He had wanted this little butterfly more than anybody else. "Steve, I think I just caught a *pringlei*". "Oh no you didn't! Oh s%"&! He just caught a mint female *pringlei*". Unfortunately it wasn't mint, it had a crack in its wing but that was all right. I am sure that I will survive!

The day then started as all the butterflies became extremely common. Every *Aeropetes* that came by went to take a look at the nice red bakkie standing at the road. There were millions of *Orachrysops* about and we also got a mint *Lycaena clarki*. Everybody tells me that it is a common butterfly almost everywhere you go but this is my second one in nine years. My father managed to get another mint male *Torynesis* but that was it. We heard many complaints as to why there were virtually no *Torynesis* or *Lepidochrysops loewensteini*. The previous group of collectors to go there, to exactly the same spot "filled their boots" with them! Why was there no good stuff on this day? I don't think you can catch all the butterflies in one weekend, no matter how hard you try. I just think we weren't at the exact spot they were at.

The trip to Lesotho ended well and it was far better than our previous trip in 1998. We did not even see a single Lycaenid nor did we even know about *Torynesis pringlei*. We drove back to the Caledonspoort border post. Of course I pulled my usual stunt and that was the last I saw of Lesotho or any other part of South Africa until we arrived at Steve Woodhall's house in Edenvale.

Zomba Plateau - Malawi

Acraea pentapolis epidica – Another Rare Gem

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This is one of those butterflies that always seem destined to exist in someone else's collection. I had heard of this elusive insect prior to my first visit to Malawi with Ivan

Bampton in 1989, but never imagined that I would be fortunate enough to actually catch one.

My first sighting occurred on the Zomba Plateau. Whilst perched on a rock admiring the view, (said rock was on the edge of the Plateau and the view was out over the plains, reminiscent of the view one has of the earth from a helicopter hovering 300m above the earth) my attention was drawn to a large clear winged light grey *Acraea* that floated past about 10m above me. I watched in rapt wonderment as it floated off over the indigenous forest of a nearby gorge. It appeared to revel in floating some 10-15m above the canopy. Eventually the sound of a passing peregrine falcon drew my attention away from the butterfly. When I looked back it was gone. This I realized was the elusive *Acraea pentapolis epidica*. I considered myself extremely privileged to have actually seen a live specimen.

A week or so later Ivan and I decided to visit the crater at Mulanje. We were staying with friends in Limbe and our trip necessitated an early dawn start. We arrived at the Lauderdale Tea Estate at about 8:00am, and, having obtained permission from the management proceeded to one of the managers houses high up amongst the tea bushes. Here we could find secure parking for Ivan's car - not even in Malawi is it safe to leave your car unattended.

The walk up to the crater is always an interesting one. Beautiful butterflies abound. I have taken such rarities such as *Cyrestis camillus sublineatus, Euriphene (Euryphura) achlys* and *Alaena lamborni* at various times along this path. The crater itself is a large circular bite taken out of the Plateau. The sides of this curious piece of erosion almost meet and one enters via the course of the Mulanje River. This opens out into a slab of rock, tilted down towards the plains south of Mulanje. The crater itself is covered with virtually impenetrable primeval forest. A truly enchanting place.

I had been collecting for a couple of hours when I decided a rest was called for. Accordingly I sought out a suitable patch of shade on the upper end of the slab of rock and lit up a much-needed smoke. My attention was drawn to a very worn looking butterfly. An *Acraea boopis* female was my immediate decision and a very rubbed one at that. Idly I watched it float across the rock. "If it comes close enough, I'll catch it" was my thought. True to form it floated over me about 2m above the ground. A casual flick of my net and it was in the bag. My attention was drawn to a *Charaxes acuminatus*, which was approaching one of my traps. I casually pocketed my *Acraea* whilst paying attention to the *Charaxes.*

Later back at the car, Ivan proudly showed me a worn female *Acraea pentapolis epidica* which he had caught. That was when I realized what my catch was. A near perfect male *A. pentapolis epidica*. On a later trip to the crater Ivan showed me a tree, *Myrianthus holstii*, which he had identified as *A. pentapolis'*s food plant.

In late 1996 I decided to pay a visit to the top of Zomba Plateau. On this visits I checked a number of *Myrianthus holstii* for larvae. I was fortunate to find several final instar larvae. They were a pale creamy colour with long (± 5mm) barbed black spikes – six on each segment. I took a good supply of foodplant and succeeded in breeding one out. The pupa was a typical Acraea pupa dressed in cream and black. On the 30th October 1997 there emerged a slightly crippled – the right side did not develop fully – female *A. pentapolis epidica.* The 12th November saw me back on the Plateau. I was rewarded with a nice female. Another visit on the 14th yielded another nice female.

My real reward was on the 18th November. The first stop was near the top of the Up Road Pass on a bend, where, some 300m from the top there were several food plants. I was delighted to find a few *Acraea pentapolis epidica* flying around these trees. After catching what I could, this was not easy as it involved waving a 8m long net at about a

45 degree angle over a 10m drop. I decided to try my luck at a tree I knew of about 1km from the pass. I was delighted to find a number of *A. pentapolis epidica* flying around it. Assembling my extensions full length, about 8m, I started trying to catch these majestic canopy dwellers. If you've never handled an 8m long net, you will know that this is much easier said than done. However my perseverance paid off and I succeeded in taking more than thirty specimens. A few were tatty and were released, but a goodly number were in good condition. I returned again on the 26th November but found that most of the specimens were in a very worn condition.

I had no qualms about taking a large bag of this very scarce insect. The leaves of the food plant had numerous clutches of eggs present. The eggs are a creamy white, and are laid as a clump. No effort is made to place each egg as occurs with our common garden *Acraea*. They are simply laid in a clump resembling half a pea. Once I realized what these creamy blotches were, I could count at least twenty clutches without moving from one spot. I have no doubt that the few specimens that I caught made no difference whatsoever to the future of this colony.

Lepidoptera and literature: a brief survey of pages and wings

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It seems that humans love reading objects which consist of two symmetrical winged halves meeting in a sort of central spine: this goes for "reading" Lepidoptera as much as reading books. Who could imagine the study of Lepidoptera without the existence of text? Would South African Lepidoptera be the same to humans without the writings, for example, of D.A. Swanepoel? Who can forget his romantic, almost mythical description of the Wolkberg in the Northern Province? Which reads...

> One of the most beautiful mountain ranges to be seen in South Africa is the northern part of the Drakensberge, that runs through the eastern Transvaal where it is known as the Wolkberg - "mountains of the clouds." Viewed from the eastern side, these mountains display an alluring uniqueness of shape and structure. At times wrapped in a veil of misty cloud, the fantastic peaks tower majestically against the blue skies, and like the folds of a curtain of green velvet their undulating slopes stretch far into the bushveld. For the naturalist those green slopes have an air of unfathomable mystery about them. He is prone to imagine that all sorts of fantastic butterflies must haunt the heights. Things that fly so fast that the eye cannot perceive them. Things that are so rare, one would never find.

Against this background, I briefly bring to your attention some results of my new collecting survey: the search for references to Lepidoptera within literature at large, including artistic literatures such as poetry, novels, and so on. Let me say up front that contrary to what one may expect, the results are too numerous to include within this essay. There is enough material out there to keep one busy for a considerable time. Let me demonstrate the extent of this literature-lepidopterist convergence, or page-puddling, or wing-puddling, by means of a couple of examples. You are probably aware that the original meaning of the word psyche - prevalent today in terms such as psychology, psychoanalysis, psychedelic, and so on - is "butterfly". Indeed, the classical Greek word for "butterfly" is "psyche". The famous Russian-American novelist Vladimir Nabokov in 1945 published one of his most important Lepidopterist papers, titled "Notes on the Neotropical Plebejinae" (today known as the Polyommatini), in the entomological journal titled *Psyche*.

The great 'American nature poet Walt Whitman suggests the quite psychological impression that butterflies make on humans in the following description from his prose book *Specimen Days* in the nineteenth century:

> Over all flutter myriads of light-yellow butterflies, mostly skimming along the surface, dipping and oscillating, giving a curious animation to the scene. The beautiful spiritual insects! Straw color'd Psyches! Occasionally one of them leaves his mates, and mounts, perhaps spirally, perhaps in a straight line in the air, fluttering up, up, till literally out of sight. In the lane as I came along just now I noticed one spot, ten feet square or so, where more than a hundred had collected, holding a revel, a gyration-dance, or butterfly goodtime, winding and circling, down and across, but always keeping within the limits.

In view of this connection between butterfly and spirit, it is no wonder that some collectors go completely *psycho* in pursuit of a rarity!

Two excellent books appeared recently in which Nabokov-who is more famous for his novels such as Lolita comes into focus as a Lepidopterist. These are *Nabokov's*

Butterflies edited by Brian Boyd & Robert Pyle, and *Nabokov's Blues* written by Kurt Johnson & Steve Coates. These books reveal that Nabokov's Lepidopterism is a universe awaiting exploration by Lepidopterists. The second of these books presents the compelling events which led to the systemization of South American Polyommatini, including the scientific naming of some twenty six species after characters within Nabokov's numerous novels, based on Nabokov's brilliant and intuitive early systemization of these South American blues.

I recently had the opportunity, when I delivered a paper on E.E. Cummings' poetry at the annual conference of the American Literature Association in Cambridge, Massachusetts, to visit the Harvard Museum of Comparative Zoology where Nabokov worked on Lepidoptera for some seven years or so in the 1940s. The exhibit of the phylogenetic lineages of South African *Thestor* species on the wall grabbed my attention, as you can imagine. Here I met Naomi Pierce, who informed me that they are working on my brother's discovery, *Thestor terblanchei.* Talk of coincidence, serendipity, the global village, and the world-wide matrix of Lepidoptera and Lepidopterists!

Some American Lepidopterists are in the habit of reading Nabokov's chapter 6 from his autobiography titled *Speak, Memory!* before the advent of spring when the blues begin to emerge, in order to savour the new collecting season that lies ahead. Among other Lepidopterist-literary highlights of this text, I draw your attention to some lines within the concluding paragraph.

> And the highest enjoyment of timelessness-in a landscape selected at random- is when I stand among rare butterflies and their food plants. This is ecstasy, and behind the ecstasy is something else, which is hard to explain. It is like a momentary vacuum into which rushes all that I love. A sense of oneness with sun and stone.

It is Nabokov's opinion that another centre of human evolution is not the head, but between the shoulder blades. "Let us be proud of being vertebrates," he writes, "for we are vertebrates tipped at the head with a divine flame". Encountered with real art, we feel a shiver up the spine, and "that little shiver behind is quite certainly the highest form of emotion that humanity has attained when evolving pure art and pure science". Nabokov sees that great art brings us the "Precision of Poetry and the Excitement of Art". In short, Nabokov foresees the point - or a high ridge - where the mountainside of scientific knowledge joins the opposite slope of artistic imagination. Let me add that Nabokov covered some 50 000 miles in his collecting trips through America, discovered new Lycaenids and Satyrids, gave names to numerous parts of butterfly genitalia of which he analysed thousands under the microscope, and so on. To me one of the striking aspects of his particular forms of mergence between Lepidoptera and literature is how his keen sense of the elusive, beautiful and scientifically meaningful patterns on the wings of blues, shimmers into his breathtaking sense of detail within his novels.

Close to Naomi Pierce's office at Harvard where I attended the Nabokov exhibition, is that of the myrmecologist and sociobiologist Edward O. Wilson. This naturalist wants us to return to the original renaissance idea of the convergence of the natural sciences and the humanities, and besides his phenomenal work in evolution, ecology and the ants, he has extensively read into the humanities, from early renaissance works to the very latest philosophies such as deconstruction. His notion of consilience, the merging of natural scientific method and the humanities, has not been unequivocally well received, but is important and intriguing nevertheless from what I gather.

Incidentally, Wilson was the first to discover and describe the notion of semiochemical communication among insects. He isolated the organ containing the semiochemical by chopping up the ant, and by drawing a line with each individual organ until he found the particular line which excited the ants into behavioral patterns. All of this started with Wilson's initial interest in butterflies, which he collected outside their mobile home by means of a net made of a broomstick, a coat hanger, and a cheesecloth bag. It is fitting that in the 1990 publication of the breathtaking book titled *The Ants* (co-authored with Bert Hölldobler), some of our South African research on the interactions between ants and butterflies is amply cited.

But perhaps the most well-known and much-discussed example of the occurrence of butterflies in literature, goes back some two thousand four hundred years, to the Taoist poet-teacher Chuang Tzu's anecdote about a dream in which he had dreamt that he was a butterfly, the rest of which could be translated as follows, as he woke from the dream:

> Now I do not know whether I was then a man dreaming that I was a butterfly, or whether I am now a butterfly, dreaming that I am a man. Between a man and a butterfly, there is necessarily a distinction. The transition is called "the transformation of material things."

In Taoist poetry one comes across the experience of the absolute identification of humans and nature, without any relational rational interference, and with the concomitant sense of the dissolvance of opposites and boundaries. This Zen Buddhist sense of seamless unity between humans and nature is continued in a unique fashion within the texts of the Afrikaans poet Breyten Breytenbach. Perhaps you have seen his painting on the cover of his book of poems titled *Yk.* The species might not be local, but it is evident that these pictures suggest that sight can pupate, like an imago, into something more profound and aesthetic. Indeed, butterflies occur frequently in Breytenbach's work. Here is one sample, also related to butterflies and sight, from the poem "breyten bid vir himself" or "Breyten prays for himself", first in Afrikaans and then in English translation.

> Dood is wel die enigste vervulling
> Maar·laat ons vleis nuut en vars soos kool bly
> Maak ons vastig soos 'n vis se pienk lyf
> Laat ons mekaar bekoor met oe diep skoelappers
> ---
> It is true we are only fulfilled in death
> But let our flesh stay fresh as cabbage
> Make us firm and pink as fish
> Let us tempt each other, our eyes deep butterflies

A sense of deep unity between humans, nature and butterflies is carried within these lines, among other things. The canonized modernist poet Ezra Pound has translated a number of oriental poems and in two of these, butterflies are found. His translation of a primitive haiku by Moratike (15th cent. A.D.) reads as follows:

> The fallen blossom returns to its branch:
> A butterfly.

This poem effortlessly and non-sentimentally presents the Taoist or Zen sense of the completeness of nature's movement and change. Fall and loss give over to return and replenishment, like the cycle of the seasons, or the alteration of night and day within nature's continuation. In Pound's translation of Li Po's eighth century poem "The River

Merchant's Wife: A Letter", in which a young wife poignantly laments the absence of her husband who has embarked on a mercenary journey down the river, butterflies form a central, vivid image, as found in the next cluster of lines:

> The leaves fall early this autumn, in wind.
> The paired butterflies are already yellow with August
> Over the grass in the West garden,
> They hurt me. I grow older.
> If you are coming down through the narrows of the river Kiang,
> Please let me know beforehand,
> And I will come out to meet you,
> As far as Cho-fu-Sa.

Among numerous other considerations in relation to this simple, striking poem, lepidopterists will be inclined to sense that the orpimentation (enyellowment) of butterflies in autumn is not only a powerful poetic image, but also makes sense in · terms of the coloration of Pierids. Brother (R.F. Terblanche) and I are working on an article for publication based on this possibility.

A number of potentially illuminating further explorations await anyone inclined to scout for Lepidoptera in literature. They are found among authors as divergent as Rudyard Kipling, Tennessee Williams, Ben Okri, William Wordsworth, Marianne Moore, and more. Recently I have been tipped off that butterflies and beetles play a symbolic role within Joseph Conrad's *Lord Jim.* Last week I had to prepare Virginia Woolf's *Jacob's Room* for a lecture, and to my astonishment found Lepidoptera quite accurately represented throughout this novel. This calls for further exploration.

I hope that these examples will entice the Lepidopterist to take along a book on the next hunting expedition. If you want to read something with specific Lepidopterist impact, you may consider Nabokov's short story about a collector titled "The Aurelian" in which the protagonist laments the fact that he could never collect in Africa among other things, or Lettie Viljoen's novel in which the heroine is an entomological researcher interested in butterflies and moths of the Freestate, titled "Karolina Ferreira". But since Lepidoptera provide the mission which takes us into the veld at large, one could also consider, say, Eugene Marais' book *The Soul of the Ant,* or *The Soul of the Ape,* or Edward O. Wilson's *Naturalist.*

At the AGM Mark Williams timeously pointed out the lack of reference within my talk to Alfred Russel Wallace's descriptions of nature and Lepidoptera - I recall from Paul Smart's encyclopaedia a caption from Wallace's writings, about a tremendous headache that lasted for a day or more which he acquired upon discovering a new· birdwing. Similarly, Champollion, upon deciphering for the first time the Egyptian hieroglyphs, ran to his colleague, shouted "I've got it!", fell ill straight away, and remained bed-ridden for months.

And James D. Watson, upon co-discovering the double helix structure of DNA with Francis Crick, felt confused and nervous and could not function properly for weeks after the publication of their results. It seems, indeed, that sometimes the individual is merely the instrument of a symphony so overwhelming in its significance, that the individual hardly copes.

But what greater happiness could there be than turning the wing of a natural book while the moths are gathering at a luminous trap somewhere in the endless night outside? And while spring, as E.E. Cummings suggests, pupates from winter like a butterfly "expanding like an opening eye", from the "earth-shell" which "cracks with underneath desire". There is something of one's very soul, or one's very nature as they say, in the presence of butterflies on this earth which we walk as they fly it. And there is something in the human mind which must respond, and float along, as a butterfly or moth rises into flight - in Lepidopterists, this sense is greatly enhanced, and this is their value to the ecosystem among other considerations. Surely those among us who discover new species must enjoy a unique "bionic eye" for the presence of Lepidoptera.

The suggestion of the link between soul and butterfly is also carried in Cummings' early, unpublished poem about a visit to the crematorium which ends with the human body divine burning and, as the shocked poetic speaker walks outside, the "warm flood of universal sunshine; And a white butterfly, hovering, soaring, ascending ... "

Works cited

Boyd, Brian & Pyle, Robert Michael. *Nabokov's Butterflies: Unpublished and Collected Writings.* Boston: Beacon Press, 2000.

Breytenbach, Breyten. *and death white as words.* Ed. A.J. Coetzee. London: Rex Collings, 1978.

Cummings, E.E. *Complete Poems 1904 -- 1962*. Ed. George J. Firmage. New York: Liveright, 1994.

Johnson, Kurt & Coates, Steve. *Nabokov's Blues: The Scientific Odyssey of a Literary Genius.* New York: McGraw-Hill, 1999.

Miner, Earl. "Pound, *Haiku*, and the Image." *Ezra Pound: a Collection of Critical Essays.* Ed. Walter Sutton. Eaglewood Cliffs: Prentice-Hall, 1963.

Pound, Ezra. *Personae: the Shorter Poems of Ezra Pound.* Rev. Lea Baechler & Walton Litz. New York: New Directions, 1990.

Sonntag, Linda. *Butterflies.* London: Hutchinson, 1980.

Swanepoel, D.A. *Butterflies of South Africa: Where, When and How They Fly*. Cape Town***: Macmillan, 1952.

Wilson, Edward O. *Naturalist*. London: Penguin, 1996.

Wilson, Edward O. & Hölldobler, Bert. *The Ants.* Cambridge, MA: Bellknapp of Harvard University Press, 1990.

Notes on the biology of threatened butterflies in South Africa

Graham Henning

Introduction

The term conservation has in the past been used broadly to include protection as well as use, maintenance, restoration and enhancement of the natural environment. The Convention on Biological Diversity defines conservation as the "conservation of biological diversity" and the "sustainable use of its components".

The South African Government White Paper on Biodiversity seeks a policy and strategy specifically concerning the sustainable use of biological resources, and avoiding or minimising adverse impacts on biodiversity. The conservation of biodiversity, both inside and outside of protected areas includes measures required to protect, maintain, rehabilitate, restore, and enhance biodiversity

According to the White Paper South Africa's approach to conserving its remarkable diversity of landscapes, ecosystems, habitats, communities, populations, species and genes in the country, has several components:

- Identifying important components of biodiversity and threatening processes;
- Maintaining and strengthening existing arrangements to conserve South Africa's indigenous biodiversity, both in and out of protected areas;
- Establishing and managing efficiently a representative and effective system of protected areas;
- Promoting environmentally sound and sustainable development in areas adjacent to or within protected areas;
- Restoring and rehabilitating degraded ecosystems, and strengthening and further developing species recovery plans where appropriate;
- Controlling, eradicating and preventing the introduction of harmful alien species which threaten biodiversity;
- Regulating the transfer, handling, use and release of genetically modified organisms.

Aspects of the above components with regard to Threatened Butterflies and Butterfly Conservation in South Africa are presented in this paper under the following headings:

- Threats.
- Environmental strategies.
- Survival strategies.
- Protected areas (IUCN).

In terms of biodiversity conservation it is accepted by the Convention on Biological Diversity that biological diversity is best conserved in the wild through the conservation and restoration of ecosystems and natural habitats, and the maintenance and recovery of viable populations of species in their natural surroundings.

In order to conserve these natural habitats in a condition to sustain the diverse populations we need to establish the biological requirements of these populations. A major faunal component in Biodiversity are the insects, and the only insects for which there is a South African Red Data Book and a fairly comprehensive biological knowledge are the butterflies (Henning & Henning, 1989). The objective of this paper is to present some of the biological requirements of threatened butterflies thus contributing to our ultimate aim, that of protecting our biodiversity.

THREATS

Overseas studies, as well as local research, have established that the major cause in the loss or decline of insect populations throughout the world is habitat destruction (Pyle *et al.,* 1981).

Conversion of natural habitats for agricultural purposes, particularly for planted food and fibre crops, is one of the most extensive land uses and has resulted in the greatest loss of indigenous insect populations. Not only is man directly involved in habitat destruction but also indirectly by introducing alien fauna and flora. Alien vegetation has invaded and even destroyed large tracts of natural flora, a process which is extremely difficult to reverse and very expensive to control on a large scale. Alien vegetation is generally unsuitable as food for indigenous fauna, including butterflies and moths. The establishment of plant invaders in existing plant communities upsets the delicate balances that operate between competitive plant communities, This usually results in the dominance of the invader species over the indigenous, usually multispecies, plant communities. The success of plant invaders can be seen all around us and is due to a great extent to the absence of natural enemies of these species. In South Africa the introduction of exotic plants, especially from Australia, has had a serious effect on butterfly populations over the past 40 to 50 years. When an ecosystem has changed, either due to habitat destruction or by invasive vegetation, it is usually no longer suitable for the fauna associated with the original plant communities. In South Africa the butterflies most at risk are the myrmecophilous (ant associated) Lycaenidae: Blues, Coppers and Opals. These species are often extremely local as they require the presence of the larval foodplant and the host ant as well as optimal climatic and habitat conditions. Being thus confined to a limited area these species are particularly vulnerable to any disturbance of their preferred habitat. Thus the building of a house, the construction of a road or the ploughing of a field could lead to the extinction of a rare species confined to a single locality. Another harmful, though often overlooked, alien which is active in habitats of many butterflies, is the introduced Argentine Ant *(lridomyrmex humilis)* regarded as the most pernicious ant in the world. This tiny species was first discovered in this country in Cape Town in the early years of this century. It is believed that it was introduced during the Anglo-Boer war. It has since spread far inland and in northerly and easterly directions. It appears to have been first recorded in Johannesburg in the 1970s. However, little is known about the true distribution of this destructive creature in South Africa, but people are well aware of its harmful activities wherever it establishes itself. Apart from doing harm in many other respects, it drives away our indigenous ants by harassing them, killing them and taking over their nests and food supplies. Sugar ants, such as the Spotted Sugar Ant *(Camponotus maculatus)*, Black Marsh Ant *(Camponotus niveosetosus)* and small Black Sugar Ant *(Acantholepis capensis)* can be attacked by this alien invader. These ants play an important role in the life-cycles of various lycaenid butterflies and hence they are necessary components of the ecosystems in which these butterflies occur.

By killing and replacing indigenous ants, the Argentine Ants could adversely affect the butterfly fauna and that of other insects and the organisms depending on them in yet another way. Many ants, including the species that act as hosts to lycaenid butterfly larvae, are agents in dispersal of elaiosome-bearing seeds. These seeds have fleshy, oily structures attached to them that contain powerful ant attractants. The indigenous ants laboriously collect these seeds and take them to their underground nest's, in the safety of which they eat off and consume the elaiosomes. The seeds without the elaiosomes, but still viable, are either left lying in the ants ' nests or they are carried to the surface and dumped outside the nests on the ants 'middens'. In both situations the seeds are more likely to germinate. The seeds are thus widely dispersed and those left in the ants ' nests are protected against seed eating birds, rats and mice. When the seeds are not dispersed by ants, the plants depending on this method of seed dispersal become rarer and eventually disappear completely. The Argentine Ants play no part in seed dispersal because, although they eat elaiosomes, they do not collect and transport seeds. Instead they leave them lying about under the parent plants, where they are easily found and eaten by birds and small mammals. The disappearance from an area of certain plants adversely affects the associated insects, including butterflies, whose larvae feed on these plants. The Argentine Ant thus not only causes the disappearance of ants associated with butterflies but also of those larval foodplants of which the seeds are dependent on ant dispersal.

Another destructive, although natural, force is veld fires. If they only occur very occasionally they are apparently advantageous to at least a number of plants making up the Cape fynbos. When they occur too frequently, or at the wrong time of the year, they can do great harm to flora and fauna. Butterflies are particularly vulnerable to fires occurring during their main breeding season, because they affect the reproductive adults as well as their eggs, larvae and pupae on the food-plants. Fortunately ant-associated larvae and pupae which at the time of the fire are in underground ants' nests usually are not adversely affected. It is quite normal to see newly emerged adult ant-associated lycaenids flying about burnt vegetation and settling on dead twigs and blackened soil. In fact some species seem to prefer to emerge only after their habitats have been burnt, for example many *Lepidochrysops* species whose larvae feed on ant brood during the latter part of their life cycles (Henning & Henning, l 992, 1996).

ENVIRONMENTAL STRATEGIES

Effective protection of a species can only be achieved if the habitat requirements are met. Without exact knowledge about its requirements, the distribution and the population dynamics, protection of a threatened species is difficult. The danger to every species has to be studied carefully not only on a regional scale but regarding the entire area of distribution. Most threatened species are populations living in small isolated areas such as islands or montane refuges. If short or long term anthropological changes have interfered with the biotope the effects must be monitored and managed. The relationship between the biological character of butterfly species and the nature of the environment where they are found has been the subject of several theoretical strategies. The question is how to select the environmental factors control ling population dynamics that can be used in planning for species conservation and nature reserve management. The analysis of the biological characteristics is a method to detect the specialization of a species and hence to what environmental circumstances it is adapted. Before butterflies can be used as environmental indicators, we first have to describe the butterfly habitat in terms of relevant environmental factors.

Habitat Characterization

In habitat characterization assume two parameters: unpredictability and stress.

- Unpredictability can be defined as the local duration of an unfavorable period relative to the organism's life cycle. Stress originating from food shortage or a harsh climate can be seen as unfavorable and can be called physical stress.
- Populations in species rich communities can suffer from competition and predation, the resulting stress can be called biotic stress.

Using unpredictability and stress, four environmental types can be distinguished. Each type requires a special life-strategy. Species can adapt to one of these environmental types when these conditions are fulfilled.

1. Highly unpredictable environment with periodically abundant food resources which allows for rapid development. The strategy of the species found in these environments consists of migration or high rates of reproduction and growth with a correspondingly swift decline under stress. One example is *Vanessa cardui* which may proliferate in a particular area and then spread itself widely into neighbouring environments.
2. Harsh environment causing physical stress but which is moderately predictable with lots of space. The strategy is based on longevity and robustness of the organism. Many of the bush veld species would be classified here.
3. Species rich environments causing biotic stress, predictable with lots of space. The strategy is based on avoiding the competition by adaptation or by being cryptic or by being noxious to avoid predation. Many of the forest species are examples.
4. Highly predictable environments are temporarily more stable than the previous ones. Due to a local buffering or protection there is a more regular and mild climate or a controlled environment. This occurs for example, locally in forests, on hill slopes and sites with seepage. In the case that host plants are highly resistant to fluctuations in weather or that other animals are involved protecting the insects, there will be an improvement of the predictability. An example of the latter is ants protecting the larvae of butterfly species in their nests. These environments can be a habitat for rare species as they often cover only a small area. The survival strategy is here to be sedentary, there is a strict population control and the environmental buffering or protection is in force. A species applying this strategy can be termed a fixture. These species are vulnerable to environmental disturbance because of their lack of robustness or flexibility. Examples would be the genera *Chrysoritis* and *Aloeides.*

Those species needing the least conservation requirements are those with high versatility, those with the highest conservation requirements are the fixtures (e.g. ant associated species) (Bink, 1992).

Ecological Status

The ecological status can be assessed as follows:

1. Autochthonous - species completes its entire life cycle in the same vegetation type. Examples would the colonial, ant associated species such as the genera *Chrysoritis* and *Aloeides.*
2. Stenotopic – autochthonous species restricted to a few specialized habitats. Some examples include montane genera within the Satyrinae and genera such as *Lepidochrysops.*
3. Eurytopic - species present in several similar habitat types. Examples would be many of the pierids and small blues.
4. Xenotopic - species present but without necessarily completing its life cycle there. It may be visiting from a neighboring habitat or a migrant. Many of our nymphalids would be examples of this group.

Vegetation Development

The development of temperate vegetation types can be assessed as follows:

Early successional vegetation types dominated by grasses and many species of herbs that flower over a long period of time and may have a biodiversity greater than that found in later successional stages. Pure grassland habitats are the climax vegetation in many areas of South Africa and are considered an early successional stage but do not have the biodiversity of conventional early succession.

Secondary successional stages are dominated by small shrubs, and usually have a reduction in plant diversity. A different set of butterfly species exploit this environment.

Late successional vegetation type comprises trees and shrubs with often a further reduction in plant diversity and the butterfly population often decreases and changes.

SURVIVAL STRATEGIES

Analysis of butterfly requirements

Populations of butterflies are increasingly beset by isolation from one another and there are likely to be periods of small population sizes and bottlenecks.

The genetic consequences of these phenomena may result in the loss of different forms of genetic variation in small populations due to genetic drift. It is considered that genetic impoverishment is unlikely to be a principal factor influencing most populations of a few hundred or so individuals even if intermittent bottlenecks occur. Most extinction events are primarily due to ecological or environmental pressures. Bottlenecks extending over more generations are likely to have more serious consequences.

Populations should not be considered solely as assemblages of similar individuals but rather as individuals which vary in genotype and phenotype, and thus are likely to differ in their fitness and their evolutionary potential for adaptation to environmental change.

The ant-associated species of butterfly have a more or less closed population structure. They show a restricted pattern of dispersal and occur in colonies associated with specific biotopes. The rate of migration between populations will tend to be low

and, therefore, there will be few opportunities for gene flow and the introduction of novel genetic variation. Rates of colonization of newly created biotopes or of re-establishment following extinction are also likely to be low.

Butterflies with this type of population structure will frequently occur in "healthy" biotopes as systems of interacting local populations. An individual system of this type is known as a metapopulation and is considered to exhibit a "shifting mosaic" type of population dynamics. The shifting mosaic moves the optimum colonial conditions according to the prevailing environmental conditions. For example during changes in the weather conditions over years the colony could move up or down the mountain to retain its moisture and temperature requirements, similarly the plant and insect associations would move in sync. The local populations will exchange some individuals and will have some degree of independence in their population dynamics.

The absolute size of a population may not be closely related to the proportion of genetic variation transmitted to the next generation. If only a small number of adults actually breed and contribute to the next generation, the effective size of the population from a genetic perspective will be correspondingly much reduced. Such factors as a biased sex ratio and non-random variability in the number of offspring influence the rate of loss of genetic variation.

The expected loss of heterozygosity for neutral alleles is due to random genetic drift when a closed population passes through a bottleneck of small effective size or when a population has been established from a small number of founders. Management programs should also pay attention to the effect of fragmentation of the landscape on the potential of gene flow between populations, especially in the context of metapopulations. When reintroduction programs are considered careful attention should be given to local adaptations to specialized biotopes or environments.

The genetic fragmentation or coherence of a species depends on the balance between natural selection, drift and gene flow. Adaptation to local environments through natural selection, random genetic drift due to finite population size and mutation result in heterogeneity among populations. Gene flow levels out this differentiation (Arnold, 1983; Menken, 1992; Brakefield, 1992).

Herbivory

Herbivores differ from other major groups of plant-feeding animals, the detritivores, in that they have the potential to influence living plants. This category includes grazers, browsers, leaf eating insects (phytophages), root feeders, sap suckers, seed eaters, flower, and fruit eaters.

It would appear that plants are resource limited, by competition for light, water and nutrients. Since plants are apparently not regulated by herbivores, the usual condition for herbivores is not to be food limited. All population numbers are regulated by something so herbivores must be regulated by natural enemies such as predators, parasites, parasitoids, diseases and other biotic conditions.

This regulation need not be reciprocal. It is possible for a herbivore to be food limited and yet the host plant may not be herbivore limited. There are differences in food quality, indigestibility and the levels of nitrogen, toxins and repellants that make most green matter inedible to most herbivores.

Feeding may be weather limiting or temperature limiting. Usually insects feed in warm weather but this is not always true. In the case of many butterflies the larvae feed at low temperatures, usually at night, but may also feed during the day if the temperature is cold enough. Herbivores will feed at the maximum rate determined by their size, sex and physiological condition.

An integral part of the predator-prey theory and optimal foraging theory is that predators will aggregate in regions of high prey density. For herbivores this process operates through habitat selection. Within a habitat the relationship between plant density and herbivore numbers is determined by the requirements of the herbivore (Crawley, 1983). For example C. *aureus* feeds on small dense bushes of its food plant, *Clutia pulchella,* growing in early successional, moisture limited, high drainage, rocky, south facing slopes. Large patches of food plants elsewhere on the mountain range that apparently have the correct host ant in residence are not utilised. These plants are generally much taller with less dense foliage indicating a distinct difference in the growing conditions. Research indicates that the early successional, stunted, food plants may have a different chemical composition due to their unfavourable position on the mountain. The normal effort to produce repellants elsewhere could have been used to enable the plant to survive in the unfavourable conditions. The shorter plants with denser foliage may also reduce the distance from the resting site of the larvae under the rocks to the food source, and the denser foliage may also protect the larvae and ants from predators. The density of the food plants was 30 plants per 10 square meters, this appears to be constant over the sites investigated. The host ants feed on the aphids and scale insects on the food plant as well as on many of the other herbaceous plants in the vicinity. The density of the plants may also favour the ant colonies that nest under very large rocks and emerge continuously along their pheromone trails to food sources (Henning & Roos, 1998,1999,2000,2001).

In general herbivore feeding is patchy even in uniform plant populations, this could be brought about by wind disturbance, or other herbivore attacks. Insect egg laying preferences also detem1ine the spatial feeding patterns in a habitat.

Many herbivorous animals eat a limited number of plant species (oligophages). Others, mainly invertebrates, are restricted to one food plant species (monophages) while some species eat a wide variety of plants (polyphages). In insect species with a complete metamorphosis the adult breeding stage which utilizes a variety of nectar sources for energy, but not to grow, should not be a factor in determining whether the species is a monophage or not. Absolute monophages are those species that feed on only one species of plant over their entire geographical range. Functional monophages concentrate on one species in a particular habitat· but may take different food plants in different places.

All herbivores show some degree of selectivity in their food source, either choosing between plant species or between different parts of the plant.

Specialist feeders are species that feed from a small number of plants, often only from one genus, or from one family e.g. Cruciferae. Generalist feeders are broadly oligophagous.

It is often difficult to compare the degree of polyphagy exhibited by different herbivore species because this is often affected by the biotope inhabited.

Polyphagy

The advantages of polyphagy are more obvious than that of monophagy. The most obvious advantage is that food for a polyphage is easy to find, most plants encountered are edible therefore the costs of the search for food is low. Similarly an individual is unlikely to starve because of the fluctuations in abundance of one particular plant species. The polyphagous herbivore can feed for longer in a season by obtaining high quality food at any time. While many plants are mildly toxic the polyphage can ingest small amounts of a variety of toxins without ill effects by varying its diet. Polyphagous vertebrates tend to be larger than monophages. This does not appear to be the case in invertebrates (Crawley, 1983). Most South African butterflies would classify as polyphages.

Monophagy

As long as plant food remains abundant, accessible and predictable, selection will favour finer and finer specialisation towards monophagy. The main advantage of monophagy is that by the development of specialised feeding anatomy or behaviour, the herbivore can exploit resources not available to other animals, and in so doing free themselves from competition.

Monophagy is also advantageous when food plants occur in high densities. The cost of food search is negligible. The initial cost for the herbivore to adapt its system to detoxify its specific food plant would be negligible in the long run. Monophagous herbivores that have overcome the plant's specific chemical defenses can use its specific chemicals to aid host plant selection by reducing the cost of search. It can also sequester these chemicals for use as pheromones thus reducing the cost of low herbivore density. It can sequester them for use as defenses against predators reducing the cost of being predictably associated with one plant species. An example would be *Erikssonia acraeina* feeding on *Gnidia kraussiana* (Gifbossie). Most threatened butterfly species in South Africa would be classified as monophages.

Habitat and host plant selection

The spatial distribution of herbivores over a mosaic of habitat patches reflects the outcome of several opposing forces. Under optimal conditions the herbivores would congregate at the area where their rate of energy intake would be maximised. At some stage spatial saturation would occur and the next best locality would be sought, and so on. Thus as herbivore population density increases, the habitat patches should be occupied in a sequence that reflects the ranking of their value as feeding sites. As the population decreases the reverse sequence should occur. Selected patches, or plants in the case of Lepidoptera, are often determined not only by food value but· by- location. Often isolated plants are selected as they may not be utilised fully by predators due to the risk attached to the predator moving across to isolated plants. This appears to be the case in forest species such as members of the Nymphalid genus *Charaxes* that often seek out smaller isolated plants on which to lay their eggs.

In Acraeinae species, such as *Acraea horta* and others the females select a tree and lay gregariously. This has a two-fold effect because the larvae are unpalatable to most predators the entire tree is left alone due to the accumulated effect of the deterring chemicals. The larvae can feed through as quickly as possible without disturbance and secondly it forms an effective population control mechanism so that when the tree is defoliated the larvae must emigrate or go into diapause and many of the weaker and slower larvae will die. Post defoliation dispersal of larvae is widespread amongst

Lepidoptera. In South Africa the Acraeid butterfly *Acraea horta* may defoliate its food plant *Kiggelaria africana* several times in a season (Henning, 1993).

Migration is the most immediate and most influential response to declining food availability. The great migrations of Pierids which occur annually in southern Africa, with huge swarms travelling from the south west (Northern Cape) in a north easterly direction at varying densities, are a result of the decline of food resources (Henning, Henning, Joannou & Woodhall, 1997).

Oviposition

The adult insect determines not only which species of plant to select but also the distribution of eggs per plant. Oviposition patterns vary according to necessity. In African butterflies many species lay their eggs singly, spaced out on different plants. A few lay their eggs in small batches, while some lay eggs in large clusters. Some species whose larvae feed on grasses disperse their small eggs while in flight, while others may lay large single eggs. Cluster laying in Lepidoptera can be correlated with unpalatability and aposematic colouring of the larvae, with reduced parasitism and with obligate ant association (Crawley, 1983). Ant associated species of Aphnaeini in South Africa indicate this trend with *Aloeides dentatis* laying two eggs, side by side, and *Poecilmitis aureus* laying three eggs a couple of centimetres apart (Henning, 1983a, 1983b; Henning & Henning, 1989; Henning & Roos, 1999, 2000).

Many butterflies avoid laying eggs on plants where other eggs have already been laid. This tends to produce a regular distribution of eggs per plant. The oviposition pattern is often determined by the spatial pattern of host plant distribution. The fact that some larvae can survive on some plants in captive conditions is no evidence that this plant would be selected under natural conditions, nor of how fecund such insects would be as adults. An example is the American butterfly *Battus philenor* that changes its ovipositional behaviour as the season advances. The foliage of its preferred host plant *Aristolochia reticulata* declines in quality as larval food as it ages, the butterfly lays progressively more of its eggs on *Aristolochia serpentaria*. The reduced quality of older leaves is due to their low nitrogen content and increased toughness rather than to digestibility-reducing plant secondary compounds. For *A. serpentaria*, mature and young leaves are equally acceptable to the butterfly larvae (Crawley, 1983).

Some Lepidoptera, such as the British holly blue butterfly *Celastrina argiolus*, exhibit host-plant alternation in different generations which indicate that the adults show different, seasonally determined, acceptance criteria. The insect is bivoltine, the first brood in June-July lay eggs on holly and the second brood lay on ivy.

Diet supplementation

Herbivore diets are often deficient in a few crucial minerals, vitamins or trace elements. Nitrogen supplementation in butterflies is found in urine puddles, animal scats or decomposing animal carcasses. Many adults take nectar from flowers and some, such as *Heliconius* spp., feed on pollen. There are sub-tropical moths like *Labocraspis griseifusca* which suck matter from the lacrymal secretions from the eyes of ungulates; others suck sweat from animals, including humans; The protein and chemicals from spermatophores are an important 'nuptial gift' for some female butterflies. There are many predatory larvae in the Lepidoptera and cannibalism is a common trait.

Food quality

Food quality can only be determined in terms of herbivore fitness. The fitness of a given herbivore genotype is measured by its rate of increase when feeding on a certain type of food.

Cellulose is a major component of food intake. The bulk of this potential energy is wasted because very few herbivores possess the cellulose enzymes necessary for digestion, so most herbivores have to defecate most of the cellulose they ingest. Species that rely on high cellulose diets foster highly complex gut floras of micro-organisms which aid in cellulose digestion (Crawley, 1983).

In addition to allowing herbivores to extract energy from otherwise indigestible substrates, the gut flora serves two important functions. First, it breaks down and renders harmless, many of the secondary plant substances that would otherwise poison or debilitate the herbivore. Second, by synthesis of amino acids and vitamins, the gut flora may rectify dietary imbalances that would otherwise impair growth, survival or reproduction. Sucking insects like aphids and scale insects which live on nitrogen-poor diets all possess complex gut floras of yeasts and bacteria-like organisms which are capable of synthesizing vitamins, amino acids and proteins using recycled or even atmospheric nitrogen. Thus the gut flora protects the herbivore from the vagaries of food quality.

The rate at which a herbivore is able to extract nitrogen from its food is a major factor determining its fitness. The nitrogen content of plant tissues varies greatly, even within a species. Butterfly larvae have been recorded to need 3% while ungulates require only 1% (Crawley, 1983). Nitrogen availability is going to limit herbivore growth more often than is a shortage of carbohydrate, and that carbon to nitrogen ratios are likely to form an integral part of the required food quality.

For chewing insects like Lepidoptera [larvae], the presence of protein-complexing agents, non-protein and toxic amino acids, and other non-nutritious forms of nitrogen, will mean that total nitrogen is a poor index of food quality. The proportions of different amino acids in the diet can also be important. There are beneficial amino acids, such as proline, aspartic and glutamic acids, and others that are usually harmful such as alanine, glycine and aminobutyric acids.

The leaf age has a profound effect on its suitability as a food. Certain species will only eat young leaves, other will eat only old leaves. Leaves of the same age from different places on the plant can also differ in their suitability as food.

Drought-induced plant selection

There is a good deal of evidence to suggest that drought-induced water stress in trees is a potentially important factor in causing outbreaks of defoliating insects. It is proposed that the increase in amino acids caused by drought-induced proteolysis represents a dramatic increase in food quality for the insects. Their enhanced rate of development allows them to increase to high densities simply as a response to an increase in the carrying capacity of the host plant, and giving the insect an edge on their normal predators (Crawley, 1983).

Similarly many arid species may only be able to survive on the increased quality of the food resource induced by water stress in drought conditioned plants. Such a phenomenon may be happening with *Chrysoritis aureus* where the food plants utilised of *Clutia pulchella* are small and stunted, many branched, growing in dry, well-drained, conditions. The larger plants growing in wetter conditions lower down on the same mountain side are not used by the butterfly, despite the presence of the host ants. The water stress may well utilize the plant's energy thereby reducing the natural Euphorbiaceae toxins and increasing the nitrogen levels allowing the butterfly larva, and other insects to feed on it.

Research on *Chrysoritis aureus* at the Alice Glockner Nature Reserve near Heidelberg indicates that the habitat of C. *aureus*, which is on the southern steep slope

of the mountain below a high peak (1 730m), is affected by a rain shadow from both the adjacent peak and from the high peaks of Suikerbosrand to the north (1902m). The soil is unique and lacking in silt which retains water (Terblanche 2001, in prep). The slope is steep and rocky which also facilitates drainage. All these factors influence the water stress of the food plant *Clutia pulchella* and influence the early successional nature of the habitat allowing well over twenty species of ant and numerous other insects to take advantage of an apparently highly nutritious environment.

The effects of water stress on plant food quality are not always straightforward, nor beneficial to the insects. It has been found that intermittent water stress was beneficial to reproduction and survival in aphids feeding on Brussels sprouts, but that continuous water stress was detrimental. The dominant beneficial effect of intermittent water stress on diet quality is due to reduced protein synthesis and increased hydrolysis increasing the availability of amino acids. The main detrimental effect of continuous water stress is through lower plant turgor pressure and increased sap viscosity that combine to reduce the rate of aphid feeding.

A species that has evolved on plants with drought-induced properties would be selected against under normal rainfall conditions.

The principal effect of habitat on average food quality is through soil nutrient. Thus in communities where the soil is nitrogen-poor one would expect to find plants with low foliar nitrogen concentrations and herbivores adapted to low nitrogen diets. The herbivores might show very slow development like the 17-year periodic cicadas that feed on nitrogen poor xylem fluids. Some plants in nitrogen-poor habitats maintain nitrogen-rich foliage by hosting symbiotic nitrogen fixing bacteria. Typically plants from poor soils have low tissue moisture content, are highly lignified and contain high concentrations of (mostly non-nitrogen based) secondary chemicals levels (Crawley, 1983).

PROTECTED AREAS

In order to promote environmentally sound and sustainable development in areas adjacent to or within protected areas and to establish and efficiently manage a representative and effective system of protected areas one needs to address the concept of what is a protected area. The following has been extracted from the IUCN.

A definition of protected areas has been promoted by the IUCN (IUCN 1994a) and simplified into six categories (IUCN 1994a):

1. Strict protection
   Strict Nature Reserve
   Wilderness Area

2. Ecosystem conservation and recreation (National Park)
3. Conservation of natural features (Natural Monument)
4. Conservation through active management (Habitat Species Management Area)
5. Landscape/seascape conservation and recreation (Protected Area)
6. Sustainable use of natural ecosystems (Managed Resource Protected Area)

Protected areas are a key part of *in situ* conservation under the Convention on Biological Diversity, but no protected area is likely to be sustainable if established or managed in isolation. There are biological, social and economic connections between different places and different system components. The processes of interaction are highly dynamic. Individual protected areas are seen as part of a network, with the total being more than the sum of the component parts. Systems thinking is a necessary part of striking appropriate balances between conservation and development and between the management emphases of different protected area units. It is also part of complementary and integrated planning between types of protected areas.

A systems approach helps consideration beyond the immediate term. It also facilitates moving away from looking at areas in isolation. Instead, the focus switches to the relationships between component parts and the broader implications of actions related to individual components.

This applies particularly to the biodiversity of the country (at relevant levels, such as genetic, species and habitat), but should also apply to earth features such as landform types and to cultural landscapes. In most countries it would be very unlikely that any one protected area on its own could be representative of the full range of biographic diversity within the country. There may well be major constraints on achieving comprehensiveness in fact.

In existing protected area systems in some parts of the world there is evidence of long standing focus on relatively large or otherwise attractive wildlife species, without adequate attention either to the habitat requirements of even those species, let alone conservation of a full suite of plant and animal species which might be characteristic of particular ecological zones. There may be too much attention on charismatic wildlife, not enough on habitats and communities.

Many existing protected areas do not sample biodiversity in any systematic way – they have been created in *ad hoc* opportunist fashion.

It may be necessary to combine assessments of reserve coverage which are based on environmental representational objectives (the biogeographic approach) with assessments based on species and habitat conservation objectives (the key species approach). It is also usual that other objectives than environmental representation may lead to certain areas being identified as a necessary part of comprehensive reserve coverage, regardless of that area's contribution to representation or its complementarity with other areas. Examples include refugia areas, rare species habitat, breeding habitat of migratory species, or landform features.

There is a wide range of issues that must be considered in selecting between alternative protected area system designs. The final location, size and boundaries of contributing areas, where there is any flexibility available, will usually be influenced by numerous factors other than representation alone. Examples include:

- habitat/area requirements of rare or other species and their minimum viable population sizes
- connectivity between units (corridors) to permit wildlife migration, or isolation to minimise transfer of disease, predators and the like
- perimeter/area relationships, buffer zones
- natural system linkages and boundaries - e.g. watersheds (surface and groundwater), volcanism, ocean currents, aeolian or other active geomorphic systems
- accessibility to undertake management operations or inaccessibility to deter potentially impacting activity
- existing degradation or external threats
- traditional use, occupancy and sustainability
- cost of achieving protected area status (most commonly land acquisition, compensation or transfer costs, or costs of establishing co-management mechanisms)

As well as the protected areas themselves, it is essential that a system plan address cooperative conservation management in buffer areas and linking corridors. Similarly, it should explore trans-boundary collaboration between countries and provinces. In short, a system plan should explore all relevant ways in which protected area management and other forms of biodiversity conservation can support each other and support other community objectives (IUCN, 1997).

The only butterfly project undertaken in South Africa which incorporates an extensive study of habitat and recommendations on Buffer Zones and Corridors is the Heidelberg Copper Project on the Alice Glockner Nature Reserve for the Gauteng Department of Nature Conservation (Henning & Roos 1999, 2000, 2001).

REFERENCES

ARNOLD, R.A. 1983. Ecological Studies of Six Endangered Butterflies (Lepidoptera, Lycaenidae): Island Biogeography, Patch Dynamics, and the Design of Habitat Preserves. *University of California Publications, Entomology,* Volume 99. University of California Press, Berkeley.

BINK, F.A. 1992. The butterflies of the future, their strategy, in *Future of Butterflies in Europe: Strategies for Survival.* Pavlicek-van Beek, T.; Ovaa, A.H. & van der Made, J.G. editors: 134. Agricultural University Wageningen.

BRAKEFIELD, P.M. 1992.Population dynamics and genetic variation: consequences for the survival of butterflies in a fragmented landscape, in *Future of Butterflies in Europe: Strategies for Survival.* Pavlicek-van Beek, T.; Ovaa, A.H. & van der Made, J.G. editors: 192. Agricultural University Wageningen.

CRAWLEY, M.J. 1983, *Herbivory. The Dynamics of Animal-Plant Interactions.* Blackwell Scientific Publications.

HENNING, G.A. 1993. Survival strategies in the Acraeinae (Lepidoptera: Nymphalinae). Metamorphosis **4**(3): 100-106.

HENNING, S.F. 1983a. Biological groups within the Lycaenidae (Lepidoptera). *Journal of the Entomological Society of Southern Africa* **46**: 65-85.

HENNING, S.F. 1983b. Chemical communication between lycaenid larvae (Lepidoptera: Lycaenidae) and ants (Hymenoptera: Formicidae). *Journal of the Entomological Society of Southern Africa* **46**: 341-366.

HENNING, S.F. & HENNING, G.A. 1989. Southern African Red Data Book - Butterflies. *South African National Scientific Programmes* Report No. 158, Council for Scientific and Industrial Research, Pretoria.

HENNING, G.A. & HENNING, S.F. 1992. Conservation of Lepidoptera in Southern Africa. In: *A practical guide to butterflies and moths in Southern Africa*, edited by S.E. Woodhall *et al.* Lepidopterists' Society of Southern Africa, Florida. pp. 29-42.

HENNING, S.F. & HENNING G.A. 1996. Butterfly conservation in South Africa. *Endangered Wildlife* 24: 10-13.

HENNING, G.A., HENNING, S.F., JOANNOU, J. & WOODHALL, S.E. 1997. *Living Butterflies of Southern Africa* Vol. 1. Hesperiidae, Pieridae, Papilionidae of South Africa. Umdaus Press, Hatfield, South Africa.

HENNING, G.A. & ROOS, P.S. 1998. The conservation status of the Heidelberg Copper butterfly (*Poecilmitis aureus*) in the Heidelberg district. *Metamorphosis* **9**(3): 131.

HENNING, G.A. & ROOS, P.S. 1999. The conservation status of the Heidelberg Copper butterfly (*Poecilmitis aureus*) in the Heidelberg district. *Report to Gauteng Nature conservation.* Tender No HK 04/98, 1999.

HENNING, G.A. & ROOS, P.S. 2000. The conservation and biology of the Heidelberg Copper butterfly *(Chrysoritis aureus). Report to Gauteng Nature conservation.* Tender No HK 04/98, 2000.

HENNING, G.A. & ROOS, P.S. 2001. Research on the Heidelberg Copper Butterfly *(Chrysoritis aureus). Report to Gauteng Nature conservation.* Order no. 546416. 2001.

MENKEN, S.B.J. 1992. Population structure dynamics and conservation of sexual and parthenogenetic butterfly and moth species, in *Future of Butterflies in Europe: Strategies for Survival*. Pavlicek-van Beek, T.; Ovaa, A.H. & van der Made, J.G. editors: 222. Agricultural University Wageningen

PAVLICEK-VAN BEEK 1992. *Future of Butterflies in Europe: Strategies for Survival.* Pavlicek-van Beek, T.; Ovaa, A.H. & van der Made, J.G. editors: 1-326. Agricultural University Wageningen.

PYLE, R.M., BENTZIEN, M.M. & OPLER, P.A. 1981. Insect Conservation. *Ann. Rev. Entomol.* 26: 233-258.

BOOK REVIEW

Dr A.J.M. Claassens: *Butterflies of the Cape Peninsula:* A comprehensive guide. Tafelberg Publishers - Cape Town.

They say patience is a virtue and how true this is, as amply illustrated by this delightful little book. It has taken great perseverance on the part of the author who not only spent a number of years putting it all together but had to weather many a delay and disappointment in finding for example the right publisher. It all however paid off as the book is of a high standard in both its contents and its publication, being well printed and produced on high quality paper.

As remarked recently by Hillary Mauve the book "has had a 21 year pupation. It follows the erudite *Butterflies of the Table Mountain Range* (Claassens & Dickson) which appeared in 1980 and soon went out of print." The new book however includes the whole of the Cape Peninsula, which is defined as the area south of a line drawn from the Milnerton lighthouse on the west coast to Strandfontein on the east coast and encompassing the Cape Peninsula National Park.

It has amply achieved what the author set out to do. To bring to the layman a pocket sized field guide to the butterfly fauna of the South Western Cape. Written with obviously a great deal of scientific knowledge it has spelt out in day to day language details of the wonders of the world of a lepidopterist. It is beautifully illustrated with a high standard of photography and reproduction.

All butterflies are referred to by their common name but included are both the Scientific and Afrikaans names. They have been kept in order of their families with a front section amply describing each family. Also included is a very brief section dealing with the vastly interesting but often neglected subject of ant association. The author is of course well known for his expertise in research on this subject.

It contains 29 plates consisting of 233 full colour photographs covering each of the 70 species described. Both upperside as well as underside. An interesting feature is not only the inclusion of pictures of the larvae and pupae but in some cases the activity of ants involved with the Lycaenid larvae. There also are line drawings interlaced with the text to illustrate some of the author's comments.

The text is concise with a short description of each insect and includes details of the distribution, the flight period and the food plant (referred to by the common name as well as scientific) together with some remarks on the early stages. The text is on the left hand page with the photograph of the insect being described on the opposite page, which makes for easy reference. No tedious paging back and forth.

This well designed and informative paperback is slim and will fit into any backpack or handbag as all good field guides should. It is therefore well suited to the hiker, casual walker or even the home gardener. Particularly to the residents of the Cape and its multitudinous visitors. In fact all who treasure our natural heritage and wish to learn more about it.

The book is reasonably priced at R90.00 per copy and is available at Kirstenbosch Gardens and Exclusive Bookstore.

G Fraser-Grant.

Letters to the Editor

More about *C. aliciae* – Extracts from an article written in the mid-1960s

It seems likely that the article referred to by Nolan Owen-Johnston when writing about this butterfly was written in about 1966 by Handman and not Hancock, in the Society of Malawi Journal (Historical and Scientific).

Therein Handman wrote, "We started up the mountain, beating the trees as we went, and it was not long before I saw one get up near Ephraim, I shouted, I do not know whether he became too excited or what, he made several sweeps with his net and missed each time: *Cooksonia aliciae* went sailing serenely down the mountain side. I never felt so frustrated or more miserable in my life.

Not long afterwards we put up a female and this time there was no mistake, one sweep of the net was sufficient and in no time it was safely stored away in the bag."

This was the only specimen he was to capture on this trip, I do not know if he ever caught any more.

ALAN GARDINER

Report from Western Cape Branch
Overview of activities:

Four meetings were held during the past year. At these meetings the following presentations were delivered.

- Ms Esther van der Westhuizen - Attended and reported on her visit to the 4th International Conference of Butterfly Breeders and Suppliers held in Penang, Malaysia.
- Dr Jonathan Ball presented a paper on Plant-Lepidoptera interactions.
- Dr Mike Picker, UCT - Gave an illustrated talk on the new book he is involved with.
- Dr. Simon van Noordt - Discussed insect research in Gabon and Central African Republic.

Various outreach activities were participated in, such as Department of Education - "Bugs of Africa"; Cheetah Challenge - an exhibition of rare and threatened butterflies;

Various talks at schools of educational value.

Jonathan Ball

EDITORIAL POLICY (SCIENTIFIC ARTICLES)

Manuscripts dealing with any aspect of the study of Afrotropical Lepidoptera will be considered.

Manuscripts not conforming to the instructions below may be returned to the author. All manuscripts of scientific papers will be evaluated by at least one reviewer. Proofs will be returned to the author if necessary and only printers' errors may be corrected. Ten (10) offprints are provided free to the author or senior author on request and only if the manuscript has been submitted on computer diskette in a word processing format that the editors are able to convert. Authors should contact the editor to enquire if the software that they are using can be converted by the editor, as the situation changes constantly. Additional offprint numbers can be ordered, at cost, at the proof stage.

A hard copy of the manuscript, the originals of illustrations, and the computer diskette must be submitted to the editor. The text should be printed on A4 paper, with double lined spacing, and a margin of at least 2 cm on each side. The pages should be numbered consecutively beginning with the title page, and including those carrying references, tables, and legends to figures. All figures, tables and references must be referred to in the text. If a computer diskette is not available, then tables are to be typed on A5 paper, exactly as found in the printed journal. To facilitate proper alignment of tables, or landscape orientation, even if a diskette is used, it would be appreciated if these can be arranged in A5 format (text dimensions having a width 4.5 inches and length 6.5 inches).

Figures must be boldly drawn in black waterproof ink, and arranged in clear and logical plates on stiff white, preferably A4-sized board. All the figures must be numbered in a common sequence in Arabic numerals, irrespective of whether they are line drawings, photographs, diagrams, graphs or maps. Magnifications should be indicated by scale bars on the figures.

Any opinions expressed in *Metamorphosis* are those of the contributors and not of the Editor or the Lepidopterists' Society of Africa.

Additional, expanded author instructions are available on request from the editor.

NOTE: The *International Code of Zoological Nomenclature* (ICZN), Ed. 4. states that infrasubspecific names applied to a taxon are invalid and have no standing in terms of the Code. However, some forms and aberrations – curiosities - are of general interest to our readership. Articles utilising such terms may occasionally be published in *Metamorphosis*; however, this does not imply that *Metamorphosis* or the editor accept or endorse such descriptions. To the contrary, these names remain invalid, and should not be italicised when in print and when applied to a particular "taxon" of infrasubspecific status.

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