BUTTERFLIES OF THE HIMALAYA

By

M.S. MANI

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Preface

This book marks the *finale* to the series beginning with *Introduction to High Altitude Entomology* (1962) and continued through *Ecology and Biogeography of High Altitude Insects* (1968), *Ecology and Phytogeography of High Altitude Plants of the Northwest Himalaya* (1978) and *Ecology of Highlands* (1981), based on the results of the Entomological Expeditions to the Northwest Himalaya (1950-56) and limited explorations in the Alai-Pamirs, Central Tein Shan and Caucasus in 1963, and in the Himalaya in 1971-1975.

The book deals with butterflies from the Himalaya. In the first three chapters attention is drawn to the salient facts of the general ecology of the Himalayan butterflies and their bearing on the biogeographical problems. Six chapters are devoted to accounts of butterflies, mainly of the families Danaidae, Papilionidae, Parnassiidae, Pieridae, Lycaenidae, Satyridae and Nymphalidae, with notes on diagnostic characters, distribution, keys to genera and species. No attempt is made at a taxonomic revision, but the material contained in these chapters provides the necessary basis for the discussion on biogeography, origin and evolution of the Himalayan butterflies in the tenth chapter. The relevant literature is listed at the end. The book is illustrated with several four-colour and black and white photographs, some of which were taken with the permission of the Director, Zoological Survey of India, Calcutta.

This is perhaps the first comprehensive monograph on the Himalayan butterflies and expectedly suffers from the limitations of first attempts. Should this book, with all its shortcomings, however, stimulate further research in a most exciting field of natural history, it would have amply served its purpose.

I take this opportunity of expressing my cordial thanks to Dr. B.K. Tikader, Director, Zoological Survey of India, Calcutta, for numerous courtesies; to Dr. A. Daniel, Joint-Director, Zoological Survey, Madras, for facilities of the photographic darkroom and to Mr. Velayudam, my research associate, for invaluable help in the preparation of the plates.

Madras

M.S. MANI

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CHAPTER I

Introduction

1. BUTTERFLIES

Butterflies are, perhaps after the ants, the best known insects. They are well known for their diurnal habits and readily recognised by their bright and showy colours. Butterflies are widely distributed all over the world and occur commonly in gardens, fields, scrublands, deserts and forests, from the seashore to the highest mountains and from the tropics to the circumpolar snows.

Butterflies are characterised by large wings, often provided with tails, with a characteristic venation and clothed by overlapping scales, forming patterns of markings and spots. The mouth parts are modified into a coiled proboscis and the antennae are generally knobbed at the tip. Their larvae generally feed on leaves of diverse plants, but some are also predaceous on mealybugs. The adults visit flowers for nectar and are indeed among the dominant cross pollinators. Not all butterflies visit flowers. Many species congregate on moist ground, near streams (Plate II); this is particularly true of males. Other species are attracted in large numbers by rotting or even over-ripe fruit, animal dung and bird-droppings. While most species are doubtless lovers of bright sunshine and occur on open ground and among bushes and tree tops, some typically prefer shady and sheltered localities. Mass assemblages of butterflies may be found on a sheltered bush or some conspicuous hill top, often exposed to the bright sun (Plate II). Hundreds and sometimes thousands of individuals congregate in this fashion. Vast hordes of migratory butterflies, such as *Argynnis* and *Colias*, are often found annihilated on snowfields on high massifs in the Himalaya after sudden snowstorms. Though some work has been done on the migration of butterflies in South India [90], we have no precise observations on these swarms in the Himalaya. There are often unaccounted aperiodic fluctuations in the abundance of Himalayan species in certain areas; a species which is conspicuously abundant in a locality disappears totally for several successive years and may only reappear, without any previous indica-

tion, sparsely in widely scattered localities, some five or six years later. A great deal of fantastic nonsense has been written about the non-existent butterfly mimicry. Except for some rare examples, we know nothing of the general habits, larval food plants, life-histories, number of broods, or the precise geographical distribution of the vast majority of species from the Himalaya.

2. CLASSIFICATION

Butterflies are placed in the suborder Rhopalocera of Lepidoptera. They are characterised by the venation being different in the fore and hind wings; antennae knobbed at the tip or thickened before the tip, but lacking pectination; ocelli absent; hind wing lacking frenulum but with the vein *Sc* generally strongly arched. The wing venation is usually obscured by the cover of scales. There are numerous longitudinal veins and a few cross-veins, forming a characteristic closed area or *cell* in the middle of the wing membrane (discoidal or basal cell), with a number of veins radiating from its apex. The veins are generally named after the Comstock-Needham System, but some authors follow the numerical notation. The typical wing venation of a butterfly is shown in figure 1 and the relation between the Comstock-Needham and the numerial systems is summarised as follows:

Comstock-Needham System		*Numerical Notation*	
Fore wing	Hind wing	Fore wing	Hind wing
Sc	Sc-R_1	12	8
R_1	Sc-R_1	11	8
—	R_3	—	7
R_2	—	10	—
R_3	—	9	—
R_4	—	8	—
R_5	—	7	—
M_1	M_1	6	6
M_2	M_2	5	5
M_3	M_3	4	4
Cu_{1a}	Cu_{1a}	3	3
Cu_{1b}	Cu_{1b}	2	2
1A-2A	1A-2A	1b	1b
3A	3A	1a	1a

The vein M_4 is distally fused with Cu_{1a}; there is a three-pronged fork of veins M_3, Cu_{1a} and Cu_{1b}, the base of which bounds the cell. Usually the stem of the vein R_{4-5} is atrophied, thus forming the large discal cell by the confluence of cells R-M and the first M_2. In the hind wing Rs is three-branched and Cu is two-branched. In the fore wing vein R has five branches

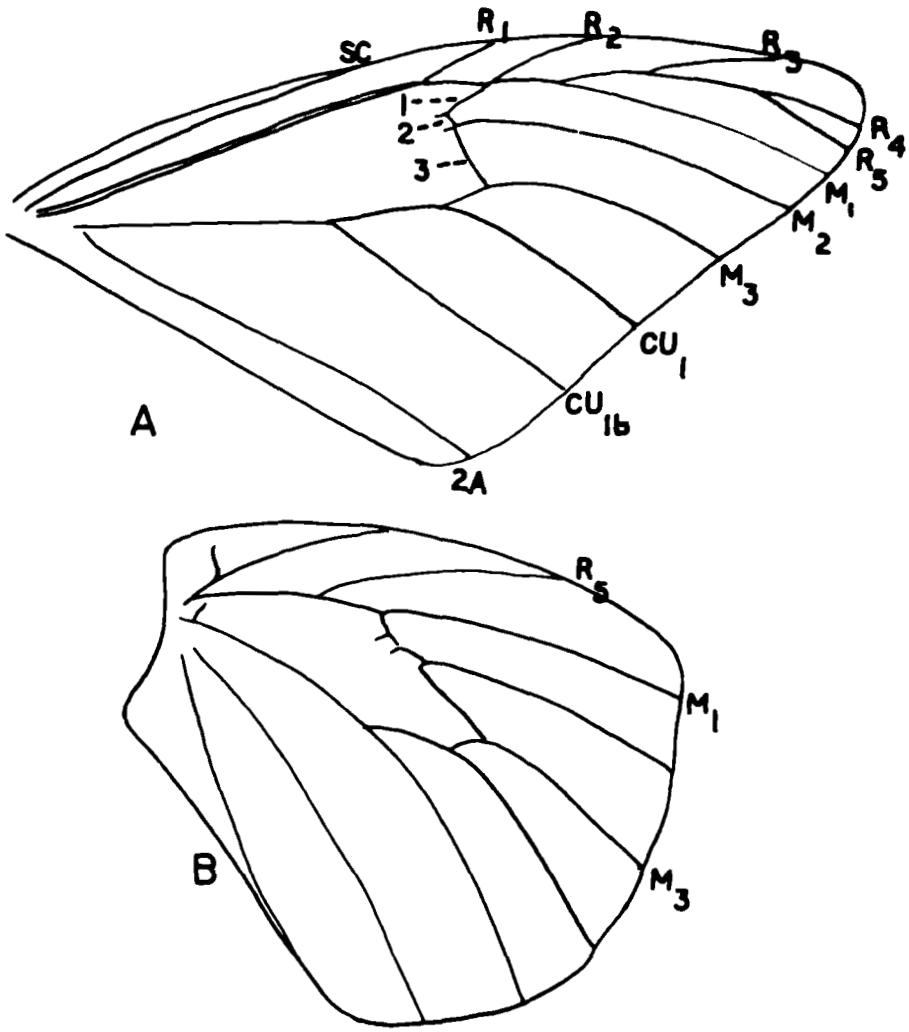

Fig. 1. Typical butterfly wing. Veins labelled according to Comstock-Needham system. (A) Fore wing, (B) Hind wing, (1), (2), (3) anterior, middle and posterior discocellulars.

and all or all but R_{4-5} arise separately from the cell.

The Rhopalocera are broadly divided into two major superfamilies Hesperioidea and Papilionoidea. The Hesperioidea include the skippers of the primitive family Hesperidae of small or medium-sized, stout, short, mostly sombre-coloured butterflies, with the antennae clavate but hooked and recurved apically and inserted widely from each other basally; the fore wing with vein R five-branched and all the branches arising separately from the cell. The larvae are mostly naked, with a large head, five pairs of prolegs and the feed mostly on monocotyledons. The family is chiefly subtropical and tropical and not typically Himalayan. The superfamily Papilionoidea are true butterflies, with the antennal club more or less rounded, never hooked apically; the antennae inserted close together basally on the head. The fore wing with vein R is five-branched, but veins

R_4 and R_5 are stalked together at the origin on the apex of the cell or may be absent; hind tibiae never with middle spur.

Butterflies are divided into some fifteen families, of which about half a dozen are strictly regional, but the others are more or less widely distributed. The families generally recognised at present include Papilionidae, Pieridae, and Lycaenidae with normally developed legs; Libytheidae and Erycinidae with only four legs in the male; Acraeidae, Heliconidae, Nymphalidae, Satyridae, Amathusiidae, Brassolidae, Ithomidae and Danaidae with only four walking legs and Hesperidae with clubbed antennae continuing beyond to a point. Nemeobidae, Brassolidae and Ithomidae are largely and Morphoidae exclusively South American butterflies and Heliconidae occur in Central and South America. Acraeidae, with narrow wings, are largely typical of Africa.

The family Hesperidae is not included in this book. The concept and limits of various families have undergone rather drastic changes in recent years and many new synonyms of genera and species have been proposed. We have followed here the most generally known names and arrangements. A strict taxonomic revision is not aimed at but, the principal emphasis is on the broad ecology and biogeography of the Himalayan forms and their evolutionary trends.

PAPILIONOIDEA

Key to families

1. Fore legs in male greatly shortened; tarsus usually unsegmented, claw generally absent, unfit for walking; if however claw is present, then eyes hairy and emarginate; hind wings with two distinct anal veins 4

   Fore legs normally developed in both sexes; eyes not hairy; bases of veins without bladder-like swellings 2

2. Claws bifid or strongly toothed; fore tibiae without epiphyses; hind wing with two distinct anal veins; inner margin not concave (sometimes may be slightly convex) ..... PIERIDAE

   Claws never bifid or toothed; fore tibiae with an epiphysis below; hind wing with only a single prominent anal vein; inner margin concave 3

3. Fore wings with vein R five-branched; vein M_2 arising midway between M_1 and M_3; supernumerary vein present between vein Cu and anal veins ..... PAPILIONIDAE

Fore wings with vein R four-branched; if sometimes five-branched, then the palpi two times longer than head; vein M_2 arises closer to M_1 than to M_3; antennae scaled; anal vein single ..... PARNASSIIDAE

4. Fore leg in female degenerate, without claw; in male usually with terminal hair tuft 7

Fore leg in female normally developed, with claw 5

5. Eyes hairy, emarginate; palpus very short, with the third segment hairy 6

Eyes glabrous; palpus long, produced in front like a spout; hind wing with precostal spur ..... LIBYTHEIDAE

6. Fore tarsus in male fitted for walking, though short and reduced to a single segment and one or both claws absent; hind wing mostly without precostal spur, but with tail; generally blue-coloured butterflies ..... LYCAENIDAE

Fore tarsus in male degenerate, reduced to a single segment, without claw and not fitted for walking; hind wing without precostal spur, usually also without tail ..... (RIODINIDAE) NEMEOBIDAE

7. Fore wing with the anal veins and veins Cu_{1a} and Cu_{1b} greatly dilated basally ..... SATYRIDAE

Fore wing without basal swellings of veins 8

8. Large tropical butterflies, with ocellate markings underside on hind wings 9

Butterflies of variable size, without ocellate markings underside on hind wings 10

9. Hind wing with the cell closed; eyes sometimes hairy; fore tarsus unsegmented and with long hairs in males; in females with five segments and spines, but not hairs ..... AMATHUSIIDAE

Hind wing with cell open; fore tarsus in male sparsely and shortly hairy, in female weakly clavate; eyes not hairy ..... MORPHOIDAE

10. Fore wing cell closed, with anal veins bifurcate basally; vein R_4 usually ending in costal margin or wing tip; fore tarsus in female heavily clavate ..... DANAIDAE

Fore wing cell rarely open; hind wing cell open or closed; anal vein 2A single; fore tarsus in female with only a small knob ..... NYMPHALIDAE

3. PREVIOUS WORK ON HIMALAYAN BUTTERFLIES

Though butterflies may be said to have been better studied than most other insect groups from the Himalaya, our knowledge is extremely fragmentary. It is unfortunate that no systematic butterfly survey has ever been undertaken in the Himalaya.

The earliest collections of butterflies were perhaps made by Hardwick and Carl von Hügel during 1846-1848. Hardwick's collections were described by Doubleday and Gray in 1846 and Hügel's material by Kollar and Redtenbacker in 1848 [57]. Major Ramsay, British Resident in Nepal, collected butterflies in Central Himalaya and his material was studied by Moore during 1852-1867. During 1878-1891 Stoliczka brought back valuable collections [1, 2, 3-10, 15-18, 84]. In 1881, Elwes [24, 25] described some interesting butterflies from East Himalaya and in 1906 the species collected by the Tibet-India Border Commission [25]. Some species were also collected from East Himalaya by Faucett [31] and from West Himalaya by Wynter-Blyth [92]. The butterflies collected by the Mount Everest Expeditions were described by Riley [73, 74] and others. Gough [40] contributed considerably to our knowledge of the Nepal butterflies during 1935. Bailey [10], British Resident in Nepal during 1935-1938, listed over three hundred and sixty-five species of butterflies from Central Himalaya. The School of Entomology, Entomological Expeditions to Northwest Himalaya of 1953-1956, led by me, collected, among numerous other insects, many interesting butterflies [64, 65]. The Kyoto University (Japan) Expedition to the Nepal Himalaya has made valuable additions to our knowledge of the Himalayan insects [56]. Epstein [26] of the International Nepal Himalaya Expedition for Lepidoptera Palaearctica devoted special attention to the Palaearctic forms from Central Himalaya.

Nearly six hundred species may be said to have been reported so far from the entire Himalayan region. Some of these species may eventually prove to be synonyms or even erroneous records. It is also true that many of the species reported from the Himalaya are not strictly typical mountain forms, but represent stragglers of lowland species common in the plains of north India. It is believed that about four hundred species may be true mountain types occurring in the Himalaya. This no doubt represents only a fraction of the total species actually occurring in the region, but waiting to be discovered by future explorations.

The Himalayan butterflies are largely Danaidae, Papilionidae, Satyridae, Parnassiidae, Pieridae and some Lycaenidae and belong largely to the following genera:

Danaidae: *Danaus* (5)*

*Numbers in parentheses indicate the number of species in each genus.

Papilionidae: *Troides* (2), *Polydorus* (11), *Chilasa* (5), *Papilio* (2), *Graphium* (14), *Teinopalpus* (1) and *Armandia* (1).

Parnassiidae: *Hypermnestra* (1) and *Parnassius* (58).

Satyridae: *Mycalesis* (5), *Lethe* (28), *Pararge* (7), *Rhaphicera* (3), *Orinoma* (1), *Coenonympha* (2), *Maniola* (19), *Hipparchia* (17), *Oeneis* (5), *Aulocera* (14), *Erebia* (23), and *Ypthima* (10).

Pieridae: *Baltia* (3), *Aporia* (12), *Delias* (12), *Pieris* (15), *Pontia* (4), *Euchloë* (6), *Dercas* (2), *Gonepteryx* (5) and *Colias* (18).

Lycaenidae: *Gerydus* (1), *Allotinus* (2), *Pithcops* (1), *Neopithcops* (1), *Spalgis* (1), *Taraka* (1), *Megisba* (1), *Cyaniris* (7), *Lycaena* (16), *Chilades* (1), *Orthoniella* (1), *Taracus* (7), *Niphanda* (1), *Lycaenesthes* (3), *Nacaduba* (6), *Curetis* (1), *Liphyra* (1) and *Poritia* (1).

Nymphalidae: *Charaxes* (5), *Eulepis* (3), *Dilipa* (1), *Herona* (1), *Hestina* (1), *Parhestina* (2), *Euripus* (2), *Sephisa* (2), *Neurosigma* (2), *Dichorragia* (1), *Stibochiana* (1), *Apatura* (5), *Abrota* (2), *Symphaedra* (1), *Dophla* (6), *Euthalia* (9), *Lebadea* (1), *Auzaka* (1), *Pantoporia* (6), *Athyma* (3), *Neptis* (14), *Chersonesia* (1), *Vanessa* (10), *Symbrenthia* (4), *Hypolimnas* (1), *Penthema* (1), *Cethosia* (2), *Cynthia* (1), *Issoria* (1), *Argynnis* (13), *Kallima* (2), *Liminitis* (6), *Cirrochroa* (2), *Pseudergolis* (1) and *Melitaea* (2).

Amathusiidae: *Faunis* (2), *Aemona* (1), *Stichophthalma* (2), *Thaumantis* (1), *Amathuxidia* (1), *Discophora* (2) and *Enispe* (2).

Acraeidae: *Acraea* (2).

Nemeobidae: *Zemeros* (1), *Dodona* (6), *Abisara* (3) and *Stiboges* (1).

It must be recalled that butterfly collecting is by no means particularly easy even in lowlands, but becomes exceptionally difficult in such a vast elevated and mostly inaccessible rugged terrain of the high Himalaya. There is however a most urgent need for a systematic butterfly survey from the east to the western end of the Himalaya, both in the wooded slopes and valleys and at higher elevations. There is promise of not only many new records and new species, but also of unprecedented advance to our knowledge of ecology and biogeography and evolution. We know virtually nothing about the geographical range and the distributional patterns of most of the species recorded so far from the Himalaya. Moreover, vast areas of the Himalaya still remain wholly unexplored by entomologists.

CHAPTER II

The Himalaya*

Any account of the Himalayan butterflies is bound to be incomplete without some reference to the outstanding features of the Himalaya. Furthermore, in view of the prevailing ignorance and general lack of interest in India and the widespread misconception abroad about the Himalaya, the following outline is not out of place.

The Himalaya is the name applied in ancient India to the great snowy range of mountains, visible in fine weather, from the plains of north India. As now understood, the Himalaya embraces the complex system of nearly parallel ranges of Tertiary fold-mountains, stretching some 3000 km from the north of Burma in the east to almost the borders of Afghanistan in the west (almost between 72° and 91° EL and 27° and 36° NL). The width of the Himalayan System varies from hardly 80 km to over 300 km.

Though the Himalaya proper may appear to terminate in the east at the bend of the River Brahmaputra and in the west similarly at the bend of the River Indus just around Mount Nangaparbat, the Himalayan System continues in reality much further westward in the mountains of Afghanistan and beyond and similarly in the east in the meridional mountains of Burma, connecting with the mountainous Sundaland. While the Himalayan System arises nearly abruptly from the plains of north India, it is continued in the north as a great series of folds of the Earth's crust, of which

*Though even as early as 1907, Burrard and Hayden, in their monumental work on the geography and geology of the Himalaya mountains, pointed out the absurdity of *Himalayas* instead of the correct Himalaya, the incorrect spelling is only too common. There is also much confusion in India regarding Central Asia and Middle Asia. Most authors speak of Central Asia, while actually meaning Middle Asia. It is necessary at this place to define precisely the correct limits of Middle Asia and Central Asia. Middle Asia comprises the Soviet Socialist Republics of Turkmenistan, Uzbekistan, Tadjikistan and Kirgiz (the old Turkestan), the southern Kazakstan and the north Afghanistan (to the north of the Hindu Kush Range). Central Asia includes the northern parts of the Kazak SSR, the Mongol Peoples Republic, the western provinces of China (Sinkiang, Tsinghai), Tibet, parts of Kansu and the Inner Mongolia. These clarifications have great relevance to the discussions of distribution and biogeography in the following pages.

the Kuen Lun represents the northernmost. Between Kuen Lun and the Himalaya proper lies the bleak, arid, desolate and wind-blown high plateau of Tibet, at elevations of 4750-4880 m above mean sea level.

The general ecology of the Himalaya is determined, besides historical factors, largely by its enormous massiveness, the great mean elevation higher than the highest mountains of Europe and comparable only to the South American Andes, the almost east-west trendlines of the mountain ranges, the Tertiary orogeny, Pleistocene glaciations and the uplift movements continuing even today. While the general ecology of the Himalayan forests may find some parallel elsewhere in the world, the high altitude ecology of the Himalaya is rather unique in many ways. Students familiar with what is generally known as "alpine ecology" will find much that is totally strange and unintelligible in the high altitude of the Himalaya. We have here in fact an ecology that is more related to that of aerospace than alpine-arctic ecology and is in a sense the threshold ecology of interplanetary space [67, 68].

The major ecological-geographical divisions of the Himalaya are: (1) East or Assam Himalaya, (2) Central or Nepal Himalaya, (3) West or Kumaon-Garhwal Himalaya, and (4) Northwest or Punjab-Kashmir Himalaya. While the rest of the divisions are to an extent artificial, the separation of Northwest Himalaya at the defile of the River Sutlej from the Himalaya to the east must be described as essentially natural. It has a sound basis on orogenic, tectonic, geological, geographical, ecological and biogeographical grounds. The River Sutlej arises to the north of the Great Himalaya in Tibet and cuts through all the mountain ranges before emptying into the River Indus in the Indo-Pakistan plains. The river belongs to the antecedent drainage pattern, established much before the uplift of the Himalaya proper.

The principal parallel mountain ranges from the south to the north include the Siwaliks, immediately from the north Indian plains, the Lesser Himalayan Ranges, the main range (Plate I) or the Great Himalaya, the trans-Himalayan Zaskar, Ladakh and Karakoram ranges. These ranges extend nearly east-west to the east of the Sutlej defile, but westwards there is an abrupt northward shift in the trendline. The Himalaya east of Sutlej is older than that to the west.

The mean elevation of the Himalayan System is much higher in the east than in the west. East Himalaya plays a dominant role in shaping the typical Indian monsoon climate and rainfall over much of India. It is also much closer to the Indian Ocean (Bay of Bengal), comparatively more humid and receives much higher precipitation, both as rain and as snow, than Northwest Himalaya. The timberline is at a mean elevation of about 3600 m above mean sea level in the east, but it sinks to almost 3000 m in Northwest Himalaya. The permanent snowline in the east is at about 4500

m, but it rises to 5200 m in the arid and continental northwest. Though the mean general elevation of the Himalaya falls westward, there is also an increase in general aridity, with increasing continentality in Northwest Himalaya. The eastern end of the Himalaya is much more densely forested than its western end. There is, therefore, a marked east-west ecological transition at the defile of the River Sutlej. The nearly east-west alignment of the parallel ranges results in great ecological differences between the north and south slopes of the same mountain range. The inner ranges are not only much higher in elevation, but they are also much farther north and thus show marked ecological differences.

Mention must be made of outline of the Himalayan uplift; it is essential to an understanding of the peculiarities of the butterfly life of the Himalaya. The Himalaya is the result of a series of great crustal movements, stretching from the Upper Cretaceous times, continued through the Middle Miocene, end of Pliocene, Pleistocene, Sub-recent and Recent times. According to the ideas of continental drift, the plate movements welded the Gondwana landmass with Asia, in what is today Assam-East Himalaya in India. From here, the Tethys Sea was gradually obliterated westward as the Himalayan uplift continued, by the folding of the Tethyan sediments and gigantic underthrust of the Gondwana Peninsular mass (South India Peninsula) under what is now Tibet. The western end of the Himalaya is thus of more recent origin than its eastern end. These facts largely explain some of the peculiarities of the general ecology of the Himalaya and are essential to an understanding of biogeographical problems, particularly of the Himalayan butterflies. Detailed accounts of the Himalaya may be had in the references cited [64, 65].

CHAPTER III

Ecology

Although our knowledge of most species is extremely fragmentary and we know virtually nothing about the habits and ecology of even the most common butterfly from the Himalaya, it is yet possible to form a general picture of the outstanding features of the ecology of Himalayan butterflies. Particular attention may be drawn perhaps to certain broad aspects like the ecological types and their abundance, annual generations and seasonal dimorphism, altitudinal succession and migration. These facts have considerable relevance in the biogeography of Himalayan butterflies.

1. ECOLOGICAL TYPES

The greatest majority of the species are typically mountain forest-forms and their taxonomic allies occur also on other mountains. Ignoring the few accidental stragglers, some characteristic lowland butterflies like *Danaus limniace, D. hamata septentrionis, D. aglaia melanoides, D. melaneus plataniston* and *D. sita sita* have penetrated deep into the interior ranges, through the river valleys. Besides these, we also find small numbers of ecologically transitional Himalayan species that occur in the submontane plains of north India during winter.

Broadly speaking, the Himalayan butterflies fall into two major ecological groups viz. (1) the forest species, and (2) the hypsobiont species. The forest species are confined to the more or less densely wooded mountain slopes of the outer Himalayan ranges and valleys. The hypsobiont species are true high altitude forms that never occur below the timberline.

The forest species are, as expected, far more abundant than the hypsobiont and are also much better studied. They represent almost 85 per cent of the butterflies species so far recorded from the Himalayan region (Fig. 2). The forest elements may be subdivided into a dominant class of humid-tropical forest type, some dry-tropical forest type, a minor group of temperate-forest type and a fairly considerable steppes type. The humid-tropical (Plate I) forest types constitute about 70 per cent, dry-tropical forest

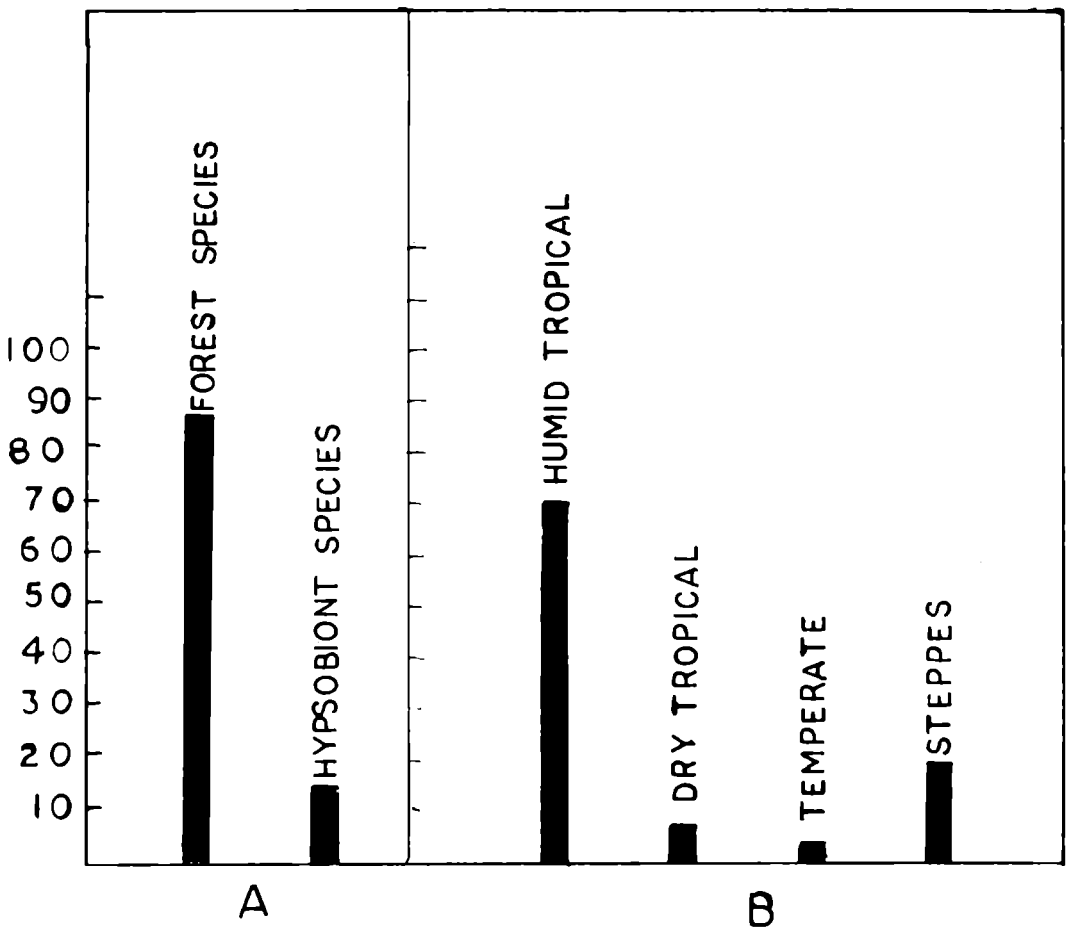

Fig. 2. Histograms showing the mean percentage abundance of the ecological types of butterflies from the Himalaya. There are two major types viz. the forest species and the hypsobiont species. The forest species are confined to the wooded mountains and valleys of the Himalaya, south of the crestline of the main range (the Great Himalaya). They are far more abundant than the hypsobiont species and represent almost 85% of the butterfly species known at present from the Himalaya. The hypsobiont species are true high altitude forms that occur above the timberline, both on the outer and the main Himalayan ranges and represent hardly 15% of the total species known. A. Histograms of the forest and hypsobiont species. B. The sub-types of the forest species, the relative abundance of which is shown by the histograms. The humidtropical forest species are the most dominant forms and are heavily concentrated in East and Central Himalaya. The dry tropical forest and steppes forms are abundant in West and Northwest Himalaya. The temperate forest forms are minor elements in the inner valleys.

types about 7 per cent, temperate-forest types about 3 per cent and the steppes elements 20 per cent of the total forest elements. In close correlation with relatively high dense forest cover, they are particularly more abundant in East and Central Himalaya than in Northwest Himalaya. The steppes types predominate in the west. The Humid-tropical forest types become increasingly sparse westward from Sikkim-Bhutan and eventually disappear almost totally at the Sutlej defile.

The Sutlej Valley is a remarkable region of ecological transition in butterfly life. Here the humid-tropical forest forms gradually give place to the dry-tropical and steppes forms. The semi-arid and often hot Sutlej valley is the home of some very interesting anomalous (*Habitatfremde*) butterflies, particularly of the Indian plains, occurring almost within the fringe of the middle latitudes. To the east of this transition the basis of seasonal dimorphism is often basically different from that to the west. Not only does the abundance of species, but also of the individuals fall off gradually westward. There are actually fewer species and fewer individuals of species in the western end of the Himalayan forests than in the east. The forests of East Himalaya are about five times richer in species than North-west Himalaya. Except for one or two species, the whole of Papilionidae, Danaidae, Satyridae and many Pieridae are typical of humid-tropical forests. All the Parnassiidae and most other Pieridae are essentially either steppes or hypsobiont elements.

2. SEASONAL DIMORPHISM

The adults of forest species readily take to wings during hours of bright sunshine or large numbers may be found congregating on moist ground near streams. At high elevations the flight of butterflies, like most other insects, is essentially a rare event, generally restricted to slopes and valleys sheltered from wind. They flit mostly close to the ground on low vegetation. While in the forest of East Himalaya butterflies appear mostly to breed continuously through the year, so that generations overlap, both in the west and at higher elevations there is usually but a single generation. The adults appear mostly in spring or early summer. The forest species breed from March to end of October but the hypsobiont species breed mostly from June to August and hibernate during autumn and winter.

Seasonal dimorphism is well known among butterflies, but in the Himalaya there are certain interesting peculiarities. Seasonal dimorphism is generally related to the differences in temperatures prevailing during the larval-pupal period. The adults of the spring generation differ often very conspicuously from those of summer generation in colour and markings of the wings. The winter forms generally agree with the local forms in cooler localities. The summer forms resemble those of warmer localities. Local forms of species, which have a wide distribution, in cold regions or at higher elevations on mountains, agree in fundamental colour characters, with those of winter forms; the latter differ from the local warm season or summer forms. The winter forms in warm areas generally resemble those of cold areas. *Polyommatus phlaeus* has, for example, a single generation in Lappland in cold north, but it passes through two generations in Central Europe. The first generation, appearing in cool season agrees with those

of Lappland, but the second generation is darker than the first. In this connection, mention may be made of the valuable observations of a number of workers like Dorfmeister, Weismann and others on *Araschnia* and *Vanessa*. The influence of heat produces in *Papilio machaon* fusion of costal spots in fore wings.

Summarising the available information, it may be remarked that pale colouration arises under warm condition if the developmental velocity is higher than that of formation of pigments. Pale colouration arises by cooling if the developmental velocity is more retarded than that of the pigment formation. Darkening arises under warm conditions if developmental velocity is slower than that of pigment formation. Darkening also results under cool conditions if the developmental velocity is more retarded than that of pigment formation. It is also peculiar that it is often the male butterfly that exhibits these changes more than the female. In the Indian butterflies the seasonal dimorphism is not, however, strictly related to the prevailing temperature differences, but to the dry and wet weather conditions (humidity-rainfall), in other words we have here dry-season and wet or monsoon-season dimorphism. This difference is marked by the appearance of characteristic "eye spots" or the so-called "ocelli" in the wet-season forms and the "dry-leaf" appearance in the dry-season forms. The wet-season form may also be generally darker and larger than the dry-season form. Generally the humid climate and wet-season forms tend to be darker coloured than those of the semi-arid and arid localities and dry-season forms. In the wet forms the wing markings and spots are also larger, darker and often tend to coalesce together, while in the dry-season form the wing spots are smaller and even become obsolecent.

The seasonal dimorphism in East Himalaya is essentially correlated to the differences in humidity-rainfall conditions, but in the semi-arid Northwest Himalaya it is the seasonal temperature differences that largely determine dimorphism. The dry-wet season dimorphism is dominant in East and Central Himalaya, but is not wholly absent in the forests of West Himalaya. In the lower semi-arid and often warm parts of the Sutlej Valley, intermediate forms are common. Some of the species occurring in Northwest Himalaya and also in the east have a curious superficial resemblance to the dry-season forms of East Himalaya. The hypsobiont species are characteristically highly melanistic and have no more than a single generation; melanism becomes increasingly pronounced at extreme high elevations [63].

Eurema hecabe contubernalis (Moore), occurring in Northwest Himalaya and in the north Indian plains, exhibits, for example, sexual dimorphism in the so-called wet-season form. The female shows a wide outer border on fore and hind wings, not readily separated from the wet-season form of *Eurema hecabe fimbriata* (Moore). The dry-season form is quite

distinct. Marked sexual dimorphism is met with in *Colias electo fieldi* (Menetr.), pronouncedly more in Northwest than in East Himalaya. In *Colotis vestalis vestalis* (Butler) the dry-season form is black above and duller than the wet-season form; underneath the costal and apical areas in the fore wing and whole of the hind wing are pale ochraceous to dark reddish-ochraceous. In the dry-season form of *Prioneris thestylis*, the male is smaller than the wet-season form; the fore wing in male above with white basally and black apically in the wet form but in the dry form the black is restricted and the hind wing tinged yellow along white. *Pontia glacuome* has greenish hind wing underneath, with narrow yellow markings, but in the wet-season form the hind wing is basally dusky green.

3. SUCCESSION

Ecological succession in the Himalayan butterflies is of two kinds, viz., east-west transition and an altitudinal succession. Reference has already been made to the dominance of forest species in East Himalaya and that of the steppes forms in the west, with the transition about the Sutlej defile. As may be expected from great elevations of the mountain ranges in the Himalaya, we observe a more or less pronounced altitudinal stratification and a thinning of species. With increase in elevation and also as we penetrate deep into the inner Himalayan ranges, there is a marked succession of species and a gradual species impoverishment. The altitudinal succession and abrupt impoverishment of species at the timberline may be illustrated by reference to the following table:

SPECIES DOMINANT UP TO ELEVATIONS OF 2500 M

Danaus hamata, D. melaneus, Euploea doubledayi, E. midamus, Troides helena, T. aeacus, T. aidoneus, Polydorus dasarada, P. philoxenus, Papilio bootes, P. polyctor, P. machaon and *Delias* spp.

SPECIES DOMINANT AT ELEVATIONS OF 2500-3000 M

Danaus sita, Polydorus varuna, Chilasa agestor, Papilio krishna, P. machaon, Teinopalpus imperialis, Armandia lidderdalei, etc.

SPECIES DOMINANT ABOVE ELEVATIONS OF 3000 M

Papilio machaon, Baltia spp., *Aporia* spp., etc.

It is estimated that almost 60 per cent of the species occur within the forest at elevations below 3000 m, of the remaining hypsobiont forms almost 50 per cent occur immediately above up to elevation of about 4200 m and at extreme elevations above 5500 m we find hardly 5 per cent of the species.

4. MIGRATION

Butterflies are known to migrate in large swarms over wide distances. It is known that certain species migrate from Middle Asia over the high Himalaya and descend into the valleys to the south. Some species from the plains regularly migrate to the hills in India. Though Uhrquart and others have developed technique of marking butterflies in studying their migrations in Mexico and the United States of America, nothing has even been attempted in the Himalaya to elucidate the intriguing problems of butterfly migration. There is, however, undoubted evidence of seasonal migration of butterflies from the plains of north India to the Himalaya. In addition to this seasonal occurrence, we have also observed in recent years a non-periodic movement of butterflies from the north Indian plains to the Himalayan foothills. The large-scale deforestation and the pressure of rapid urbanisation that have enveloped the Terrai areas in recent years, at the foot of the Himalaya, seem to have brought about extensive habitat destruction. This has apparently pushed typical lowland butterflies up into the mountain slopes and Himalayan valleys. The occurrence of some typical Himalayan species during winter in the north Indian plains is not the result of migration; this represents Pleistocene relicts, which are dealt with further in a later chapter.

5. BUTTERFLY-PLANT ASSOCIATIONS

An important part of the ecological specialisation of butterflies, apart from their role in effecting cross-pollination of flowers, is the more or less pronounced specificity of the larval food plants. This specialisation naturally limits the distribution of butterflies; the occurrence of a species is obligatorily bound up with the occurrence of the larval food plant. Thus forest and grassland forms stand distinctly apart. Truly polyphagous species are uncommon, but oligophagy and monophagy mark extreme specialisation. Certain groups are bound up with specific families or even genera of plants; the Lauraceae are food-plants of larvae, for example, of *Chilasa, Graphium cloanthus* and *G. sarpedon, Teinopalpus*, etc. Papilionaceae are larval food of *Colias, Aristolochia* for *Troides, Polydorus*, etc., *Zygophyllum turcomanicum* for *Hypermnestra, Saxifraga* for some species of *Parnassius*, Umbelliferae (Plate II) for *Papilio machaon*, Cruciferae for *Pieris* and diverse grasses for *Erebia, Lethe, Mycalesis, Maniola* etc. *Gonepteryx* breeds on leaves of *Rhamnus* and *Aporia* on *Berberis, Prunus* or various Rubiaceae. *Colias* ssp. at lower elevations breed on Capparidaceae, but at higher elevations mostly on *Indigofera dosua, Thermopsis* (Plate I), *Astragalus, Trifolium* and other Leguminosae. Nymphalids like *Vanessa* breed in Urticaceae. There is, therefore, close correlation with the geographical distribution of plants and butterflies.

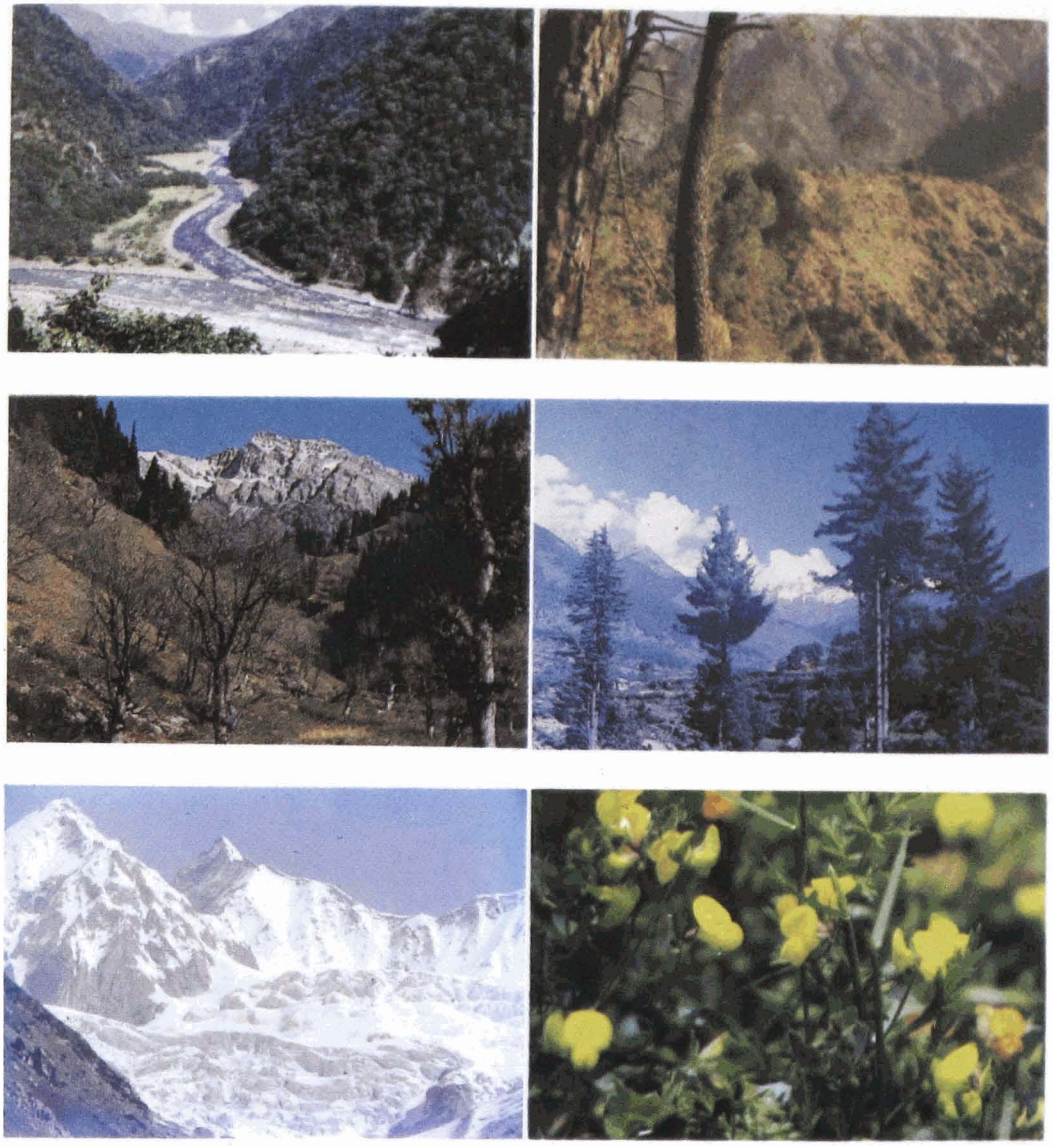

PLATE I. Himalayan butterfly habitats

Top row left: Humid tropical forest
right: Semi-arid tropical forest

Middle row left: Montane steppes
right: Temperate forest in the inner Himalayan valley

Bottom row left: The Main Himalaya: Abode of eternal snow: the home of the high altitude butterflies
right: High altitude meadow, with *Thermopsis* in bloom during summer; the home of *Colias*-butterflies

PLATE II. Himalayan butterfly habitats and some butterflies

Top row left: High altitude meadow of wild Umbelliferae in full bloom; the home of many high altitude butterflies
right: Butterfly assemblage at Hasimara

Middle row left: *Papilio*-butterflies congregated in swarms on sheltered plants in the outer valleys of the Himalaya
right: *Colias electo fieldi*

Bottom row left: *Parnassius chitralensis*
right: *Parnassius tianschanica*

PLATE III. Some high altitude butterflies

Top row left: *Parnassius apollo*
right: *Parnassius hardwickei hardwickei*

Middle row left: *Parnassius hardwickei virescens*
right: *Parnassius stoliczkanus*

Bottom row left: *Parnassius tibetanus*
right: *Parnassius nicevillei*

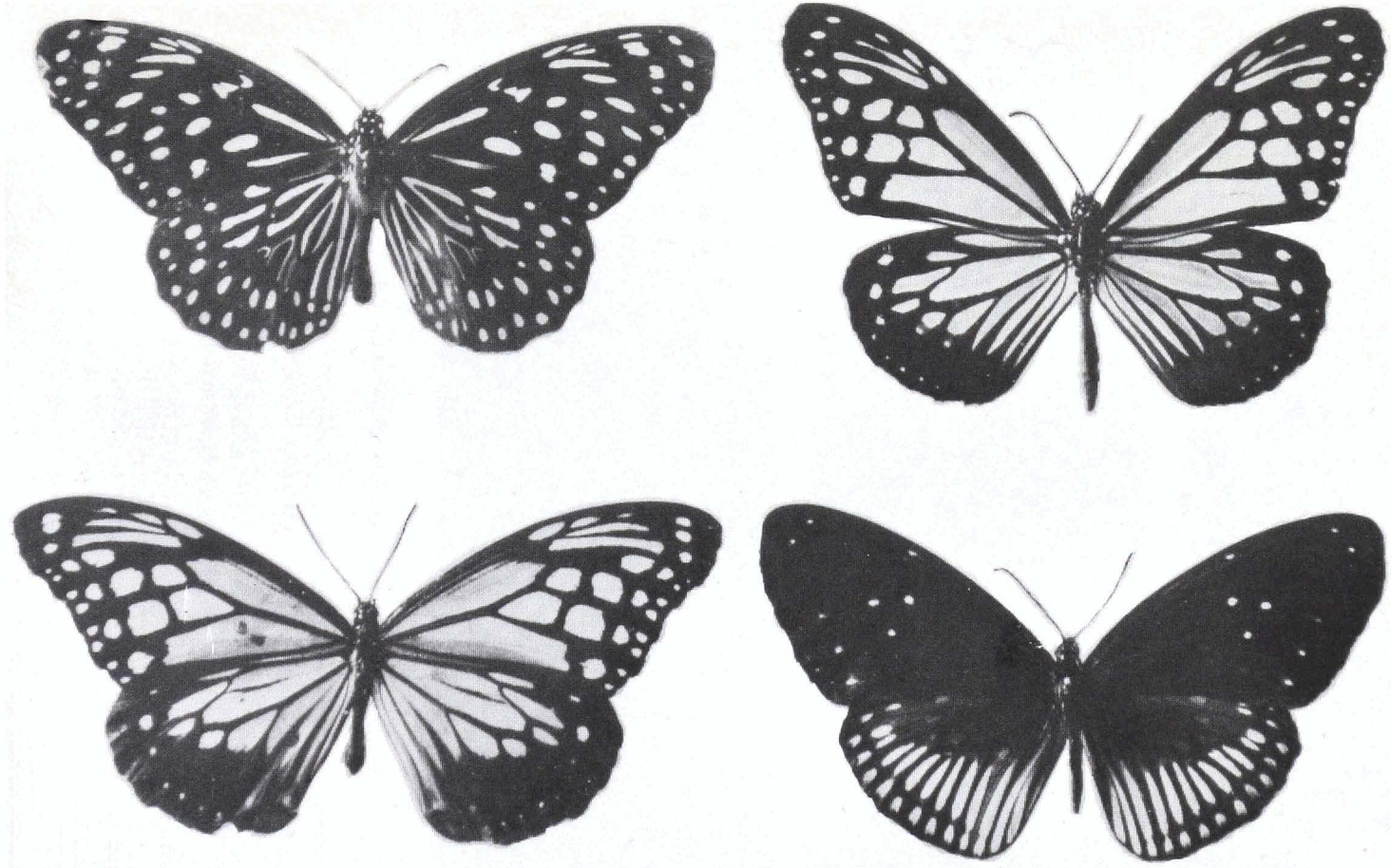

PLATE IV. Top row left: *Danaus melissa septentrionis*
right: *Danaus malaneus platanistan*

Bottom row left: *Danaus sita*
right: *Euploea doubledayi*

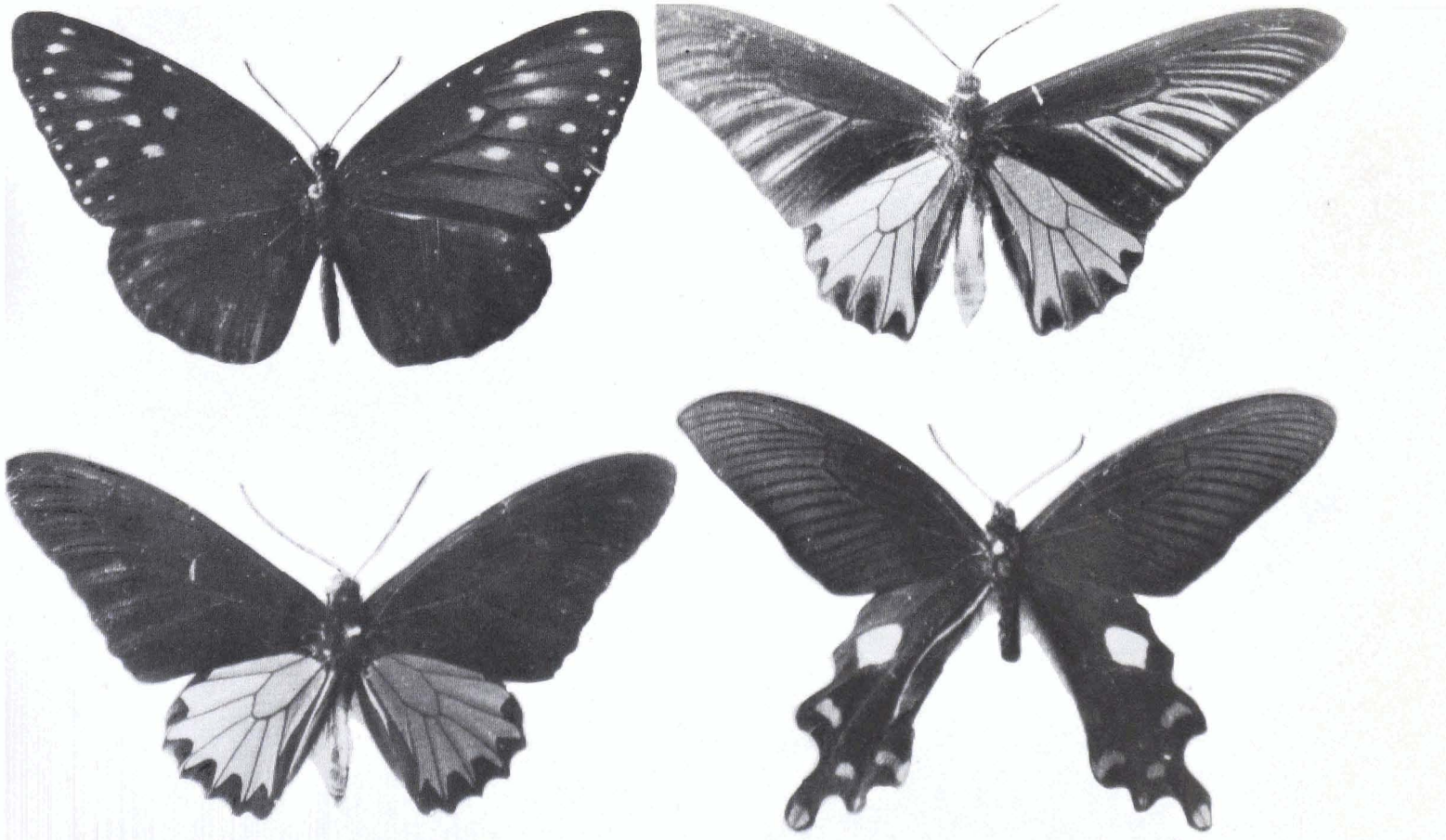

PLATE V. Top row left: *Euploea midamus*
right: *Troides aeacus aeacus*

Bottom row left: *Troides helena cerberus*
right: *Polydorus philoxenus*

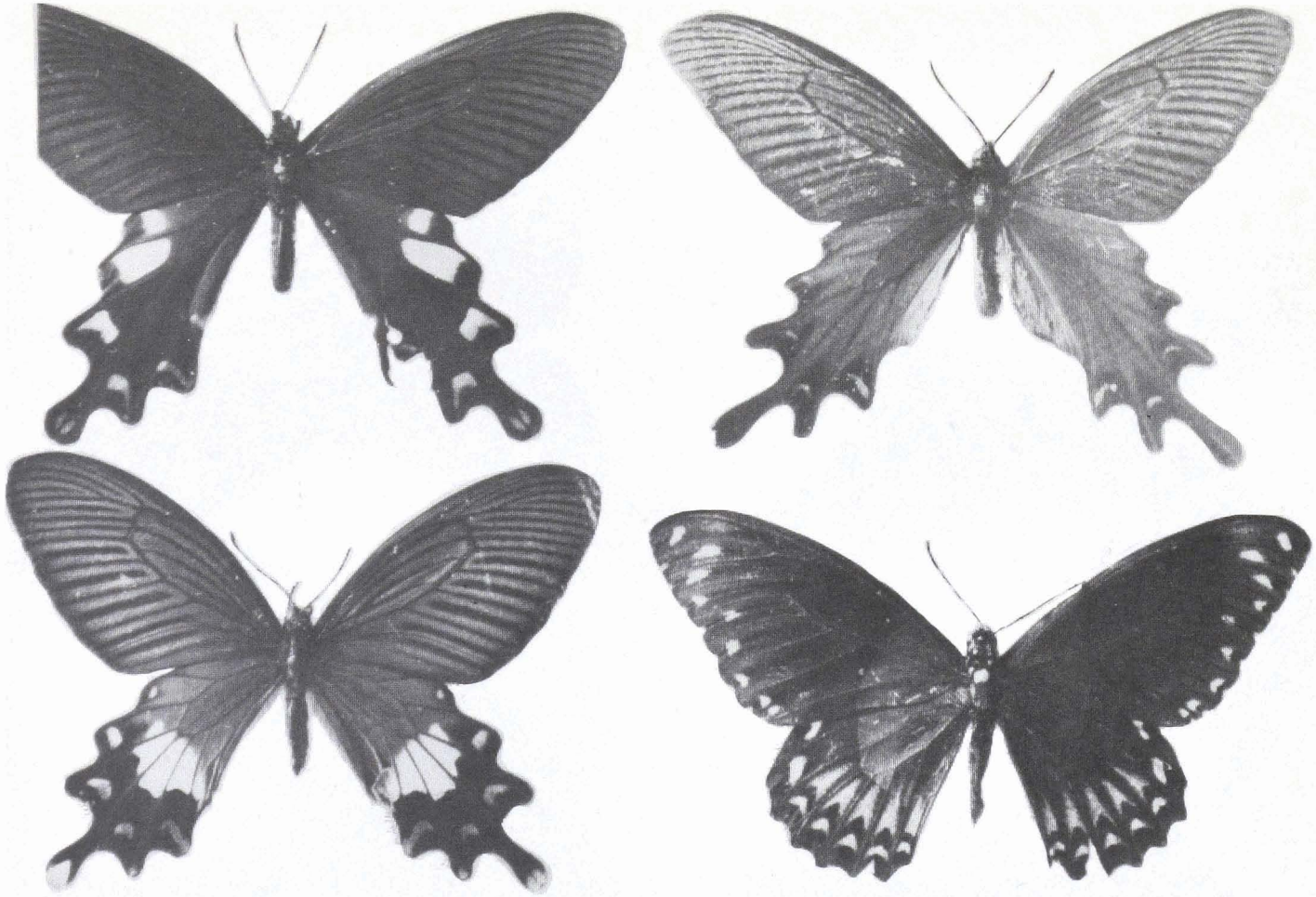

PLATE VI. Top row left: *Polydorus dasarada*
right: *Polydorus plutonius*

Bottom row left: *Polydorus latreillei*
right: *Chilasa clytia*

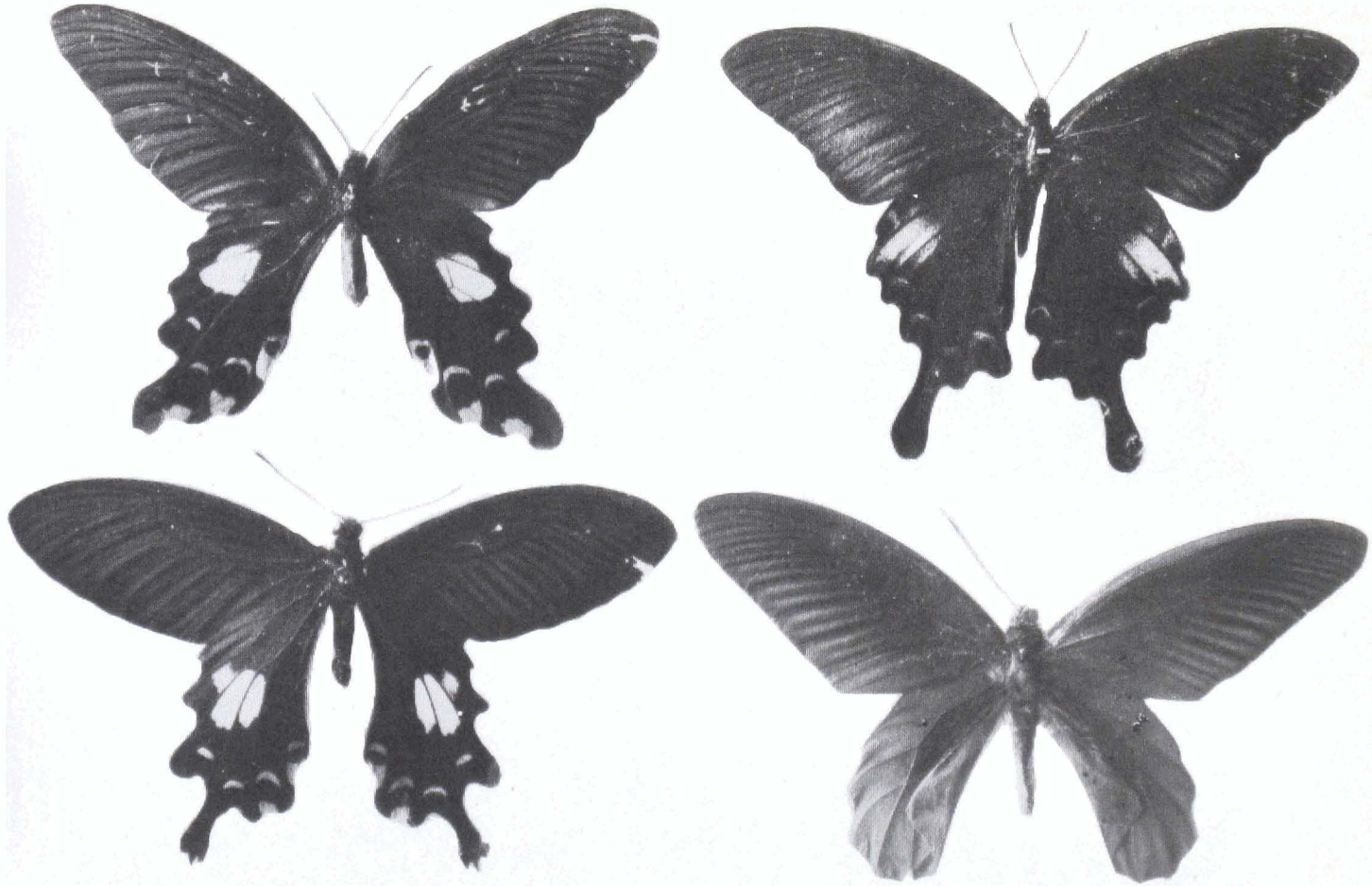

PLATE VII. Top row left: *Papilio rhetenor*
right: *Papilio polyctor*

Bottom row left: *Papilio bootes janaka*
right: *Polydorus varuna*

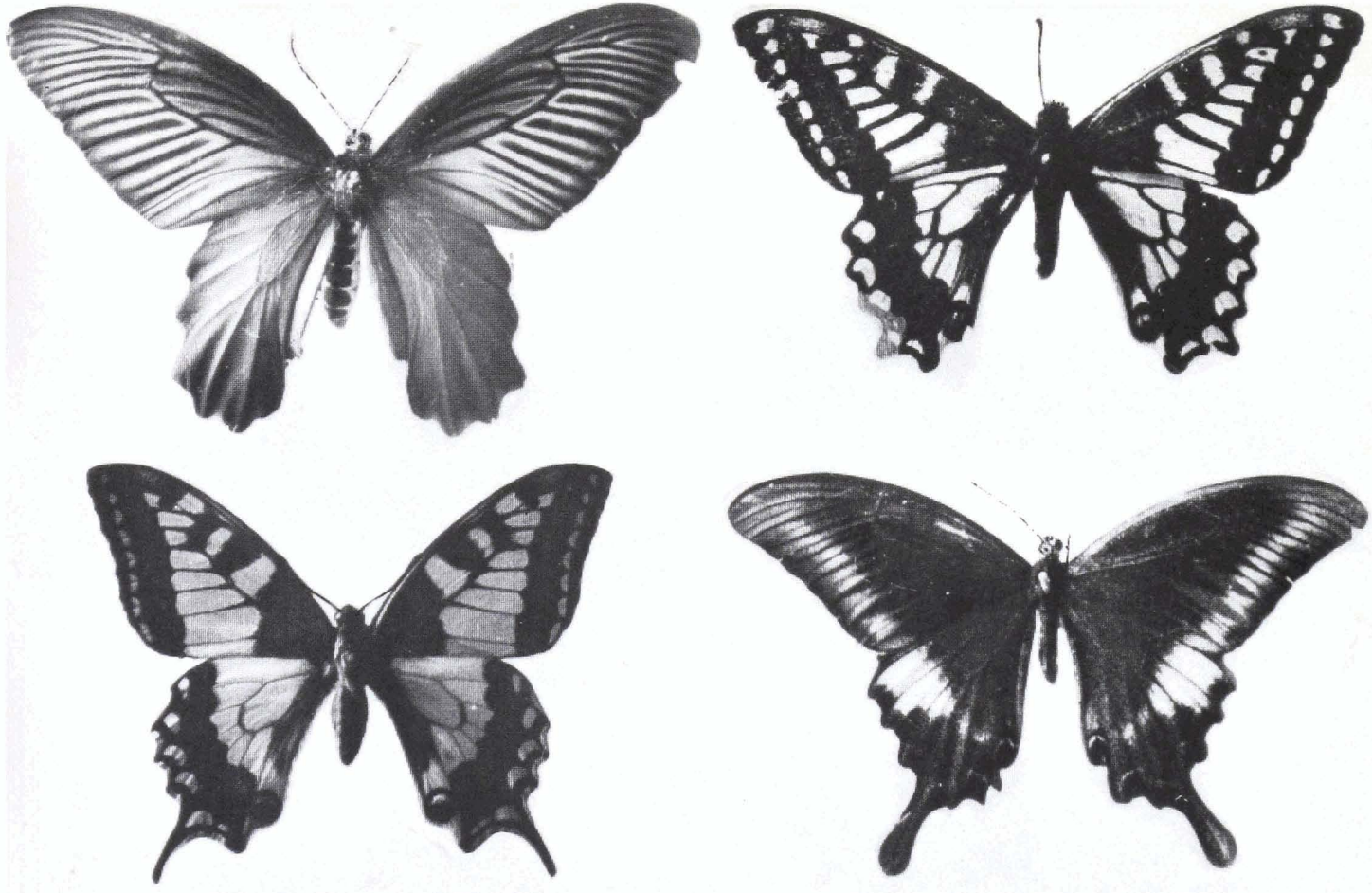

PLATE VIII. Top row left: *Polydorus aidoneus*
right: *Papilio machaon asiatica*

Bottom row left: *Papilio machaon centralis*
right: *Papilio arcturus arcturus*

CHAPTER IV

Danaidae, Papilionidae and Zerynthiidae

Family DANAIDAE

The Danaidae are typically tropical lowland butterflies, which are widely distributed throughout India. Many species extend into the Palaearctic and Nearctic areas, but some like Ithomiinae are strictly South American. The larvae generally breed on milkweeds of the family Asclepiadaceae, often also on Apocynaceae and sometimes on *Ficus* spp. (Moraceae). As these plant families represent only minor elements in the Himalayan flora, the Danaids hardly account for 1 per cent of the butterflies so far recorded from the Himalaya. Species of Danaids may be met with in the Himalaya up to elevations of 2300 m, particularly in the eastern forested mountain slopes and valleys, sparsely in isolated and localised patches.

The Danaids are recognised by short palpi, with the first segment much shorter than the second; tibiae equal to femora; claws absent; in male the fore tarsus is elongate and threadlike, with long setae; in female fore tarsus clavately expanded, with four segments compacted; characteristic scent organs present on wings. Fore wing with vein R_2 arising from the cell or stalked together with veins R_5, R_4 and R_3, rarely before the angle; vein R_1 either free or anastomosing with Sc; hind wing usually pyriform or triangular; cell large, with the discocellulars variable and angles accentuated; posterior discocellular long, outwardly oblique or short and erect; precostal spur arises from point of the separation of vein Sc-R_1; antennae gradually thickened apically, but without an abrupt club.

The family has many characters similar to the Nymphalidae, in which the Danaids were formerly placed. Of the several subfamilies recognised, only the Danaininae occur in India. The subfamily is remarkable for the presence of secondary sexual characters called androconia in the male; in many species the hind wings have usually patches of modified scales along veins in the inner area and others have a small pouch with androconia. The abdomen has often a hair-pencil or a tubular style, bearing a rosette of radiating hairs, particularly well-developed in the genus *Euploea*.

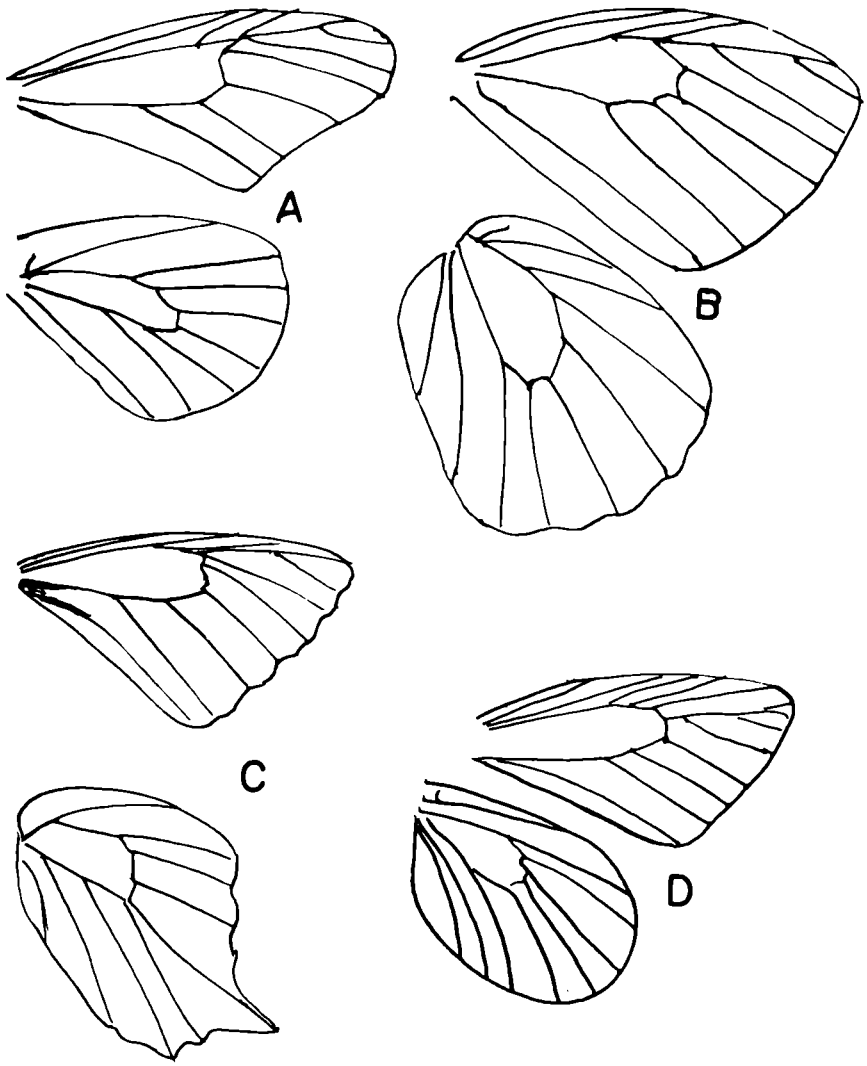

Fig. 3. Wings of butterflies (A) *Danaus melaneus plataniston*, (B) *Appias*, (C) *Lethe sura*, (D) *Baltia*.

Subfamily DANAINAE

Palpi short, first palpal segment shorter than the second; tibia equal to femur; claws absent; tarsus in male filiform, with long hair, in female clavate. Genera represented in the Himalaya are *Danaus* Kluk and *Euploea* Fab.

DANAUS KLUK

Antennae short, with distinct club; palpus short, erect; middle and hind tarsi long; paronychia and pulvilli absent, claws simple; fore wing with

costal area widely curved, outer margin nearly straight before wing tip (Fig. 2 A); inner margin straight; vein R_2 arising from apex of cell or stalked with R_5, R_4 and R_3, vein R_1 free or anastomosed with Sc; anterior discocellular reduced or absent; posterior discocellular outwardly oblique, middle discocellular long.

Danaus hamata septentrionis (Butler)
(Plate IV)

This species resembles another common Indian species *Danaus limniace*, but is readily differentiated by the streaks of pale colour on fore wing beyond the end of cell being much narrower than half of their length and the spots are also smaller. The general ground colour above is also darker. Two cell marks in hind wing joined basally and wide beyond. The species is widely distributed from Taiwan, China through Thailand, Yunnan, Burma, Malaya, Sumatra across the Himalaya into Afghanistan on to the Hindu Kush Range. The size varies from 100 mm wing expanse East Himalaya to about 90 mm in Northwest Himalaya.

Danaus melaneus plataniston (Fruhstorfer)
(Plate IV)

Distributed in Indo-China, Yunnan and Thailand, this species extends across the Burmese mountains into East Himalaya and thence through the entire length of the Himalaya to the Hindu Kush in the west, gradually decreasing in size from 95 mm to almost 85 mm. Fore wing above black, hind wing dark purple-brown, with faint pale blue semi-hyaline markings and the underside of fore wing black, suffused some brown near tip; hind wing below brown.

Danaus sita sita (Kollar)
(Plate IV)

This species generally looks like *D. melaneus plataniston* but has larger patches in fore wings. This is also larger, about 100 mm. Fore wings above mostly black, with pale-blue subhyaline markings; hind wings somewhat reddish, with subhyaline streaks and spots. This species extends from China, Tibet, Thailand, Yunnan, north Burmese mountains and Assam hills to the Himalaya into the Hindu Kush. In the Himalaya it is common at elevations of 1800-2400 m, particularly along the valleys.

EUPLOEA FABRICIUS

This genus is much larger and more widely distributed than *Danaus*, from which it differs sharply in claws having paronychia and pulvilli. Antennae gradually thickened; palpi short; fore tarsi in male biarticulate, in female

with four segments; paronychia and pulvilli present on middle and hind legs. Fore wing (Fig. 15d) with veins Sc and R_1 free, the anterior discocellular short, middle discocellular long; vein R_2 arising from cell; hind wing with cell more than leaf of wing length, precostal spur arising from beyond the origin of vein R_4.

Euploea doubledayi doubledayi C. & R. Felder
(Plate IV)

This species extends from north Burmese mountains to East Himalaya. Male above generally with wings brown, without tinge of blue; fore wings without spots or at the most with two to three white dots near tornus; post-discal series of white paired stripes between veins become longer behind and often joined with submarginal series of white spots.

Euploea midamus rogenhoferi C. & R. Felder
(Plate V)

The nominotype of *E. midamus* comes from Hong Kong but the subspecies *rogenhoferi* occurs on north Burmese mountains, hills of Assam and sparsely in East Himalaya. With a wing span of 95-105 mm, fore wing blue, with cell spot and postcellular series of violet spots, sometimes centred white; hind wing underneath darker basally than apically.

Euploea klugii klugii Horsfield & Moore

This species extends from north Burmese mountains across the Assam hills to east Himalaya and varies very much from locality to locality. With a mean wing expanse of 90 mm, but sometimes also reaching up to 100 mm; fore wing dark brown, suffused blue, cell apex with a spot; post-discal stripes short, submarginal and marginal spot series, the former subtriangular; underside without blue sheen.

Euploea diocletianus ramsayi (Moore)

Fore wing blue-sheened especially apically, basally brown, with large, irregular white spot covering cell apex to costa; post-cellular white spot and longer spot; hind wing with wide white stripes. The species extends from Indo-China (Annam), Malaya, Sumatra, Burma over Assam hills up to Nepal in the Himalaya.

Family PAPILIONIDAE

A moderately large family, well represented in the Himalaya by species of *Papilio, Graphium, Troides, Chilasa,* etc. The family is related to Pieridae and is perhaps a specialised group among Rhopalocera. Fore wing with vein R 5-branched; vein M_2 arises midway between veins M_1 and M_3;

supernumerary vein present between Cu and anal vein; fore tibiae with an epiphysis below; claws large, not bifid or toothed; hind wing with only a single prominent anal vein; inner margin concave; fore leg normally developed in both male and female; eyes not hairy; bases of veins not swollen into bladder-like expansions. Precostal vein directed distally. Four subfamilies are recognised in the Himalaya.

Key to subfamilies

1. Claws dentate; vein R_1 in fore wing mostly anastomosed with Sc ..... GRAPHIINAE
   Claws simple; vein R_1 in fore wing not anastomosed 2
2. Thorax or abdomen red below ..... TROIIDINAE
   Thorax or abdomen not red below 3
3. Palpi short; hind wing with an abdominal fold ..... PAPILIONINAE
   Palpi long; hind wing without abdominal fold .... TEINOPALPINAE

Subfamily TROIIDINAE

Popularly known as aristolochia butterflies, two genera *Troides* Hübner and *Polydorus* Swain. are represented in the Himalaya.

TROIDES HÜBNER

Large and very brilliantly coloured butterflies, widely distributed in the Indo-Australian area, but with only two species in the Himalaya. Mostly black and yellow coloured, head black and collar red.

Troides helena cerberus (C. & R. Felder)
(Plate V)

Ranging from Borneo, through Malaya and Burma, it occurs in the densely forested hills of East Himalaya. With wing span of 150-180 mm, with or also without vein stripes; underneath the cell with a white or yellow stripe; hind wing basally silky-yellow, otherwise black. There appear to be large variations in this species depending on season and locality. There seem to be four generations.

Troides aeacus aeacus (C. & R. Felder)
(Plate V)

Wing span 120-185 mm. Fore wing in female generally blackish-brown, above with broad grey vein stripes reaching into cell; in male semi-hyaline at veins; hind wing with large black subtriangular spots in female and yellow in male; abdomen ringed yellow above. The form extends from western China through Burma to West Himalaya.

POLYDORUS SWAINSON

Wings not very large; vein R_1 in fore wing arising opposite level of Cu_{1a}, thus much shorter than in *Troides*; head red coloured in front. About half a dozen species are typically Himalaya.

Key to species

1. Hind wing without tail or only with short pointed tail 7
   Hind wing spatulate and narrowed basally 2
2. Hind wing above with white discal spot 3
   Hind wing above without white discal spot 6
3. Hind wing above with a submarginal spot between veins M_1 and M_2.....4
   Hind wing above without such a submarginal spot 5
4. Hind wing above with a submarginal spot in front of vein M_2; fringe black from tornus to vein Cu_{1a} ..... *Polydorus latreillei latreillei* (Donovan)
5. Hind wing above with submarginal spot in front of vein M_3 red ..... *Polydorus philoxenus* (Gray)
   Hind wing with submarginal spot in front of vein M_3 largely white ..... *Polydorus dasarada* (Moore)
6. Tail black; hind wing below with submarginal red spots in front of vein M_1 ..... *Polydorus plutonius* (Oberthür)
7. Hind wing with abdominal fold rounded; scent organ behind white; female above brown..... *Polydorus aidoneus* (Doubleday)
   Hind wing with abdominal fold quadrate; scent organ only a small white patch ..... *Polydorus varuna* (White)

Polydorus latreillei latreillei (Donovan)
(Plate VI)

Pale brown above; fore wing elongate; cell more than half of wing; anterior discocellular a little shorter than the middle; hind wing narrow, broadly scalloped; wing span 110-130 mm; fore wing with stripes in cell; intervein stripes black; hind wing with elongate, white spots. This species seems to be restricted to the Himalaya up to the Garhwal area at elevations of about 2000-2700 m.

Polydorus philoxenus (Gray)
(Plate V)

With three submarginal spots, there are three subspecies in the Himalaya. *P. philoxenus philoxenus* (Gray) velvety black, with wing span 110-130 mm; fore wing with pale vein streaks not reaching margin; hind wing with large quadrate white spot in front of vein M_2. Reported from

Central to Northwest Himalaya. *P. p. punchi* (Bang-Hass) somewhat smaller occurring in Northwest Himalaya and *P. p. polyeuctes* (Doubleday) extending from Annam, Yunnan, Thailand, Burma to East Himalaya are other forms.

Polydorus dasarada (Moore)
(Plate VI)

This is larger than *P. polyxenus*, with hind wing tail somewhat wider. *P. dasarada ravana* (Moore), with fore wing velvety-black streaks veins reaching into cell; hind wing with series of submarginal white markings tinged crimson and lunular behind and elongate in front. Common in West and Northwest Himalaya. The nominotype is confined to East Himalaya and Assam hills.

Polydorus plutonius (Oberthür)
(Plate VI)

A west Chinese species, represented in East Himalaya by the subspecies *pembertoni* (Moore); black, with vein streaks from near base to margin; hind wing with submarginal series of pink-white lunules and unspotted tail.

Polydorus aidoneus (Doubleday)
(Plate VIII)

Wing span 112-162 mm; wings above blue-black, female grey-brown; hind wing without tail or with a short tail; vein stripes obscure; female with dark stripes in between veins. This species is widely distributed from China, north Burmese mountains and the Himalaya up to Garhwal-Kumaon.

Polydorus varuna (White)
(Plate VII)

Wing span 86-136 mm; fore wing below with blue-black basally; hind wing blue-black, somewhat metallic tinted; cell above dark, without blue. The species extends from Malaya, Thailand, Burma to the Himalaya, where it is represented by the subspecies *astorion* extending up to Kumaon; female with wing above with a large white to greenish-grey patch behind anal vein.

Subfamily PAPILIONINAE

Antennae and tarsi without scales; margin of hind wing near abdomen curved downward to form a groove beneath. *Chilasa* Moore, and *Papilio* Linn. (= *Princeps*) are represented in the Himalaya by a number of species.

CHILASA MOORE

The butterflies have a superficial resemblance to some Danaiids. Hind wing basally with a white spot and abdomen with a row of white spots or dots.

Key to species

1. Hind wing with the anterior discocellular not 0.50 of vein R_3, which latter arises farther apically than level of Cu_{1b} 2
   Hind wing with the anterior discocellular subequal to vein R_3, which arises nearer basally 4
2. Fore wing black, with blue-grey or white markings 3
   Fore wing dark brown, with a blue spot at end of cell; discal stripe blue ..... *Chilasa slateri* (Hewitson)
3. Hind wing chestnut-brown, with bluish-grey markings .... *Chilasa agestor* (Gray)
   Hind wings black, with white markings *Chilasa epycides* (Hewitson)
4. Hind wing below with a row of yellow marginal spots .... *Chilasa clytia* (Linn.)

Chilasa slateri slateri (Hewitson)

Fore wings above black, with two to three obscure spots in cell apex, inter-vein series of clavate blue stripes; hind wing dark chocolate-brown, with a small white spot below at base; wing expanse 80-100 mm. Reported from north Burmese mountains and East Himalaya.

Chilasa agestor (Gray)

Fore wing greyish-white, veins black, hind wing brown, with white markings, abdomen with transverse pale spots. Extending from central and south China and Taiwan, Malaya, the species has differentiated into a series of subspecies in the Himalaya at elevations up to 2100 m. The nominotype form *C. agestor agestor*, with a wing span of 100-120 mm occurs in Malaya, Burma and East Himalaya. *C. agestor govindra* (Moore) with the hind wing above postdiscal blue-grey spots from West to Northwest Himalaya and *C. agestor chiragshahi* (Bang-Hass) from Northwest Himalaya with hind wing inner margin yellowish-brown.

Chilasa epycides epycides (Hewitson)

Ranging from Formosa and west China through Burma, this subspecies occurs in East Himalaya. Fore wings above dull black, with two cell-streaks diverging outwards and three shorter stripes in between and above near tip; expanse 70-90 mm.

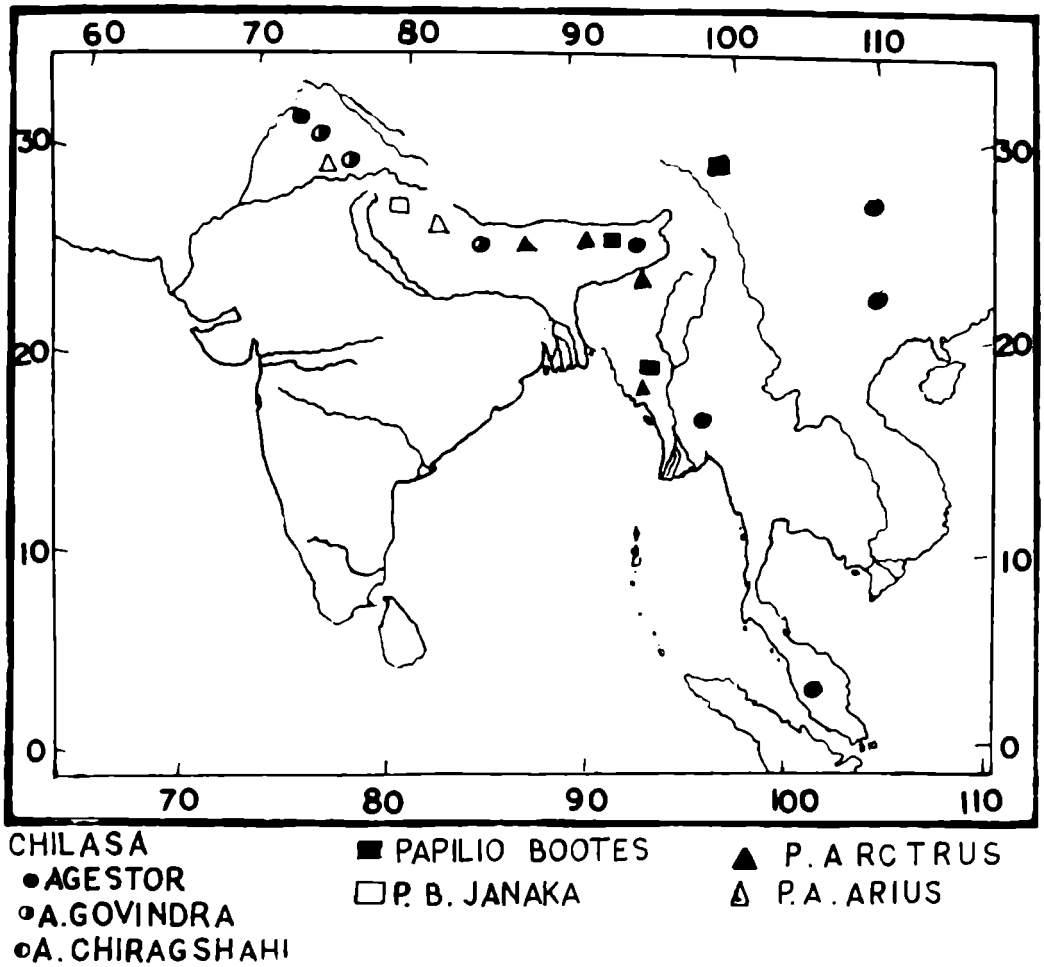

Fig. 4. Distribution area of *Chilasa agestor*, *Papilio bootes* and *P. arcturus*.

Chilasa clytia clytia (Linnaeus)
(Plate VI)

Fore wing above black or dark brown, with submarginal white spots truncate outside; hind wing with discal series of conical white streaks; submarginal series of four white lunules. Extends from Burma through the entire Himalayan Range.

PAPILIO LINNAEUS

These butterflies differ from *Chilasa* in abdomen lacking white dots. Except *machaon*, nearly all the other species included here are placed in *Princeps* Hübner by some authors.

Key to species

1. Wings below basally red-marked; male black above.....2
   Wings below not red-marked basally.....3

2. Head red; abdomen laterally striped red ... *Papilio bootes* Westwood
   Head not red; abdomen not striped red.. *Papilio rhetenor* Westwood
3. Hind wing cell black, without scattered white or yellow scales .....
   ..... *Papilio protenor* Cramer
   Hind wing below with white or yellow scales.....4
   Both fore wing above and hind wing below dusted with yellow scales
  6
4. Hind wing above with the inner edge of green straight patch diffuse..... *Papilio polyctor* Boisd
   Hind wing with the inner edge of blue patch longer in front of M_1 than in front of M_2; submarginal lunules red.....5
5. Fore wing above with a post discal green band .... *Papilio arcturus* Westwood
   Fore wing above with a narrow pale yellow discal band .....
   ..... *Papilio krishna* Moore
6. Tail absent in male and female; hind wing above with large white discal spots behind and small spot in front.... *Papilio castor* Westwood
   Hind wing with tail 7
7. Body black, with white dots on head and pronotum; wings black; hind wings with submarginal red lunules .... *Papilio chaon* Westwood
   Body yellow below, with black lines .... *Papilio machaon* Linnaeus

Papilio bootes Westwood
(Plate VII)

This species, with the hind wing spatulate-tailed, head and lateral abdominal stripes red; underside of both wings with a red band, extends from west China across Assam hills up to West Himalaya, and is represented in the Garhwal hills by the subspecies *janaka* Moore up to elevations of nearly 2000 m. Wing span about 120 mm.

Papilio rhetenor rhetenor Westwood
(Plate VII)

Wings bluish-black; hind wing undulate, below with a wide red stripe, fore wing of female with vein streaks broad. Wing span 110-130 mm. Distributed from west China through Burma to Northwest Himalaya at elevations of 1800 m.

Papilio protenor Cramer
(Plate IX)

This species, with a wide white subcostal stripe on hind wing above, is represented by two subspecies in the Himalaya. *P. protenor protenor* is restricted to West and Northwest Himalaya and *P. protenor euprotenor* is reported from the Burmese mountains and East Himalaya.

Papilio polyctor Boisduval
(Plate VII)

This species, common in Thailand, Burma and the entire Himalaya, is recognised by the fore wing above with narrow, hind wing above with a large blue patch, diffuse-margined inside; it is differentiated into the subspecies *P. polyctor ganesa* Doubleday in Burma and East Himalaya and *P. polyctor polyctor* in West and Northwest Himalaya, at elevations of 1800 m.

Papilio arcturus Westwood
(Plate VIII)

Fore wing with the submarginal green band obliterated in front; hind wing with large discal blue patch extending to outer margin, with a complete row of submarginal red spots, often coalescing with margin spots into rings. The nominotype form is confined to the area from north Burmese mountains to Central Himalaya. The subspecies *P. arcturus arius* Rothschild is somewhat smaller than the typical form and occurs in Northwest Himalaya and sometimes transitional forms extend to Kumaon.

Papilio krishna krishna Moore
(Plate IX)

Both wings above dusted with green; well-defined post discal band in fore wing and a series of inter vein pale streaks underneath. This is confined to Burma and East Himalaya.

Papilio castor Westwood

Fore wing with very small or also without submarginal spots; discal spot of hind wing above separated by veins into 4-5. Extending from Taiwan, Malaya, Burma across the Assam hills, it is differentiated into the subspecies *polias* in East Himalaya.

**Papilio chaon chaon* Westwood
(Plate IX)

Fore wing black, with yellow scales in longitudinal streaks in cell and between veins, occurs from the north Burmese mountains to Central Himalaya.

Papilio machaon Linnaeus
(Plate VIII)

Fore wing above basally yellow, with a bar across middle of cell, yellow discal band of oblong patches. A common Palaearctic species, which is differentiated into a series of subspecies in the Himalaya. *P. machaon*

*Now considered as *Princeps nephelus chaon* (Westw.)

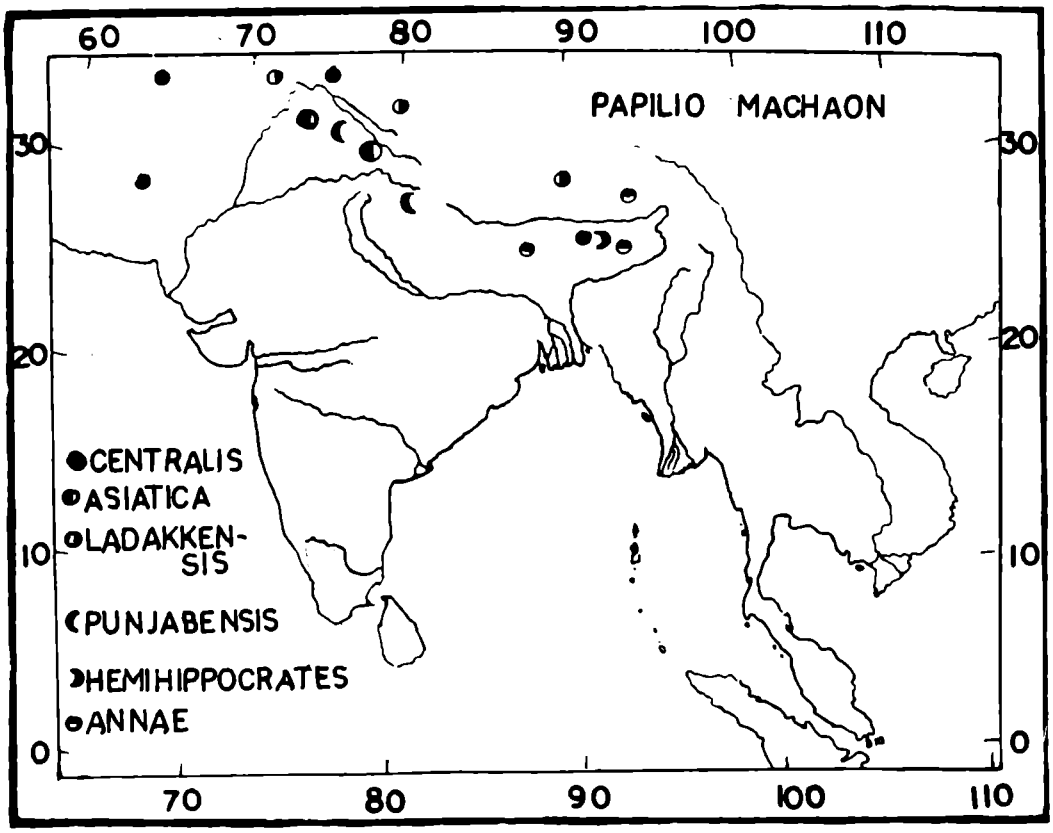

Fig. 5. Pattern of distribution of *Papilio machaon* and subspecies in the region of the Hindu Kush, Pamirs and the Himalaya. In this and in the following maps, the different symbols for species do not indicate exact localities of find of the species, but only mark the broad areas of distribution.

centralis Staud. large, with yellow markings, wing dusted yellow basally occurs in Middle Asia, Baluchistan and Northwest Himalaya. *P. machaon asiatica* Mén., pale cream coloured, with two transverse bands in cell, occurs in Tibet and the Himalaya, up to elevation of 4200 m (near Mount Everest). *P. machaon ladakensis* Moore with a shorter tail occurs in the Pamirs and Northwest Himalaya at elevations of 3900 m. *P. machaon punjabensis* Eimer somewhat smaller occurs from Northwest to Kumaon Himalaya. *P. machaon hemihippocrates* Verity is very similar to *punjabensis* and is reported from Nepal. *P. machaon annae* Gistel with relatively broad black bands and with a red spot in tornus is reported from Tibet and East Himalaya.

Subfamily GRAPHIINAE

Club stout; tarsi with spines above and below well separated; wings thinly scaled, semi-transparent; scales absent in green or blue bands above; fore

wing with vein R_1 reaching Sc; hind wing with inner margin sometimes bent upward and fringed. Claws dentate, tail long and often gradually pointed. The group is represented in the Himalaya by *Graphium* Scopoli.

Key to species

1. Fore wing with vein R_1 not ending in Sc; tail spatulate 9
   Fore wing with vein R_1 ending in Sc 2
2. Hind wing tail short, obtuse or absent 3
   Hind wing tail long, gradually pointed 4
3. Hind wing below with red or yellow discal spot; one or two red or yellow sub-basal spots 11
   Hind wing below without red or yellow spots 10
4. Fore wing above with a single discocellular bar 5
   Fore wing above with double bars 8
5. Fore wing above with three dark cell bars ..... *Graphium agetes* (Westw.)
   Fore wing above with four cell bars 6
6. Hind wing below with discal row of red spots 7
   Hind wing below without discal row of red spot ..... *Graphium antiphates* (Cramer)
7. Fore wing above with green submarginal, moniliform line ..... *Graphium aristeus* (Cramer)
8. Hind wing below with three discal spots ..... *Graphium glycerion* (Gray)
   Hind wing below with a complete row of pale discal spots ..... *Graphium eurous* (Leech)
9. Wings below basally orange-yellow, spotted brown ..... *Graphium payeni* (Boisduval)
   Wings below basally dark chocolate-brown ..... *Graphium gyas* (Westwood)
10. Hind wing below with small yellow tornal spot ..... *Graphium macareus* (Godt.)
    Hind wing below with large tornal spot ..... *Graphium xenocles* (Doubleday)
11. Fore wing above without submarginal row of green spots 12
    Fore wing above with submarginal row of green spots 13
12. Hind wing tail short; wing black, with green band ..... *Graphium sarpedon* (Linn.)
    Hind wing tail long; fore wing above hyaline-green ..... *Graphium cloanthus* (Westwood)
13. Tail absent; fore wing with one cell spot 14
    Tail short; fore wing with double cell spot ..... *Graphium agamemnon* (Linn.)

14. Hind wing with costal bar below separate from the basal dark band, centred red; discal veins not black..... *Graphium doson* (Feld.)

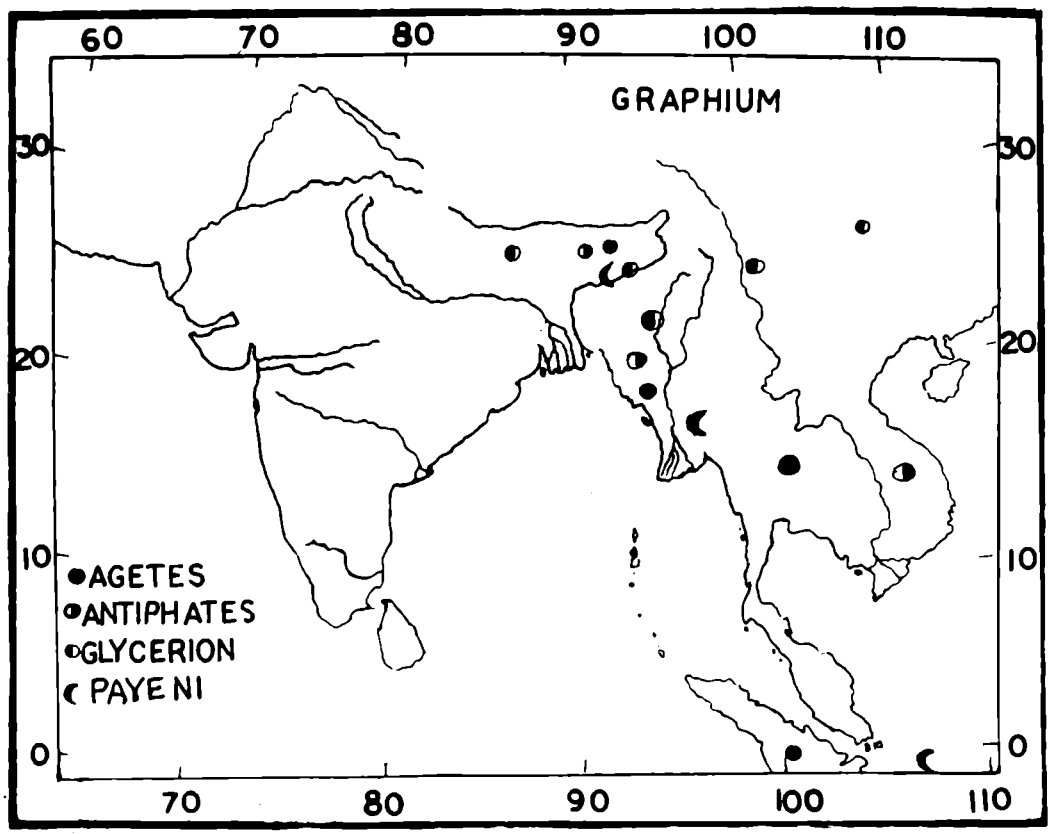

Fig. 6. Distribution of *Graphium* species in the Himalaya, extending from the Tertiary mountains to the east and southeast of India.

Graphium agetes agetes (Westwood)
(Plate XI)

Fore wing above white, with cell crossed by three broad oblique black bands; triangular costal black spot in front of cell apex. Extending from Borneo, Sumatra through Burma, occurs in East Himalaya.

Graphium antiphates pompilius (Fabr.)
(Plate XII)

Fore wing with the second band from base reaching anal vein; white, fore wing above and below green in front and basal 0.50 below. Found in Indo-China, Thailand, Burma and East Himalaya.

Graphium aristeus (Cramer)
(Plate XI)

White above, with black bands and brown bands below; of the seven

bands on fore wing above three to five short, four sometimes absent, five often joined with six; wing span 70-80 mm; ranging from north Australia through the Bismarck Islands, Borneo, Malaya, the Philippines, Burma across the Assam hill, it is represented sparsely in East Himalaya.

Graphium glycerion (Gray)
(Plate XI)

With wing span 65-75 mm, white or cream-coloured above, cell and interspace between black subhyaline; cell with five transverse bands, of which basal two reach the inner margin. Range includes China, Yunnan, north Burma and extends up to Central Himalaya.

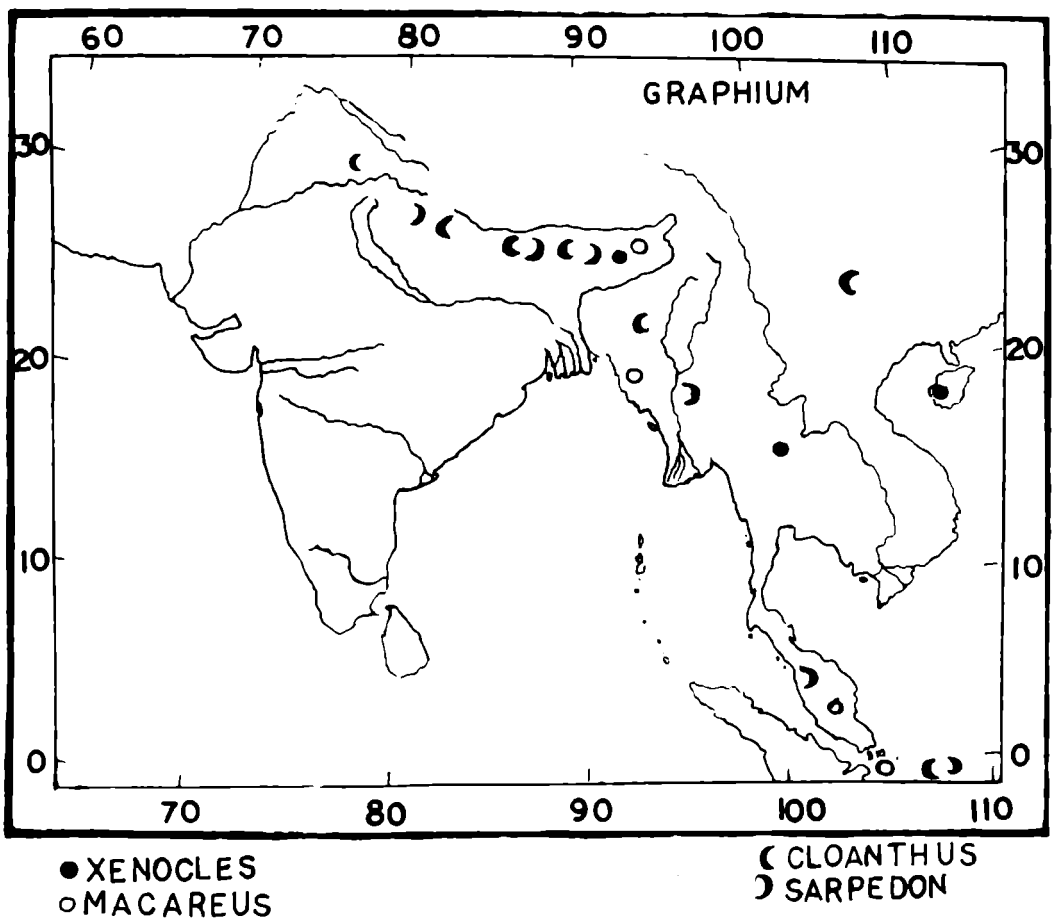

Fig. 7. Distribution of *Graphium* species, continued from Fig. 6.

Graphium eurous (Leech)

Fore wing subhyaline, with 10 black bands and black basally; hind wing tail long and gradually pointed; range extends from Taiwan, China to the entire Himalaya; forms from Northwest Himalaya are somewhat paler than those from East Himalaya.

Graphium payeni (Boisduval*)
(Plate XI)

Yellow with some green; forewing cell above largely yellowish-brown; brownish-black discocellular patch and cross cell spot; hind wing without tail, with a number of silvery spots. Extending from Borneo across the Sunda Islands and Burma and Assam hills, reaches East Himalaya.

Graphium gyas (Westwood*)

Wing span 100-115 mm; wings above dark brown, with dark outer border, surrounding a row of yellow spots; apical cell spots in both fore and hind wings. This species seems to be confined to the mountainous areas of Burma, Assam and East Himalaya.

Graphium macareus Godart
(Plate X)

Generally white, with some green tinge, veins with black stripe and long stripes between veins, without tail; fore wing with three cell stripes, sometimes broken into spots; hind wing with white stripes. Its range extends from the Philippines, Sunda Islands, Malaya, Burma across the Assam hills to East Himalaya.

Graphium xenocles (Doubleday)
(Plate IX)

This species is much larger than the foregoing, with a yellow anal spot in the hind wing. It comes from Hainan, Thailand, Burma and the Assam hills and is represented by the subspecies *phrontis* (de Nic.) in East Himalaya. Wing span highly variable between 80 and 120 mm.

Graphium cloanthus (Westwood)
(Plate XII)

Fore wing with two large cell patches, wide discal band; hind wing with four submarginal patches; wing span 90 mm; discal area pale green, broken in front by irregular black bands; hind wing below with a row of narrow red markings basally along anal vein. Ranging from Taiwan and China through Sunda Islands and Burma, the species occurs throughout the Himalaya; but East Himalayan forms are somewhat darker and larger than those from Northwest Himalaya.

Graphium agamemnon Linnaeus
(Plate X)

Brownish-black above, with bluish-green patches, hind wing with tail,

*Considered by some under *meandrusa*.

especially longer in male than in female, and basal cell stripe. Widely distributed in the Indo-Australian area, it ranges from the Burmese mountains to West Himalaya.

Graphium sarpedon (Linnaeus)
(Plate X)

Brownish-black above, with green-blue discal band; tail very short; fore wing above without a row of submarginal green spots; hind wing below with five red discal spots; wing expanse varies from 80 to 90 mm. Distributed from the Philippines through the Sunda Islands and Burma, it occurs throughout the Himalaya. In East Himalaya, it is usually somewhat darker than in Northwest Himalaya.

Graphium doson (C. & R. Felder)
(Plate X)

Wing span 70-80 mm; above with pale green, scale-free marking, five cell spots above in the fore wing; hind wing with an elongate-triangular discal band; hind wing below with the costal bar separated from the dark basal band and red centred. The range of this species includes south Japan, China, Sunda Islands, South India, Sri Lanka (previously Ceylon), Burma, Assam hills and the Himalaya up to Kumaon.

Graphium eurypylus (Linnaeus)

Hind wing below with short costal band. with red spots, joined behind with sub-basal band. This is widely distributed from the Philippines, Celebes, (now known as Sulavese) Moluccas, Sunda Islands, Australia, Malaya, Burma and East Himalaya.

Subfamily TEINOPALPINAE

This was formerly placed as a separate family Teinopalpidae by Grote in 1892, but treated as a tribe by others under Papilionidae. There is a single genus *Teinopalpus* Hope, readily recognised by frons conically produced; palpi long; antennae short, with curved club and without scales except basally; hind wing in male with one and in female two long tails.

Teinopalpus imperialis Hope
(Plate XII)

Fore wing above black, with green marking; before the middle with a slightly curved black line; two post-discal black faint bands; hind wing with black discal line; below brownish-yellow. This is restricted to south China, Burma and East Himalaya. Wing expanse 100-120 mm.

Family ZERYNTHIIDAE

The butterflies of this subfamily are recognised by the tailed or toothed margin of hind wing; elongate basal cell; precostal vein curved basally; short antennae; long palpus. This is largely a Palaearctic group with only a single genus *Armandia* Blanchard represented in the Himalaya. This was formerly considered a subfamily of Papilionidae.

Wings long; veins R_1 and R_2 free; veins R_3, R_4, R_5 stalked together; vein M_1 arising from cell angle; hind wing with long tails.

Armandia lidderdlei (Atkinson)
(Plate XII)

With a wing expanse of 90-110 mm, black above, traversed by eight yellow-white lines in fore wing; hind wing with larger patch, basally pale red, apically with yellow lunules and black; hind wing below crossed by ochraceous bar.

The species is confined to western China, north Burmese mountains and East Himalaya.

CHAPTER V

Family Parnassiidae

This is the family of the apollo butterflies of mountainous, boreal and sub-circumpolar regions, abundantly represented in the Himalaya at high elevations, above the timberline, particularly in the Turkmenian Subregion.

Wings broad, rounded; fore wing without small cross-vein between anal vein and cell; vein R_3 absent; hind wing ovate or nearly so, no anal fold, without precostal spur; generally white, with black spots.

Antennae short, clavate, ringed with black and white; palpi short; abdomen generally densely hairy in the male and sparsely in female and in the genus *Parnassius* with a horny pouch at the end.

HYPERMNESTRA MENETRIES

Fore wing with veins R_2 and R_5 arising from the same point; vein Sc in hind wing shorter than anal vein of fore wing; club short, abrupt, flat; female without pouch at tip of abdomen. *Hypermnestra helios* (Nick.) is the only species, known so far, from western China, Iran, Baluchistan and the extreme western end of Northwest Himalaya.

PARNASSIUS LATREILLE
(Plates II & III)

Antennae short, often ringed black and white, with stout club; palpi short; wings broad, fore wing almost right-angled triangular, with the costal margin somewhat arched; broadly rounded apically; outer margin convex; inner margin straight; semi-diaphanous; with black markings and spots; cell about 0.50 or less of wing; veins R_2 and R_5 separate at origin; anterior discocellular very short or absent; middle discocellular twice the posterior, concave; veins R_5 and M_1 approximate, arising from cell apex; R_3 absent; R_4 from R_5; R_2 from apex of cell or from R_5 and usually free; hind wing ovate, with prominent tornus and concave inner margin; abdomen in male densely hairy and sparsely in female; with a postcopulatory horny

pouch in female at tip.

About a dozen species, differentiated into almost fifty subspecies, occur above the timberline in the Himalaya almost up to elevations of 6000 m, particularly abundantly in the Pamir-Northwest Himalaya region.

Key to species

1. Antennae mostly ringed black and white 2
   Antennae not white ringed, but totally black 5
2. Fore wing fringe chequered ..... *Parnassius epaphus* Oberth.
   Fore wing fringe not chequered 3
3. Fore wing at least 33 mm long, with conspicuously large red spots ..... *Parnassius tianschanica* Oberthür
   Fore wing hardly 30 mm long, with very small red spots..... 4
4. Fore wing without or with only a very faint post-discal dark band; hind wing basal red spot unusual ..... *Parnassius actius* Eversm.
   Fore wing with conspicuous post-discal dark band; hind wing usually with a basal red spot ..... *Parnassius jacquemontii* Boisduval
5. Veins R_1 and R_2 in fore wing anastomosed 9
   Veins R_1 and R_2 in fore wing not anastomosed 6
6. Fore wing with vein R_5 and M_1 separate basally 7
   Fore wing with veins R_5 and M_1 arising from a point, far remote from origin of vein R_2; spots at cell end not connected by dark band to middle of anal vein ..... *Parnassius hardwickei* Gray
7. Hind wing above with red spot at base of vein R_3 ..... *Parnassius imperator* Oberthür
   Hind wing without basal red spot; fore wing without sub-basal red spot on vein R_5 8
8. Hind wing with five antemarginal ocellar spots; discal ocellar spot nearer the margin than to the cell .. *Parnassius stoliczkanus* Feld.
   Hind wing with two anal ocellar spots, but no antemarginal ocellar spots; discal ocellar spot remote from submarginal line ..... *Parnassius delphius* Eversm.
9. Fore wing with vein R_2 arising from R_5; veins M_1 and R_5 well separate at origin ..... *Parnassius charltonius* Gray
   Fore wing with vein R_2 separate from R_5 basally; veins M_1 and R_5 approximate basally 10
10. Fore wing above with fringe black..... 11
    Fore wing above with fringe white or pale yellow 12
11. Fore wing less than 30 mm long; hind wing above with small red discal spots in front of veins M_2 and R_3, without red spot basally on vein R_3, below with red spot basally ..... *Parnassius simo* Gray
    Fore wing 30 mm long or longer, without red spots; with post-discal band of separate small spots; hind wing with an elongate ocellar spot

in front of vein M_3 ..... *Parnassius maharaja* Avinoff
12. Hind wing above white, with red spots ..... *Parnassius acco* Gray
Hind wing above white, without red spots .....
..... *Parnassius hannyngtoni* Avinoff

Parnassius epaphus Oberthür

Antennae most usually ringed white and black; wings above white, with narrow vitreous marginal bands; ocellar spot in hind wing sometimes pupillated in female. The species ranges from Turkmenian area to south-east China and is differentiated into four subspecies in the Himalaya. *P. epaphus cachemiriensis* Oberthur without basal red spot in hind wing; ocellar spot broadly bordered black, yellow to orange-yellow, with wing expanse of 50-60 mm, occurs from Northwest to West Himalaya. *P. epaphus hinducucia* Bang-Haas differs in the greatly reduced submarginal spots in both fore and hind wings and may even be absent; ocellar spots very small and occurs at elevations of 5670 m on Northwest Himalaya and the Hindu Kush. *P. epaphus hillensis* Bang-Haas with somewhat large ocellar and red spots, is reported from Spiti in Northwest Himalaya. *P. epaphus sikkimensis* Elwes from Sikkim 4875 m has wing span of 50 mm, with darker black marking, the white area also dusted with black scales, antennae ringed black and white. *P. epaphus phariensis* Avinoff differs from *sikkimensis* in the better developed black markings, marked red-centres of spots and ocellar spots and is reported from Bhutan in East Himalaya.

Parnassius tianschanica Oberthür
(Plate II)

Generally white or sometimes also yellow, with sparse black scales; costal spots in fore wing with small red centre; hind wing with red centred ocellar and faint submarginal subtriangular spots. Ranging from Turkestan, Hindu Kush and the Pamirs, it is differentiated into three subspecies in Northwest Himalaya. *P. tianschanica binghami* Bryk, with a wing span of 70-80 mm, very closely similar or perhaps identical with the Middle Asiatic *P. discobolus insignis*, but with a somewhat narrower inner vitreous border to the white submarginal band in fore wing, is reported at elevations of 3660-3960 m in Northwest Himalaya. *P. tianschanica baroghila* Tytler somewhat smaller is reported from Chitral. *P. tianschanica hunzaica* Tytler reported to be somewhat smaller and darker than the foregoing subspecies, occurs in Hunza in Northwest Himalaya.

Parnassius actius Eversmann

This species is related to *P. tianschanica*, but with a narrow vitreous margin in fore wing and submarginal spots rather poorly developed; hind wing grey basally and with red basal spot only occasionally above. The

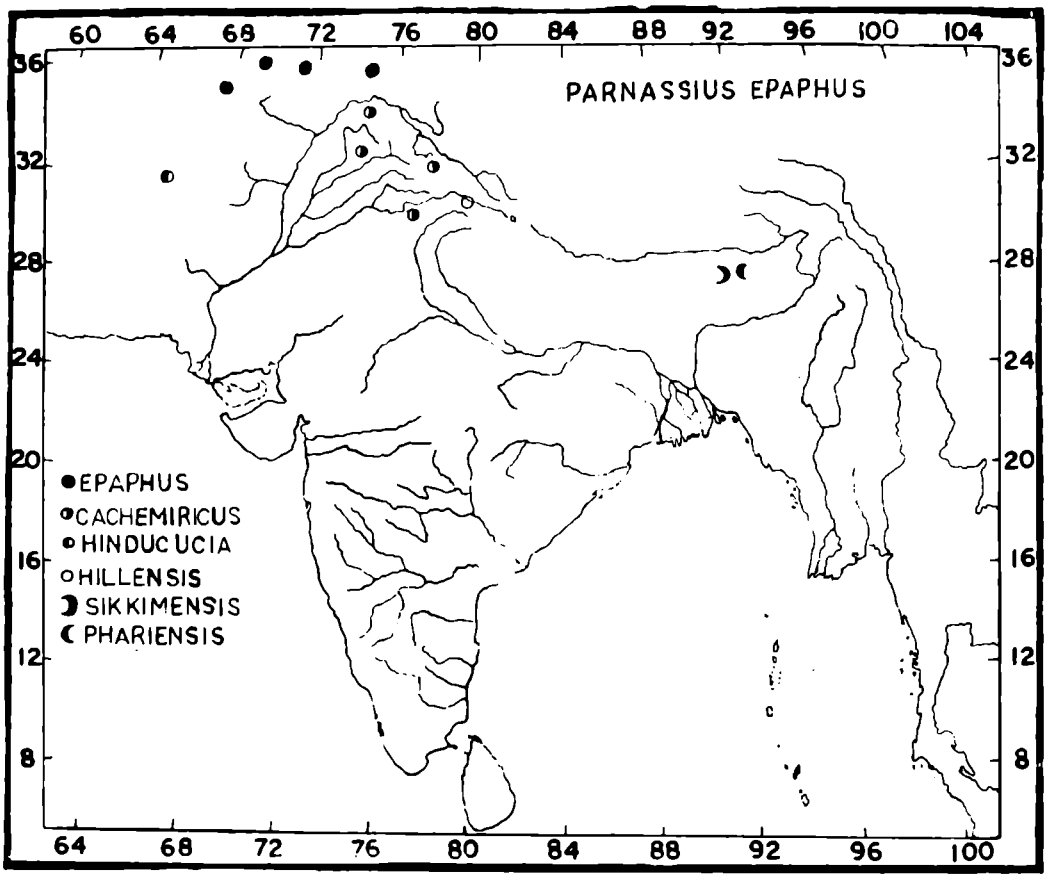

Fig. 8. Distribution of *Parnassius epaphus* and subspecies.

three subspecies from the Himalaya include *P. actius sulla* Bryk & Eisner from Chitral, *P. actius catalina* Eisner & Peschke from Gilgit and *P. actius yelyangi* Bang-Haas at elevations 4100 m in the Zaskar area.

Parnassius jacquemontii Boisduval
(Plate II)

Small species, with four costal spots in fore wing; inner marginal spot large, with red centres; fringe hardly chequered; hind wing ocellar spot with white pupil and broad submarginal lunules; antennae ringed white and black. The species occurs in China, Turkestan, Tibet and in the Himalaya, with three subspecies. *P. jacquemontii chitralensis* Moore creamy-white above, with diffuse black scale; fringe speckled black; fore wing with a short transverse bar across the middle of cell, post-discal lunules diffuse; three to four red spots circled black; below more or less shiny; wing expanse 55-70 mm; from Chitral. *P. jacquemontii jacquemontii* Boisd. and *P. jacquemontii shandura* Tytl. occur in Northwest Himalaya.

Parnassius hardwickei Gray
(Plate III)

Fore wing with veins R_5 and M_1 arising from a common point and remote from the origin of vein R_3; with spots at tip of cell, middle anal area generally red; submarginal band formed by a row of spots; hind wing above without red spot basally in front of vein R_3; green submarginal spots; with marginal spots above without blue; white centred. The species is restricted to the Himalaya; in the east specimens from Sikkim are generally darker than those from Northwest Himalaya. The nominotype occurs from Chitral to Kumaon; paler forms occur at lower elevations near the timber line, but darker forms occur at elevations of 4500 m. Wing expanse is 55-65 mm. *P. hardwickei albicans* Fruhstorfer is reported from East Himalaya; *P. hardwickei hardwickei* is considered as a "dry-season" form. A wet-season form has also been reported.

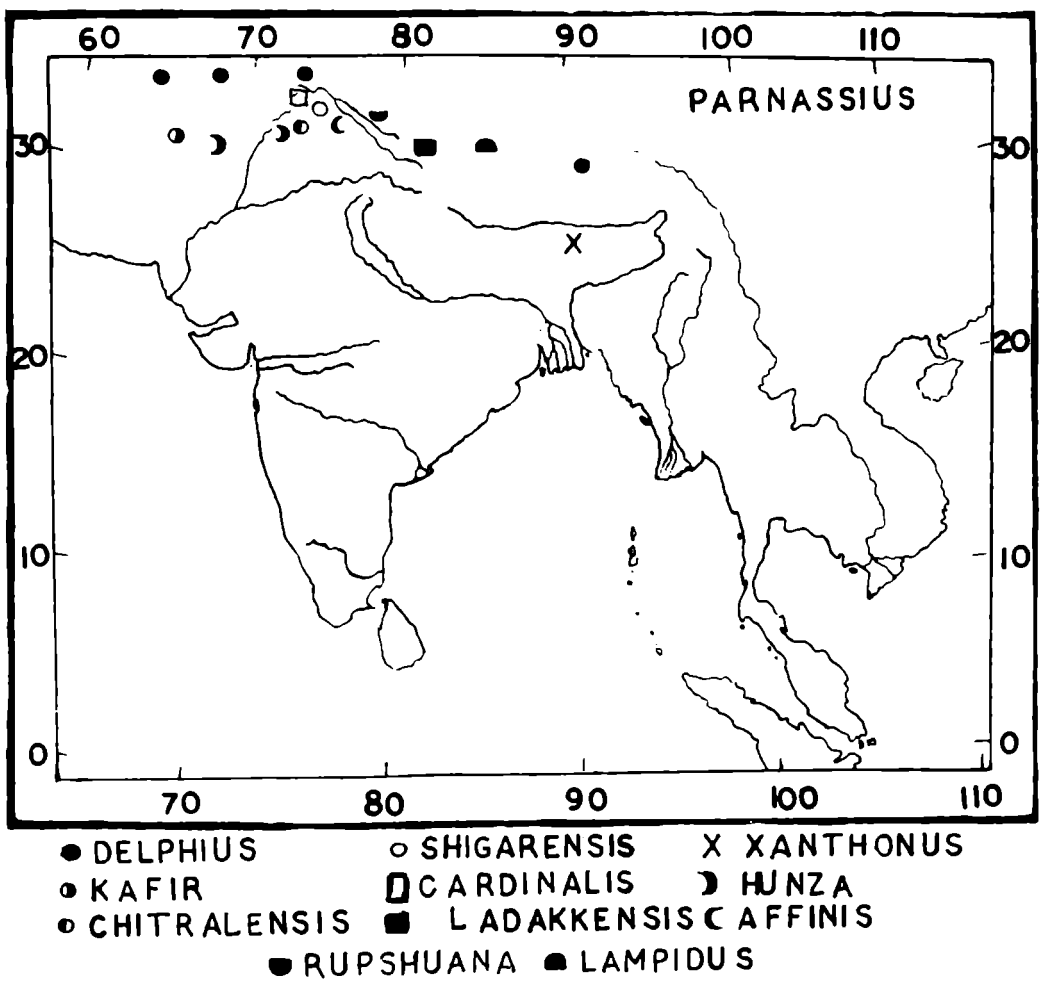

Fig. 9. Distribution of *Parnassius* species, note the marked concentration in the area of the Pamirs-Northwest Himalaya

Parnassius imperator Oberthür

With a wing span of about 90 mm, strongly dusted with grey; with the submarginal band better developed than the marginal band and separated by series of white lunules; hind wing with large ocellar spot; the species occurs in southeast China and East Himalaya at an elevation of 4500 m.

Parnassius stoliczkanus Felder
(Plate III)

This species is recognised by the row of five antemarginal ocellar spots, on the edge of the black marginal border; discal ocellar spot red centred. It seems to be restricted to West and Northwest Himalaya and is differentiated into seven subspecies: the nominotype, with about 50-60 mm wing expanse, fore wing above with post-discal dark band as wide as the marginal band; submarginal white spots small, few; occurs in Ladakh and Kulu Valley. *P. stoliczkanus rileyi* Tytler is reported from the Rupal Valley and *P. stoliczkanus nicevillei* Avinoff from Burzil in Northwest Himalaya. *P. stoliczkanus atkinsoni*, with broader bands in fore wing, hind wing with two red ocellar spots ringed black and two red-centred marginal spots is reported from Gilgit in Northwest Himalaya. *P. stoliczkanus zogilaica* Tytler is somewhat paler and with smaller marginal spots comes from the Zojila Pass in Northwest Himalaya. *P. stoliczkanus spitiensis* Bang-Haas, with wide submarginal and marginal bands in fore wing occurs at 4500 m Spiti an *P. stoliczkanus florenciae* Tytler is reported from the Kumaon-Garhwal area of West Himalaya.

Parnassius delphius Eversmann

This widely distributed and highly variable species, originally from the Altai Mountains, occurs in China, Pamirs, Turkestan, Tibet and the Himalaya. Hind wing with two anal ocellar spots, but without antemarginals; dark submarginal line separated from black marginal border; size varies from 30 mm to nearly 70 mm wing expanse. The Himalayan subspecies include *kafir* Avinoff without discal band in fore wing from Hindu Kush; *chitralica* Verity small and dark, with fore wing heavily black-banded and large sized from Chitral; *hunza* Grum-Grsh. a pale form from the East Hindu Kush; *affinis* Peschke & Eisner perhaps the smallest form from Gilgit; *workmani* Avinoff larger form with wings covered by dark scales along veins from Saltoro Glacier; *shigarensis* Bang-Haas from the Baltoro Glacier (4500 m); *cardinalis* Avinoff from the Burzil Pass; *ladakensis* Avinoff from Ladakh; *mamaievi* Bang-Haas also from Ladakh; *rupshuana* Avinoff at an elevation of 5335 m in Rupshu; *lampidius* Fruhstorfer reported from Tibet and East Himalaya and somewhat darker than those subspecies from Northwest Himalaya; and *lathonius* Bryk from Sikkim (East Himalaya).

Parnassius charltonius Gray

With a wing span of 80-90 mm and ranging from South Ferghana in Middle Asia to northwest Himalaya at elevations of 4270-5790 m, is differentiated into four subspecies in the Himalaya. The nominotype *P. charltonius charltonius* Gray is readily recognized by the vein R_2 emitted from R_5; veins R_5 and M_1 separate at origin; discal band expanded behind cell; discal ocellar spot white centred; occurs from Central Himalaya westward to Northwest Himalaya and extends into Tibet. *P. charltonius ducalis* Boullet & Le Cerf, with the black markings better defined than in the nominotype, is reported at an elevation of 4270 m in Chitral. *P. charltonius deckerti* Verity with larger blood-red coloured ocellar spots at elevations of 3660-4390 m in Northwest Himalaya. *P. charltonius bryki* Haude, somewhat smaller than the foregoing subspecies and hind wing more densely dusted, is reported from Spiti at elevations of 4270 m.

Parnassius simo Gray

Wing span of 45-55 mm, with fore wings pointed, fringe black; hind wing fringe white, basal red spot faint; antemarginal band of series of black dots. The species ranges from Middle Asia (Central Tien Shan) westward to the Hindu Kush and the Himalaya southward almost to Sikkim. *P. simo simo* Gray is reported from east Tibet and Central Himalaya. *P. simo avinoffi* Verity, with somewhat yellow ground colour, with faint discal band in fore wing, is reported from an elevation of 5485 m in the eastern Hindu Kush. *P. simo lorimeri* Tytler from Gilgit, *P. simo colosseus* Bang-Hass from Baltistan (4115-4500 m), *P. simo saserensis* Bang-Haas from Saser Pass, *P. simo zarraensis* Bang-Haas from Tagalang Pass (Northwest Himalaya), *P. simo simonides* Austant from north Ladakh, *P. simo simoides* Bang-Haas from Ladakh, *P. simo peteri* Bang-Haas from the Shipki Pass and *P. simo acconus* Fruhstorfer from Sikkim are other subspecies from the Himalaya.

Parnassius maharaja Avinoff

Fore wing with the marginal band fuscous and with a series of small dark submarginal lunules. The species ranges from Middle Asia through the Karakoram to Northwest Himalaya and is reported at elevations of 5180-5490 m.

Parnassius acco Gray

This species is restricted to the Himalaya at elevations of 5180-5790 m. Wings with fringe pale yellow; fore wings usually with three complete bands distally of cell; hind wing with red basal spots; ocellar spots small and red or white centred. *P. acco acco* Gray is reported from east Tibet and Nepal. *P. acco tagalangi* Bang-Haas is reported from the Tagalang Pass in

Ladakh (4500 m). *P. acco hampsoni* Avinoff is reported from the Karakoram, *P. acco baltorana* Bang-Haas from the Baltoro Glacier, *P. acco pundjabensis* Bang-Haas from east Spiti and *P. acco gemmifer* Fruhstorfer from Sikkim.

Parnassius hannyngtoni Avinoff

Wing expanse about 45 mm, fore wings above white, without red markings; post-discal dark band, submarginal white spots and marginal band subequally wide. The species was reported from Sikkim (4500-5180 m).

CHAPTER VI

Family Pieridae

Pierids are generally white butterflies, with some black markings, but some are yellow. They occur in all parts of the world and are remarkable for marked sexual polymorphism. The males congregate in numbers on wet ground in bright sunshine (Plate II), but the females usually seek sheltered spots.

Club ovate, gradually stout to tip; legs normal; claws bifid; cell closed in both wings; fore wing with veins R_1 and R_2 from cell; vein R_3 present; vein R_5 coincident with R_4 and stalked with M_1; hind wing without precostal vein or with a very short one turned towards wing base or apically; inner margin channelled to fit abdomen.

Key to subfamilies

1. Hind wing without precostal vein; if this is present, it is short, turned basally; palpi not hairy ..... *Coliadinae*
   Hind wing with precostal vein turned apically; palpi hairy ..... *Pierinae*

Subfamily PIERINAE

Key to genera

1. Fore wing with veins R_4 and R_5 coincident 2
   For ewing with veins R_4 and R_5 separate 8
2. Vein R_2 absent ..... *Delias* Hub.
   Vein R_2 arising from cell 3
3. Vein R_3 absent 4
   Vein R_3 stalked with veins R_4 and R_5 5
4. Hind wing with veins M_1 and M_2 far apart at origin .. *Pontia* Fabr.
5. Fore wing costa serrate ..... *Prioneris* Wall.
   Fore wing costa not serrate 6
6. Fore wing with vein R_1 free; vein M_2 issuing from stem of R_4-R_5 and R_3 ..... *Baltia* Moore

Fore wing with vein R_1 issuing from cell.....7

7. Fore wing with vein M_1 arising midway between fork of R_4-R_5 and cell .....*Aporia* Hübn.

8. Fore wing with vein M_1 arising from stem of R_4-R_5 and R_3 ....*Euchloë* Hübn.

DELIAS HÜBNER

Fore wing (Fig. 10 A) with costa only very slightly arched; apex broadly rounded; tornus obtusely rounded; inner margin straight; cell about 0.50 of wing length; vein R_2 absent; vein R_1 arising from cell; veins R_4-R_5 and R_3

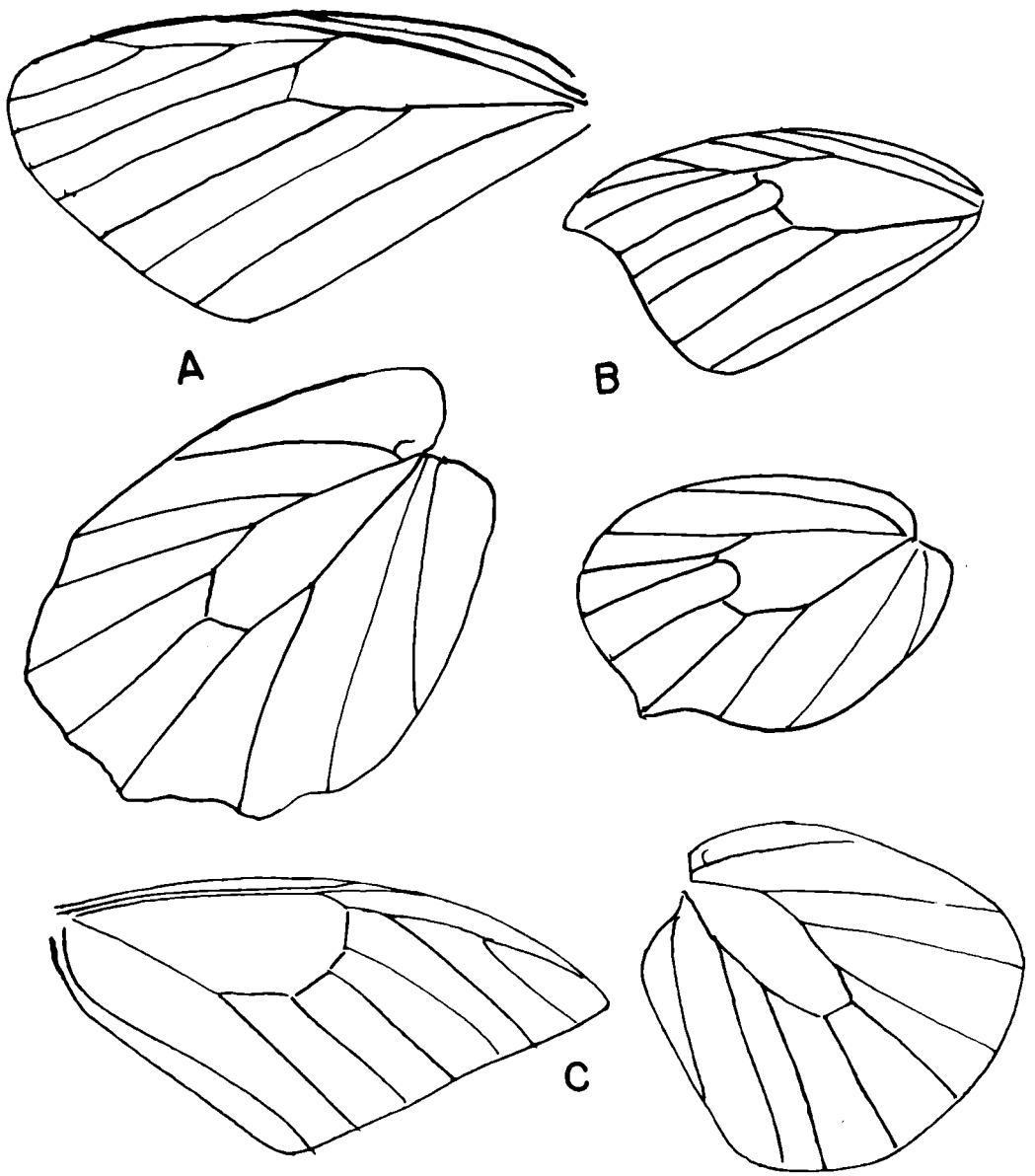

Fig. 10. Butterfly wings. (A) *Delias*, (B) *Gonepteryx*, (C) *Prioneris thestylis*.

long stalked, from the stalk of which arises vein M_1; anterior discocellular absent; posterior discocellular generally longer than the middle; hind wing with cell ovate, a little more than 0.50 of wing length; precostal vein long, directed distally. Lowland forest form, often ascending to 2400 m, rarely to 3000 m on the Himalaya.

Key to species

1. Hind wing below with red markings 2
   Hind wing below without red markings 6
2. Hind wing below with red subcostal stripe in front of vein R_3 ..... *Delias descombesi* (Boisd.)
   Hind wing below with the red sub-basal band from costa to the inner margin near vein Sc-R 3
   Hind wing below with a sub-marginal row of red spots 4
3. Hind wing above without red patch ..... *Delias aglaia* (Linn.)
   Hind wing above with red patch extending behind cell ..... *Delias thysbe* (Cramer)
4. Hind wing above without submarginal black line ..... *Delias hyparete* (Linn.)
5. Hind wing below yellow ..... *Delias agostina* (Hew.)
   Hind wing below not yellow 6
6. Hind wing below with yellow cell stripe .. *Delias belladonna* (Fabr.)
   Hind wing below with cell stripe partly white 7
7. Hind wing above with an elongate white cell stripe ..... *Delias lativitta* (Leech)
   Hind wing above with cell stripe not elongate 8
8. Hind wing below with white cell stripe elongate ..... *Delias sanaca* (Moore)
   Hind wing below with white cell stripe absent or not produced .... *Delias berinda* (Moore)

Delias descombesi (Boisduval)
(Plate XII)

Female wing span about 90 mm, male about 65-85 mm; fore wing above white, costa black narrowly; hind wing largely yellow to orange, with marginal black; fore wing below black, veins white streaked. The species ranges from Indo-China, Thailand across Burma to the Himalaya up to Nepal.

Delias aglaia (Linnaeus)

Hind wing below with red sub-basal band, but without red above; wing span in female 70-90 mm, male 70-85 mm. The species occurs in the Philippines, Taiwan, China, Sunda Islands, Burma and extends across

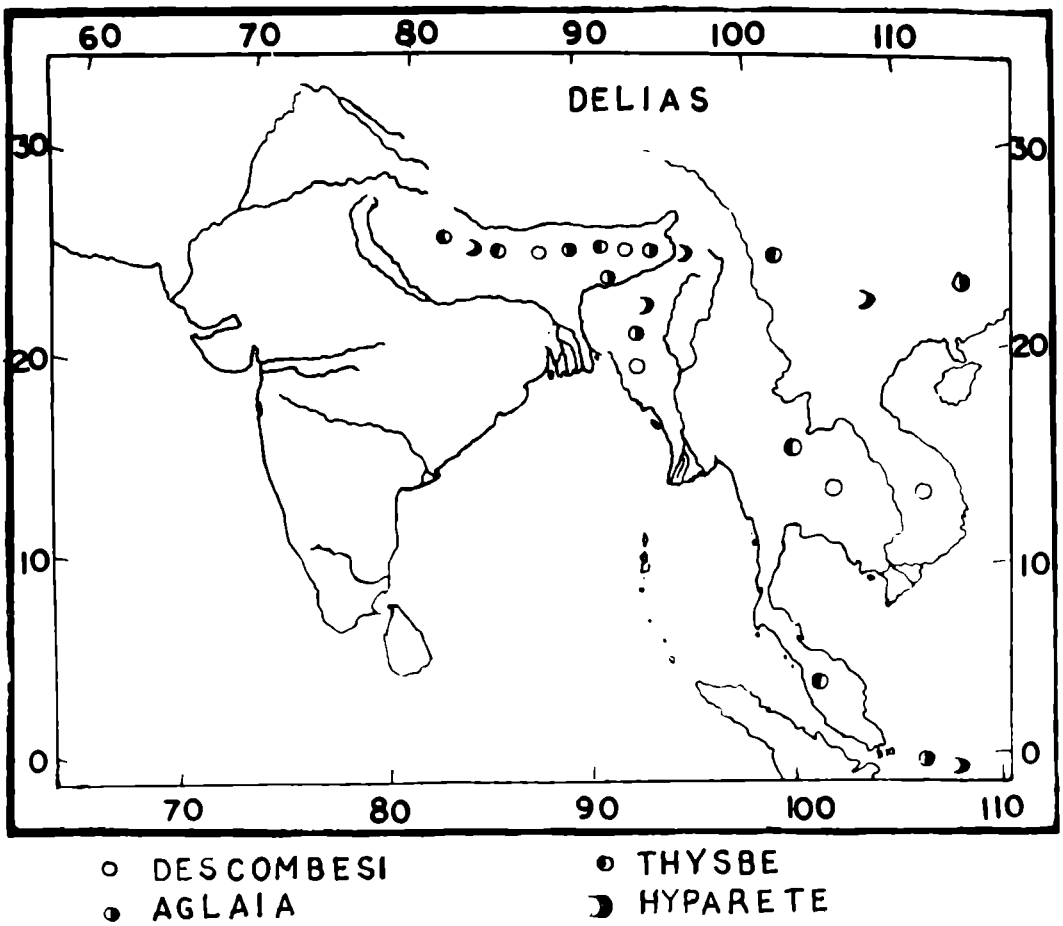

Fig. 11. Distribution of *Delias* species.

Assam hills to the Himalaya up to Nepal.

Delias thysbe (Cramer)

Hind wing with large basal red area extending behind cell; wing span in female almost 100 mm and male about 90 mm. The species is distributed in Yannan, Thailand, Malaya and Burma and extends in the Himalaya to Garhwal; it occurs also on the Eastern Ghats.

Delias hyparete (Linnaeus)

Fore wing above white, usually with a black apical area, veins black; hind wing with submarginal band of red spots and basally yellow; wing span 70-85 mm. Distributed from the Philippines, Borneo, Sunda Islands, south China, Burma and India; it is represented in the Himalaya by subspecies *D. hyparete indica* (Wallace) reaching almost to Kumaon-Garhwal.

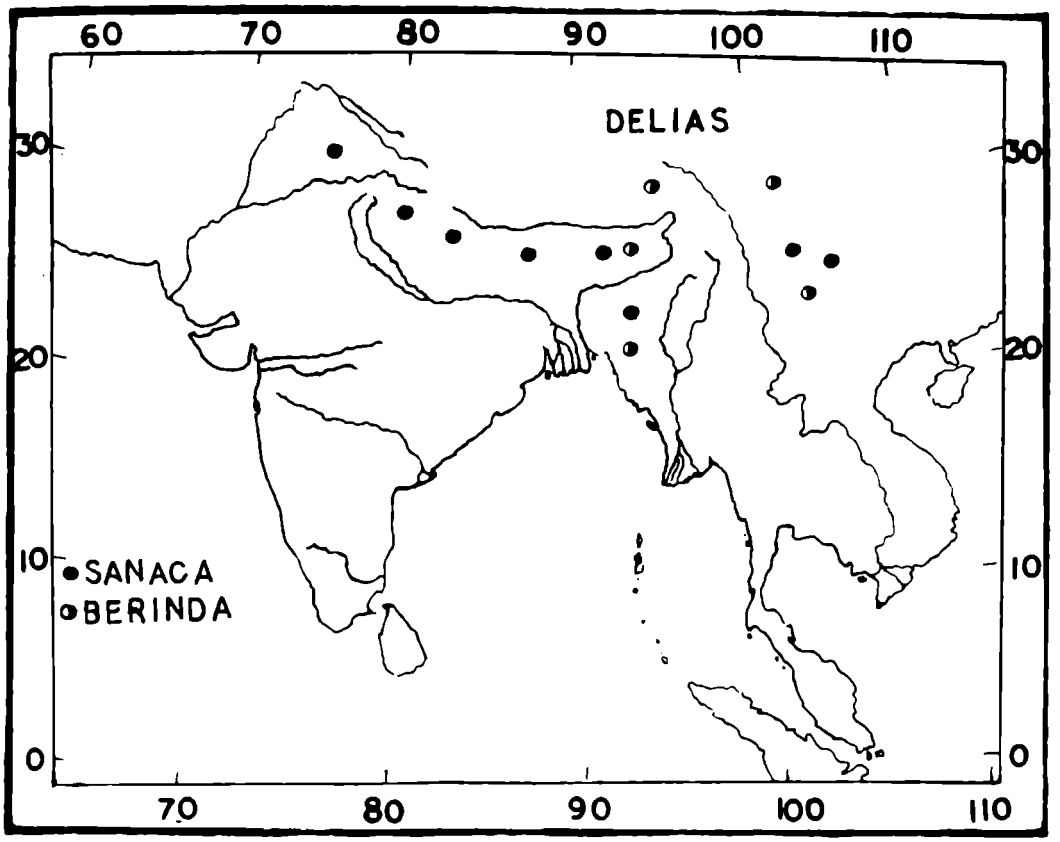

Fig. 12. Distribution of *Delias* species.

Delias agostina (Hewitson)
(Plate XIII)

Fore wing above in male, hind wing below yellow; fore wing in female above brownish-black; cell and costa dusted grey; wing span 65-75 mm. The species occurs in Thailand, Malaya, Burma, Assam hills and in the Himalaya up to Nepal.

Delias belladonna (Fabr.)

Hind wing below with cell patch yellow, without cell stripe below in female; wing span 80-90 mm. The species is distributed in Celebes, Sunda Islands, Malaya, Thailand, southern China, Yunnan, Burma across Assam hills and the Himalaya almost to the Kulu valley, usually at elevations of about 2000 m. The subspecies *D. belladonna horsfieldi* (Gray) is reported from Northwest Himalaya and *D. belladonna ithiela* (Butler) in East Himalaya.

Delias lativitta Leech

Hind wing above with a long cell stripe white; wing span about 80 mm.

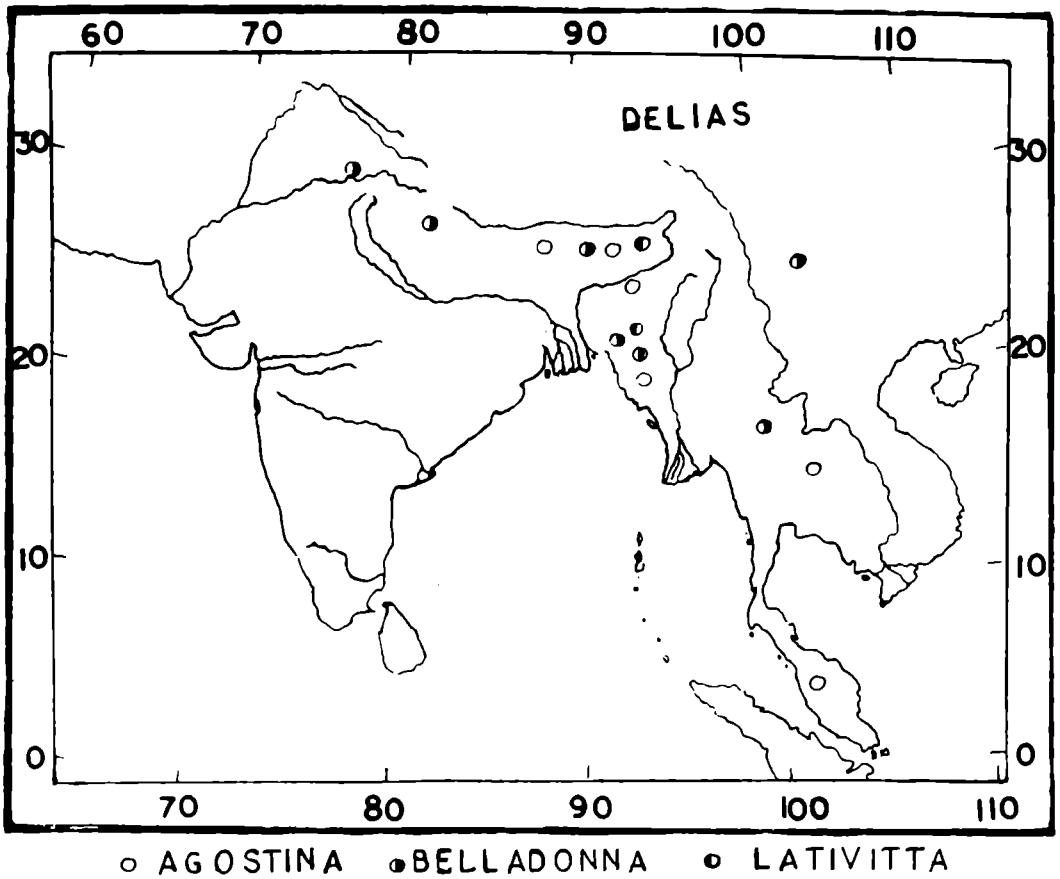

Fig. 13. Distribution of *Delias* species.

This is reported from Burma and East Himalaya, at elevations of 1500-2000 m.

Delias sanaca (Moore)
(Plate XIII)

This species is separated from the foregoing species by the broader cell stripe in hind wing. Wing span female 85-95 mm, male 70-95 mm. Its geographical range covers Yunnan, China, Burma and the Himalaya. The nominotype has large triangular submarginal spots above in fore wing; hind wing with broad white cell stripe; fore wing below with well developed white stripes; hind wing below with yellow discal spots, bordered white, common in Northwest and West Himalaya, at elevations of 1000-1500 m. The subspecies *D. sanaca oreas* Talbot is reported from Sikkim and Darjeeling and *D. sanaca bhutya* Talbot from Bhutan (1800-2800 m).

Delias berinda (Moore)

Hind wing without yellow below; black with grey markings; wing span

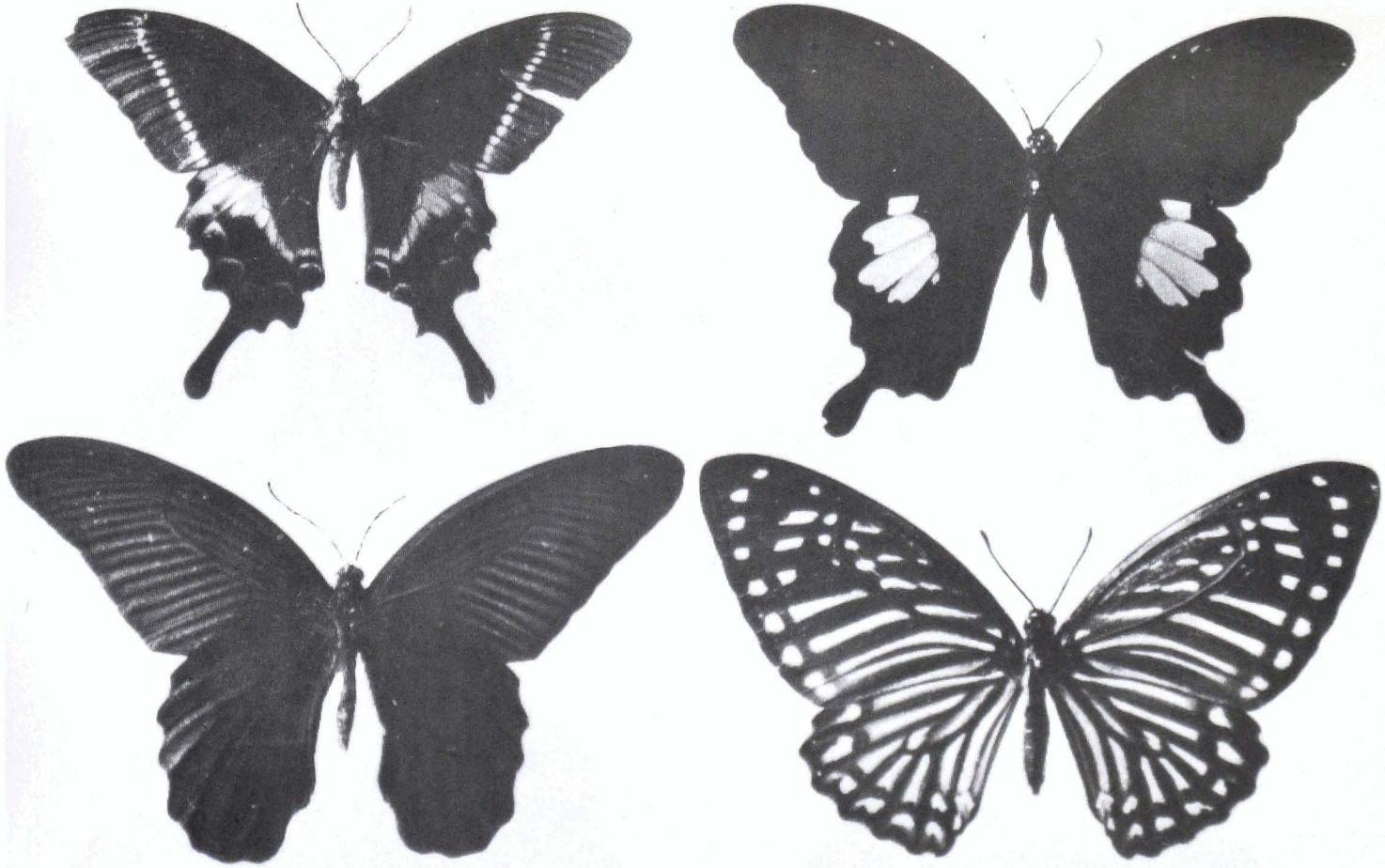

PLATE IX. Top row left: *Papilio krishna*
right: *Papilio chaon*

Bottom row left: *Papilio protenor*
right: *Graphium xenocles*

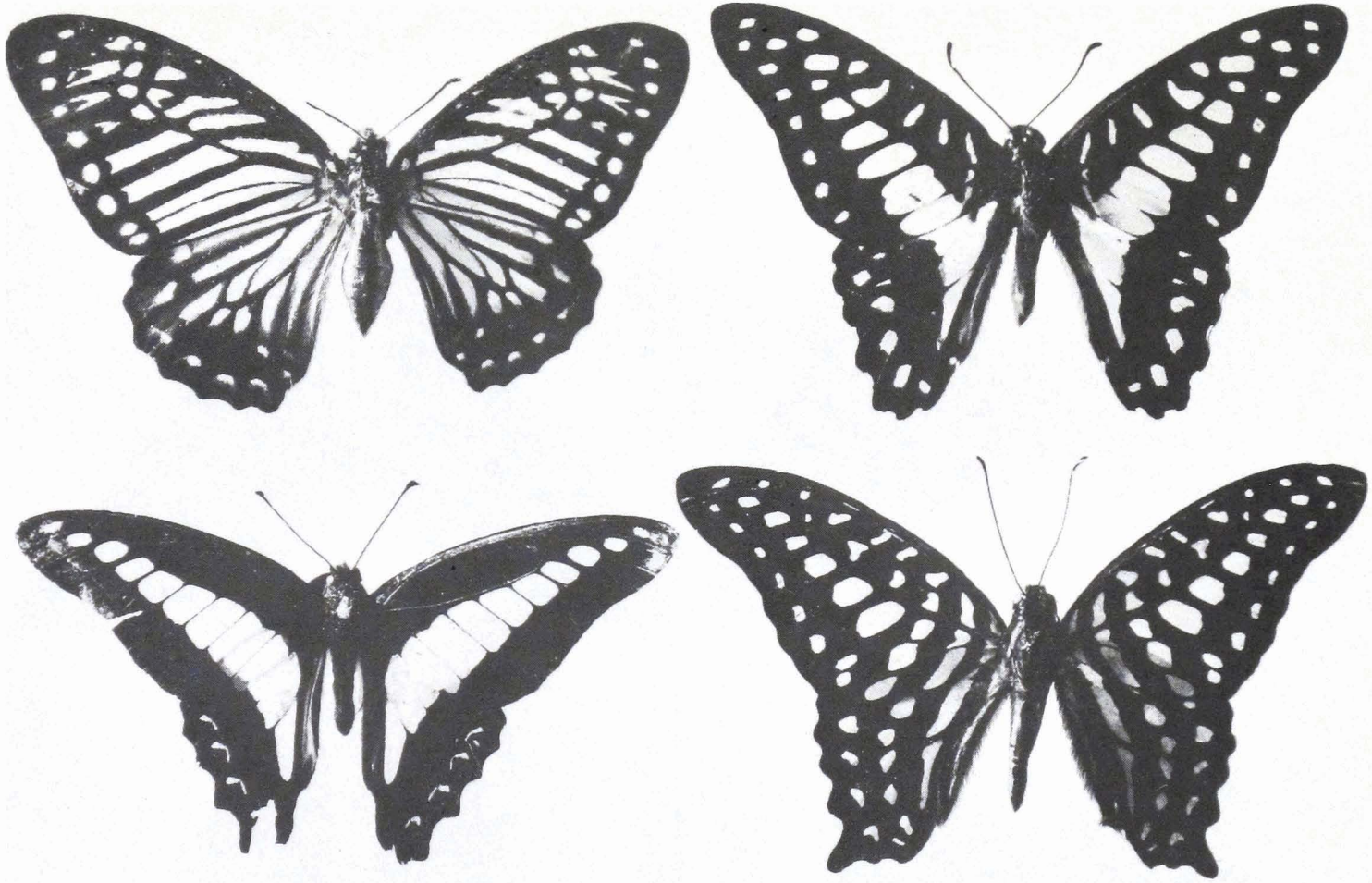

PLATE X. Top row left: *Graphium macareus*
right: *Graphium doson*

Bottom row left: *Graphium sarpedon*
right: *Graphium agamemnon*

PLATE XI. Top row left: *Graphium aristeus*
right: *Graphium payeni*

Bottom row left: *Graphium agetes*
right: *Graphium glycerion*

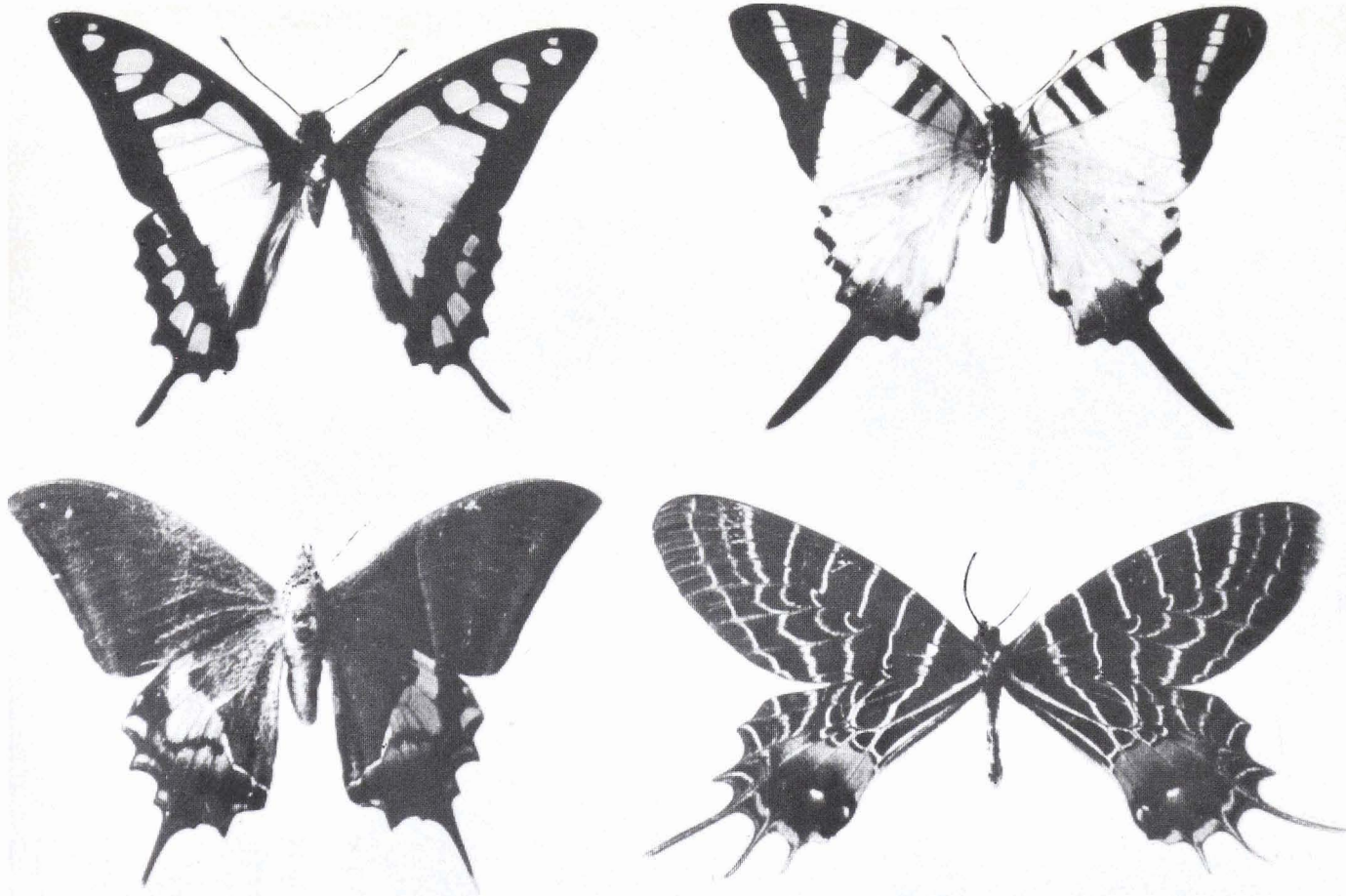

PLATE XII. Top row left: *Graphium cloanthus cloanthus*
right: *Graphium antiphates*

Bottom row left: *Teinopalpus imperialis*
right: *Armandia (Bhutanites) lidderdalei*

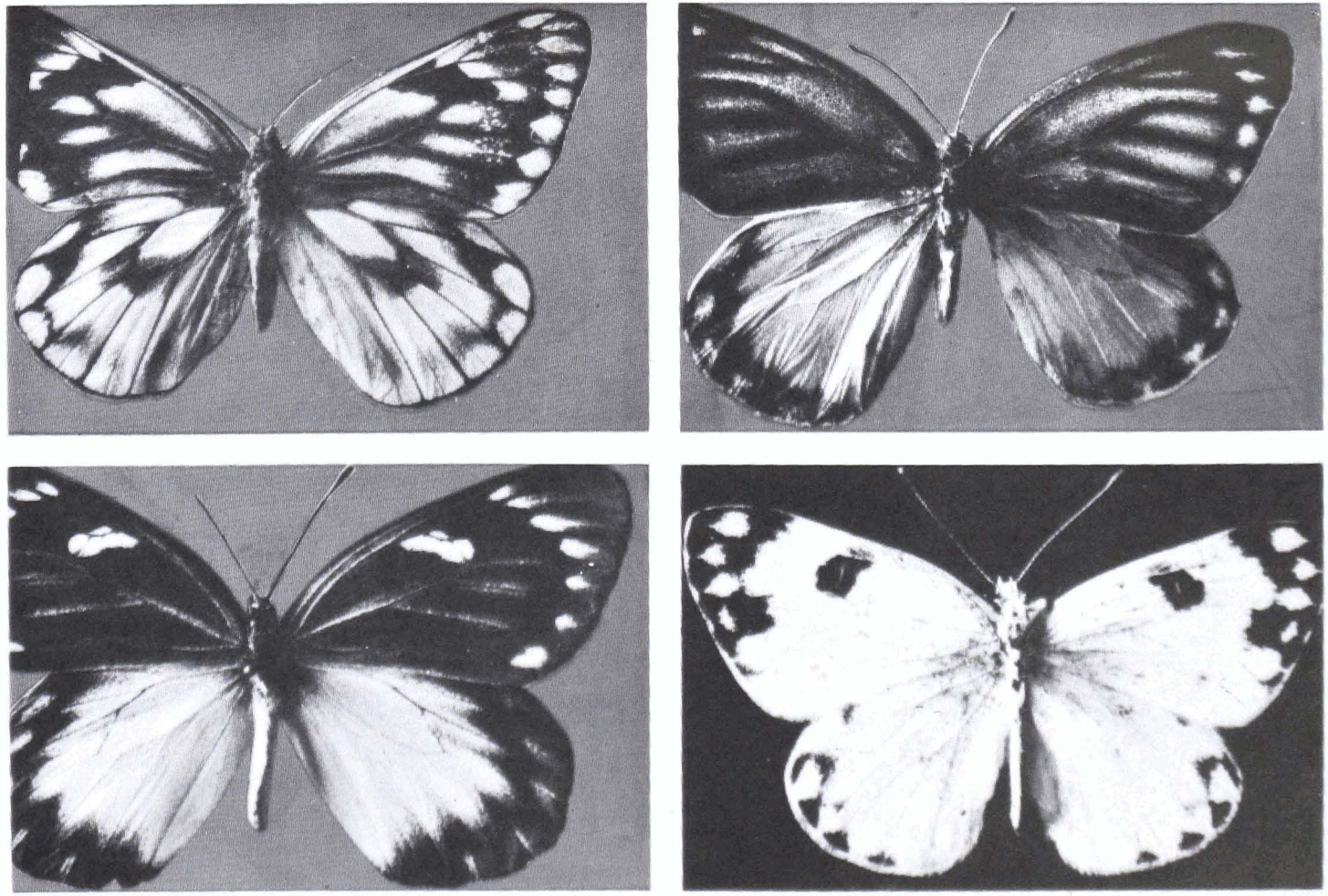

PLATE XIII. Top row left: *Delias sanaca*
right: *Delias agostina*

Bottom row left: *Delias descombesi*
right: *Pontia chloridice*

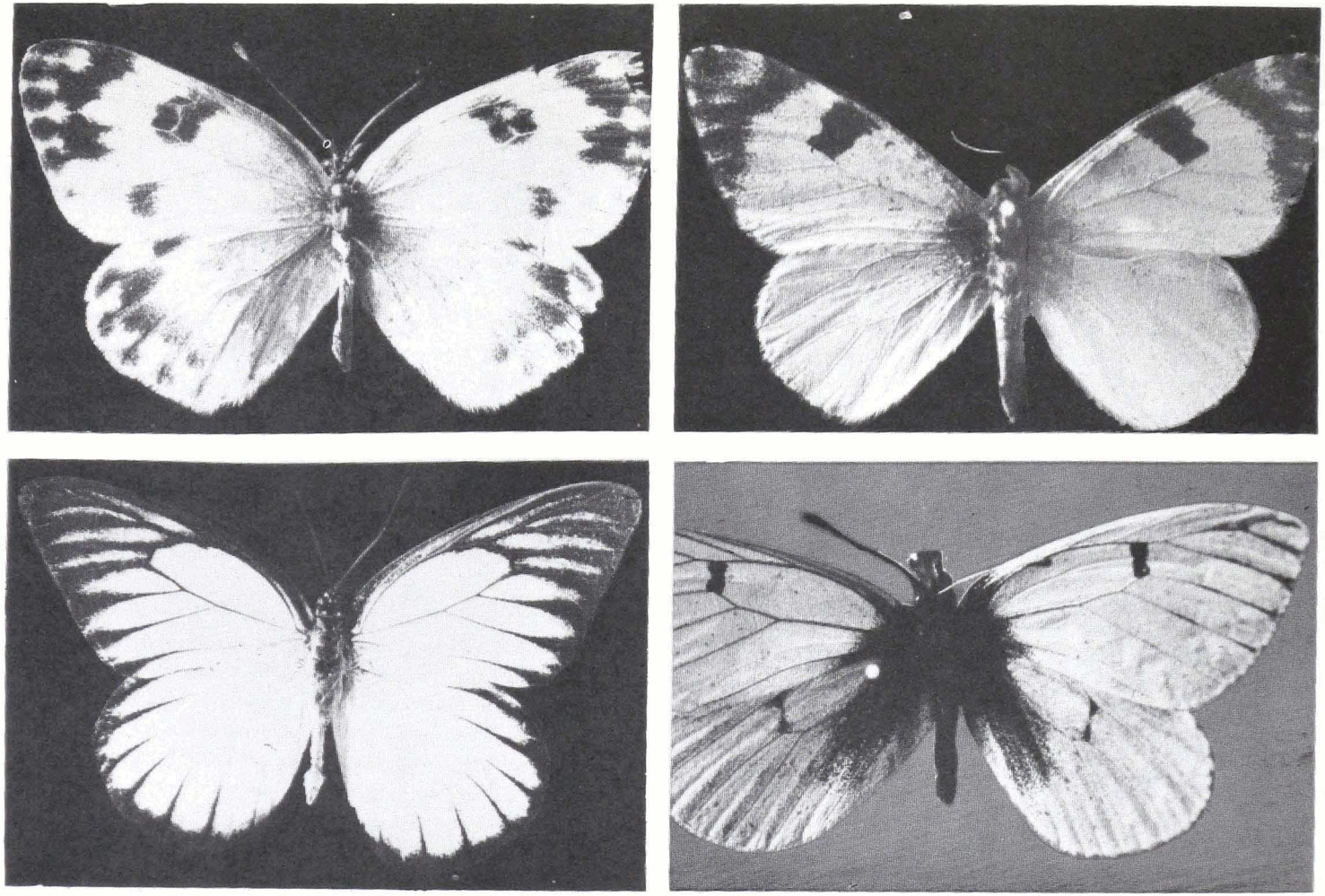

PLATE XIV. Top row left: *Pontia glauconome*
right: *Pontia daplidice*

Bottom row left: *Prioneris clemanthe*
right: *Baltia butleri*

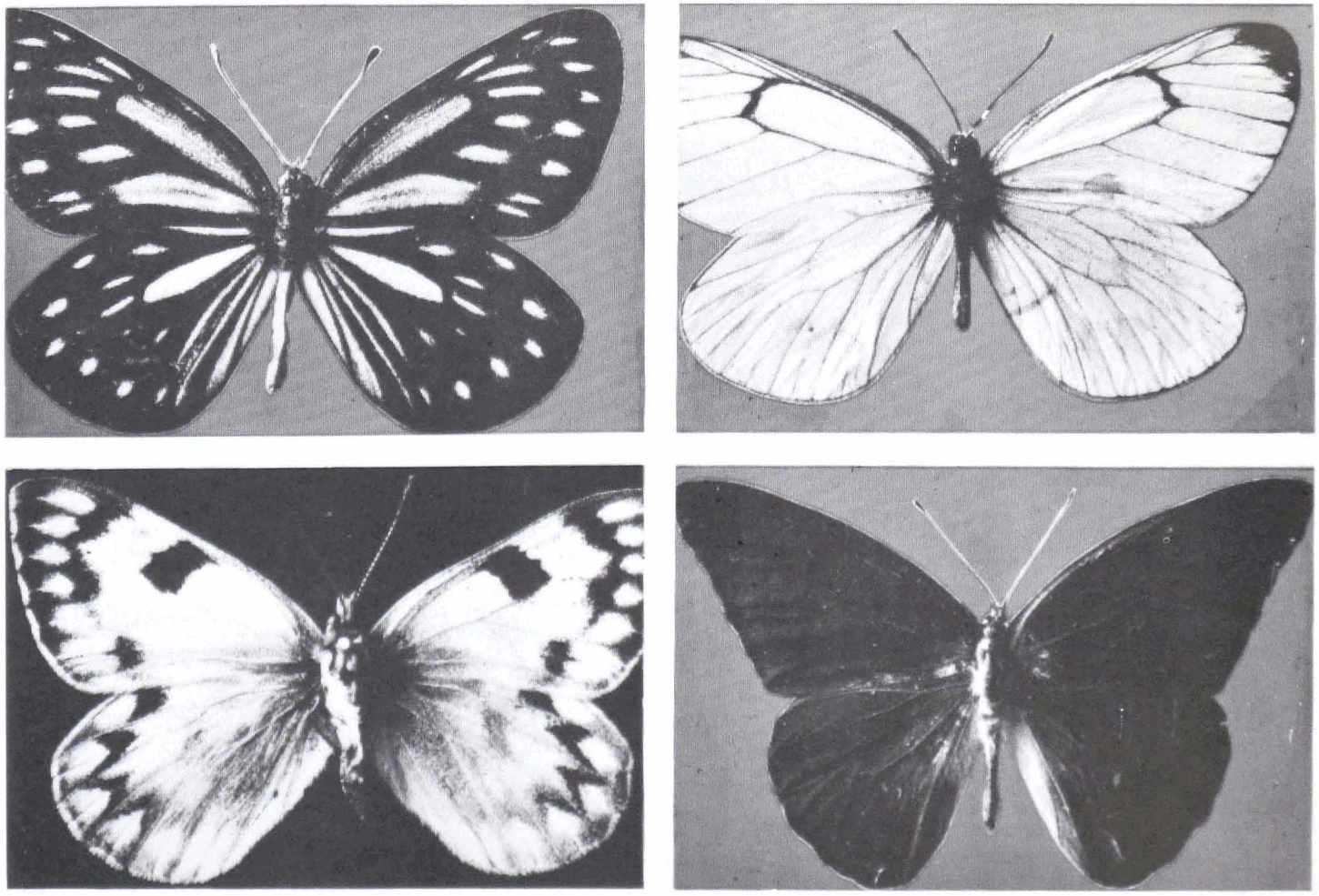

PLATE XV. Top row left: *Aporia agathon*
right: *Aporia nabellica*

Bottom row left: *Pieris dubernardi*
right: *Pieris callidice*

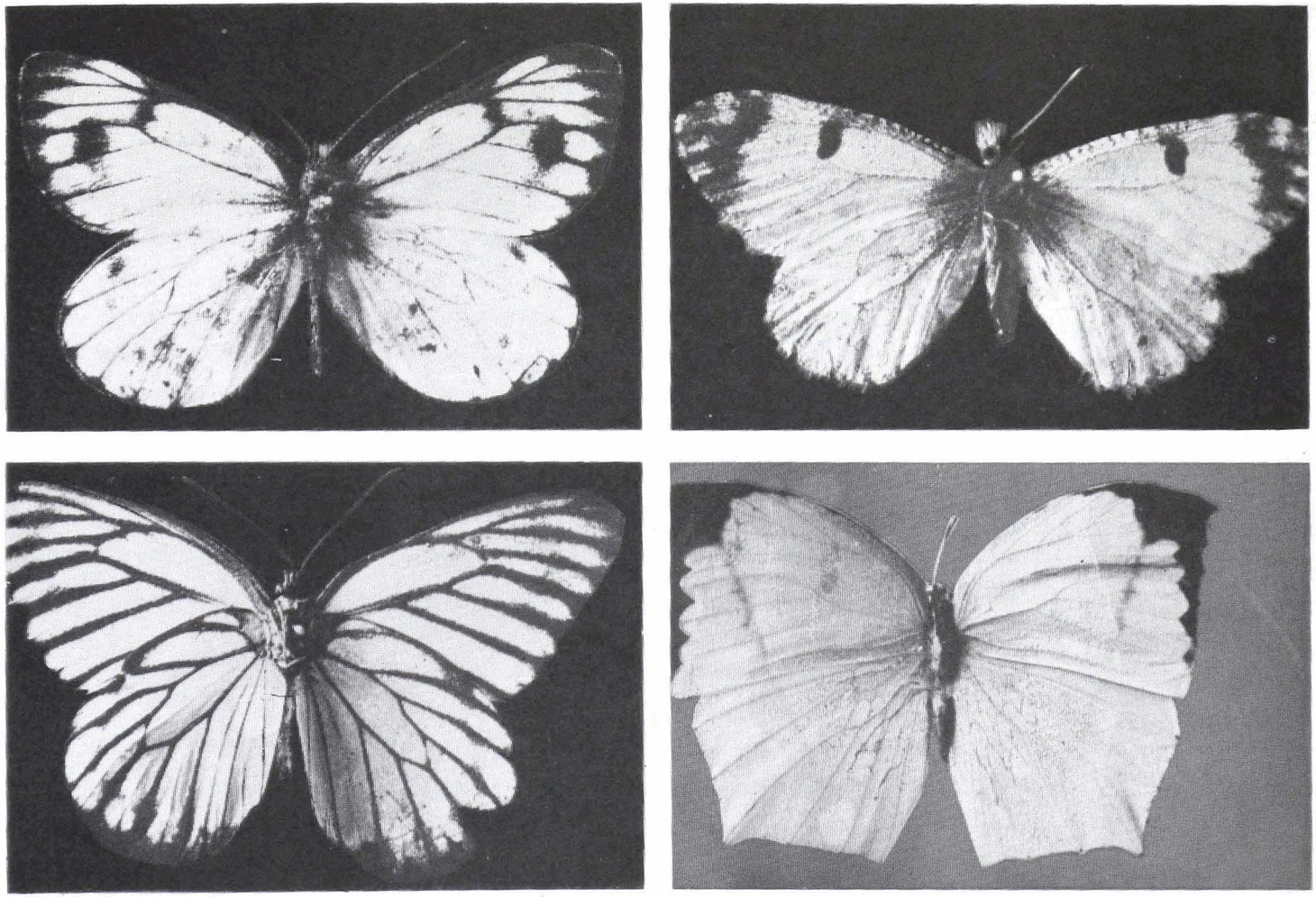

PLATE XVI. Top row left: *Euchloë ausonia*
right: *Euchloë charlonia*

Bottom row left: *Appias nerio*
right: *Dercas verhuelyi*

male 80-95 mm, female 90-100 mm. It ranges from southwest China, Yunnan, Burma, southeast Tibet and East Himalaya at elevations from 1500 to 3000 m. It is also reported from Assam hills. The Himalayan form is designated as subspecies *D. berinda boyleae* Butler.

PONTIA FABRICIUS

Fore wing above with broad black area, enclosing white spots; discocellular spot large, subquadrate; hind wing below greenish, with white post-discal and marginal spots; fore wing with veins R_3, R_4, R_5 fused together. A Holarctic genus, occurring also in Africa, with 3 species in the Himalaya.

Key to species

1. Hind wing with veins yellow below ..... *Pontia glauconome* Klug
   Hind wing with veins not yellow below.....2
2. Hind wing below with sub-basal rounded spot in front of vein R_3.....*Pontia daplidice* (Linn.)
   Hind wing below with sub-basal, short white bar in front of vein R_3..... *Pontia chloridice* (Hübn.)

Pontia glauconome Klug
(Plate XIV)

This species is reported from Middle Asia, Asia Minor, North and East Africa, Hindu Kush and Northwest Himalaya. Hind wing above with 4 small marginal spots on veins Cu to M_1; a dry-season form is described as having narrower markings on hind wing below somewhat greenish.

Pontia daplidice (Linnaeus)
(Plate XIV)

Fore wing above with large discocellular black spot; broadly black apically, with white submarginal spots; hind wing below with a round white cell spot. It is widely distributed in Europe and North Africa, China, Siberia and is represented by the subspecies *P. daplidice moorei* (Röber) in Northwest Himalaya and Tibet, up to almost 2800 m.

Pontia chloridice (Hübner)
(Plate XIII)

Fore wing above with black discocellular spot; below the discocellular spot is white-centred; hind wing with green markings. A Palaearctic species, represented by *P. chloridice alpina* (Verity), with a wing span of 50 mm, darker hind wing below, in Northwest Himalaya.

PRIONERIS WALLACE

Fore wing with costa arched, serrate in male; cell a little over 0.50 of wing length; veins R_1 and R_2 arising from cell; veins R_4-R_5 and R_3 long stalked; middle discocellular longer than posterior discocellular; hind wing with costa straight almost to wing tip, beyond strongly arched to tornus; precostal vein curved distally; palpi fringed with hair; eye not hairy (Fig. 10C).

Prioneris clemanthe (Doubleday)
(Plate XIV)

Fore wing above white, veins dark; hind wing often with a narrow black border; hind wing below with a basal red spot; outer margin with submarginal spots. Wing span 80-90 mm. The species ranges from south China, Malaya, Burma to East Himalaya.

Prioneris thestylis (Doubleday)

Fore wing above white, with black apical area, enclosing white spots; wing span 70-90 mm. The species extends from south China, Taiwan, Malaya through Burma to West Himalaya.

APPIAS HÜBNER

Club abrupt, flattened; third palpal segment slender; costa widely arched; outer margin straight; cell slightly more than 0.50 of length; veins R_1 and R_2 from cell; veins R_3, R_4 and R_5 long stalked; middle discocellular about 0.50 of the posterior; hind wing with long precostal vein (Fig. 3B). This is an Indo-Australian genus, extending to parts of China and Africa.

Appias nero (Fabr.)
(Plate XVI)

Wing span 65-80 mm; wings above crimson to orange; veins black; outer margins dusted black; fore wing below apically and most of hind wing below yellow; fore wing below discally and basally orange. The species occurs in Thailand, Burma to East Himalaya, almost up to the eastern borders of Nepal (Bhutan-Sikkim).

BALTIA MOORE

Antennae slender, club large, abrupt, third palpal segment shorter than second; fore wing with costa arched basally, straight apically, outer margin convex, inner margin straight; cell more than 0.50 of wing length (Fig. 2D); vein R_1 from cell; veins R_5-R_4 and R_3 long-stalked, vein M_1 arising from stem of R_5-R_4 and R_3 midway between cell and wing tip; vein M_2 from near

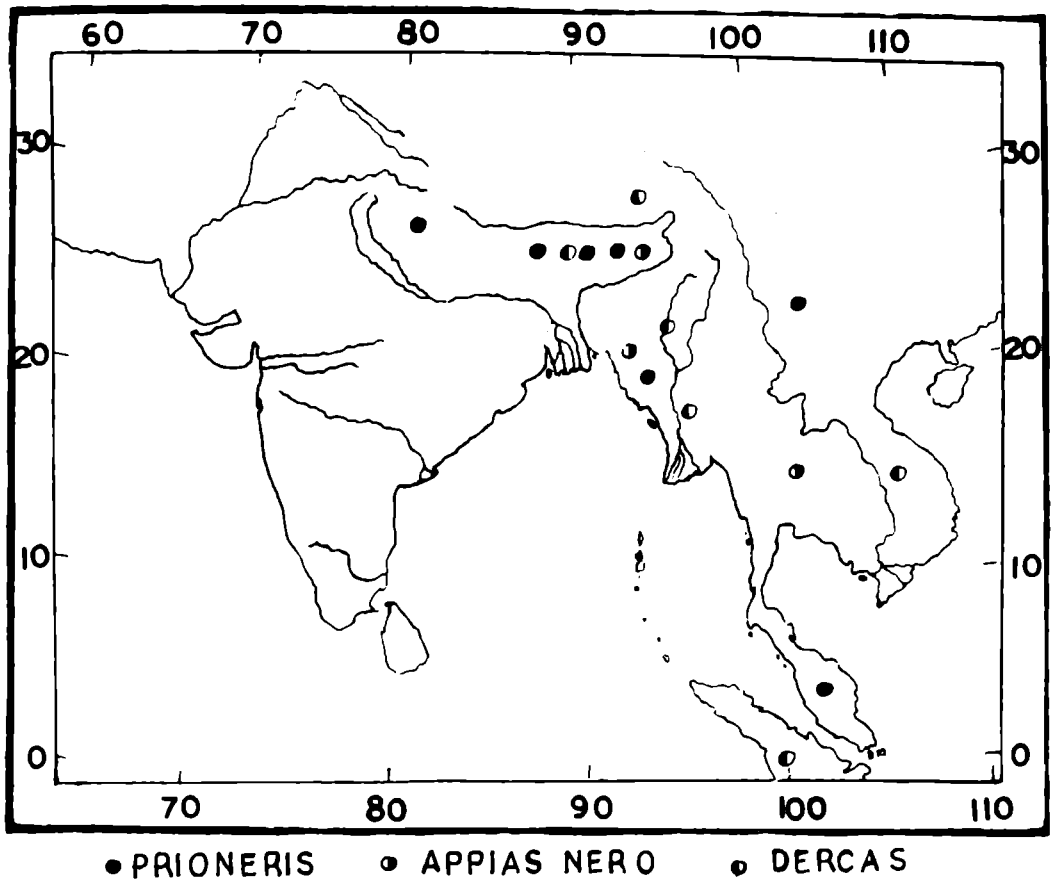

Fig. 14. Distribution of *Prioneris*, *Appias nero* and *Dercas*.

of stem; hind wing ovate, with precostal vein long, curved distally, vein R_1 very short; pulvilli and paronychia absent. The genus is distributed on the mountains of Middle Asia, Mongolia, Tibet and is represented by two species in the Himalaya.

Baltia bulteri (Moore)
(Plate XIV)

Fore wing above with small markings; below white; veins dusky; costa tinted narrowly pink-red; discocellular as on upper side; hind wing above with 2 discocellular spots, below pink-red, veins white; wing span 35-45 mm. Distributed from Ladakh to West Himalaya and occurring at elevations up to 5485 m; a somewhat more brightly coloured form is reported from Sikkim at elevations of 3660-5180 m. It is also reported from eastern Tibet.

Baltia shawi (Bates)

This species differs from *B. butleri* in the hind wing below dusted with

black scales; fore wing above white, basally with black scales; veins Sc and R_1 with dust of scales; black spot at end of cell; subapical, subtriangular, narrow, oblique black bar and series of balck marginal spots; fore wing below white; costa and outer margin with a yellowish-orange line; wing span 30-40 mm. The species occurs in the mountains of Middle Asia, Hindu Kush and Northwest Himalaya, at elevations of 4500-5485 m.

APORIA HUBNER

This Palaearctic genus is recognised by somewhat elongate wing; elongate cell exceeding 0.50 of wing length; veins R_1 and R_2 from cell; veins R_5-R_4 and R_3 stalked together, from which stalk arises vein M_1 at basal 0.33; vein M_2 arises from cell; hind wing elongate-pyriform.

Key to species

1. Hind wing with vein Sc-R_1 short, ending in front of level of origin of M_1 ..... *Aporia peloria* (Hewitson)
   Hind wing with vein Sc-R_1 extending beyond the level of origin of vein M_1 2
2. Hind wing above with dark border 4
   Hind wing above bordered pale yellow 3
3. Hind wing above unmarked, without sagittate discal band ..... *Aporia leucodice* (Eversm.)
   Hind wing above with sagittate discal band ..... *Aporia nabellica* (Boisduval)
4. Fore wing above black, with a series of postcellular white spots ..... *Aporia harrietae* (de Nicev.)
   Fore wing above with white discal area, veins dark ..... *Aporia agathon* (Gray)

Aporia peloria Hewitson

Female fore wing above and hind wing below yellow; male with fore wing above white tinged yellow and below and female hind wing above yellow; fore wing in male subhyaline apically; wing span 40-45 mm. Distributed from west China across Tibet to West Himalaya (3900 m).

Aporia leucodice (Eversmann)

Fore wings above white, without dark suffusion; submarginal band and variable discocellular marking. Distributed in Middle Asia, Iran and Baluchistan and represented by 3 subspecies in the Himalaya: *A. leucodice balucha* Marshall, with broader black bands than the typical form and somewhat larger is reported at elevations of 2400-3050 m from Baluchistan and Northwest Himalaya. *A. leucodice soracta* Moore, larger than the

preceding subspecies, with vein black, occurs in Northwest and West Himalaya. *A. leucodice sara* Evans is reported from Kumaon.

Aporia nabellica (Boisduval)
(Plate XV)

This species is restricted to the Himalaya. With a wing span of 50-65 mm, fore wing above in male pale yellow, with black, with a submarginal series of quadrate spots, large diffuse discocellular patch; below white, veins blackened; fore wing slightly yellowed apically; hind wing below dark yellow; male above white, suffused with black scales. The subspecies *A. nabellica hesba* Evans is reported at an elevation of 2700 m from Chitral and the nominotype occurs up to Kumaon and at elevations of 3900 m; discal band sagittate above in hind wing.

Aporia harietae de Nicéville

Fore wing above with white markings; hind wing with a large yellow spot basally of costa; both wings with cell stripe; fore wing with a row of 5 post-cellular spots; hind wing spots similar, but smaller; wing span 70-80 mm. The species is reported from Yunnan, west China, southeast Tibet and East Himalaya (Bhutan).

Aporia agathon (Gray)
(Plate XIV)

Extending from Taiwan, Yunnan and Burma, the species reaches up to Garhwal in the Himalaya. The Himalayan forms from the east are darker than the western forms. Black above, with white discal and submarginal stripes; hind wing below yellow basally of costa, cell white above. *A. agathon agathon* (Gray) occurs in north Burmese mountains and reaches up to Nepal in the Himalaya; *A. agathon ariaca* (Moore) is restricted to Kumaon, *A. agathon caphusa* (Moore) to Garhwal and *A. agathon phryxe* (Boisduval) extends across Garhwal to Northwest Himalaya. Mean wing span of the different forms in the Himalaya 80-90 mm.

PIERIS SCHRANK

This Holarctic genus is fairly widely distributed in the Indo-Malayan area.

Fore wing with cell exceeding 0.50 of wing length; veins R_1 and R_2 arising from cell; veins R_5-R_4 and R_3 stalked together, from which arises vein M_1; middle discocellular oblique, longer than posterior discocellular; hind wing subtriangular, with cell more than 0.50 of wing length; precostal vein long, strongly curved distally; middle discocellular shorter than either anterior or posterior; outer margin short, slightly arched.

Key to species

1. Club large, spatulate; hind wing above with post-discal or submarginal series of spots 2
   Club not large and not spatulate; hind wing above without post-discal or submarginal series of spots 3
2. Hind wing below with green markings ..... *Pieris callidice* Hübn.
   Hind wing below with the markings not green ..... *Pieris dubernardi* Oberthur
3. Fore wing above with a wedge-shaped, subapical black costal patch ..... *Pieris krueperi* Stgr.
   Fore wing above without a wedge-shaped, subapical black costal patch 4
4. Hind wing below with veins bordered black 5
   Hind wing below with veins not bordered black 6
5. Fore wing with small, rounded black spots above in front of vein Cu_{1a} ..... *Pieris napi* (Linnaeus)
   Fore wing with large black spot in front of vein Cu_{1a} ..... *Pieris extensa* Pouj.
6. Fore wing above with the marginal black reaching behind to back of vein Cu_{1a} 7
   Fore wing above with marginal black not reaching behind to back of vein Cu_{1a} ..... *Pieris rapae* (Linnaeus)
7. Fore wing above with the inner edge of black area dentate 8
   Fore wing above with the inner edge of black area not dentate ..... *Pieris brassicae* (Linnaeus)
8. Hind wing above with continuous black marginal band ..... *Pieris deota* (de Nic.)
   Hind wing above without marginal band, but only specks ..... *Pieris canidia* (Sparrm.)

Pieris callidice Hübn.
(Plate XV)

Fore wing above in female with black markings; in male white, with discocellular spot; black marginal spots on veins; below markings green; hind wing with pale sagittate spots above in male, darker basally; outer margin black, with submarginal white spots. This is Palaearctic species, widely distributed on mountainous areas, extending through the Hindu Kush across Northwest Himalaya to Kumaon; represented in the Himalaya by the subspecies *P. callidice kalora* Moore, with a wing span of 50-60 mm.

Pieris dubernardi Oberthür
(Plate XV)

Turkmenian species from the south Palaearctic, extending to north and

west China, Yunnan and eastern Tibet and is represented in East Himalaya by the subspecies *P. dubernardi chumbiensis* (de Nicev.), at elevations of 4200 m. Wing span 45-60 mm, fore wing above with black spot in front of vein Cu_{1a}, below basally white and apically yellow, veins broadly black bordered; hind wing above with apical black spot and post-discal black; male with black veins, costa narrowly black, outer margin broadly black; below with distal marginal area yellow; fore wing above brownish-black; hind wing yellow.

Pieris krueperi Staudinger

Fore wing above with a large subapical costal subtriangular black patch; marginal spots coalescent; fore wing above dusted with black scales at base of costa; below outer marginal area greenish-yellow; hind wing densely dusted black scales in the basal 0.66; wing span 50-55 mm. A Mediterranean species, occurring in *Middle Asia and represented by subspecies *P. krueperi devta* (de Nicev.) in the Pamirs-Northwest Himalaya.

Pieris napi Linnaeus

A widely distributed and highly variable Holarctic species, reaching through the Himalaya to the mountains of Burma, with fore wing above apically black; below veins black edged; hind wing below green. The subspecies *P. napi ajaka* Moore, with a wing span of 40-55 mm occurs up to Kumaon; *P. napi montana* Verity with a wing span of 50-60 mm occurs in East Himalaya to Burmese mountains and *P. napi melaina* Rober somewhat darker than others is reported from eastern Tibet and Sikkim, at high elevations.

Pieris extensa Poujade

A west Chinese species, represented by the subspecies *P. extensa bhutya* Talbot, with wing span of 70-80 mm, fore wing above white, with narrow apical black border; hind wing above with the veins edged with black, in Bhutan (East Himalaya) at elevations of 3000 m.

Pieris deota de Nicéville

Wing span 60 mm; fore and hind wings above with black outer border, dentate inside in fore wing; fore wing below apically and marginal border ashy-brown; densely dusted black. Reported at an elevation of 3300 m from Northwest Himalaya.

Pieris rapae Linnaeus

A widely distributed Holarotic species, with wing span of 45-55 mm.

*Erroneously called Central Asia in the English language publications.

fore wing above white, dusted basally black, is represented by the subspecies *P. rapae iranica* Le Cerf with somewhat relatively large black area above in fore wing, at elevations up to 2400 m in Northwest Himalaya.

Pieris brassicae Linnaeus

Palaearctic species; with fore wings white above, apical black reaching back up to vein M_3; below with discal black spots two, yellow in hind wing; the Himalayan examples often have somewhat extensive black markings; occurring in the whole of Himalaya and extending to Assam hills and also Yunnan.

Pieris canidia Sparrman

A Turkmenian species that occurs also in China and extends through the Himalaya to Burma and Malaya and occurs disjointly in the Nilgiri Mountains in South India. Wing span 55 mm; fore wing above with marginal black border dentate inside; hind wing margin with black vein spots and with a costal black spot.

EUCHLOË HÜBNER

Fore (Fig. 15A) wing with vein R_4 and R_5 separate; vein M_1 arising from the stem of R_4, R_5 and R_3 midway between apex of cell and origin of vein R_3; middle discocellular short; cell about 0.50 of wing length; hind wing long, with costa arched, obtusely angulate in the middle; outer margin somewhat convex, short; precostal vein curved distally in a wide angle. A Holarctic genus, particularly abundant in the Southern and Eastern Palaearctic areas.

Key to species

1. Hind wing below green with white patches .....*E. ausonia* (Hübn.)
   Hind wing below uniformly green ..... *E. charlonia* (Donzel)

Euchloë ausonia Hübner

(Plate XVI)

Wing span 40-45 mm. Fore wing above without yellow; apically black; discocellular spot black; hind wing below with irregular greenish-brown lines, enclosing pearly spots. South Palaearctic species, extending east to Siberia, Middle Asia, North Africa and represented in the Himalaya by the subspecies *E. ausonia daphalis* (Moore) occurring up to West Himalaya.

Euchloë charlonia Donzel

(Plate XVI)

A South Palaearctic species, with hind wing below green or greenish-

brown; fore wing yellow; wing span 35-45 mm; reported from Baluchistan and western end of Northwest Himalaya.

In addition to the genera mentioned above, sometimes we find on the Himalaya stragglers of the lowland *Ixias* Hübner on the foothills.

Subfamily COLIADINAE

Club gradual; third palpal segment very short; wings generally yellow or orange coloured; fore wing with vein M_1 emitted from R_5; veins R_4 and R_5 coincident; hind wing with the precostal vein obsolete or nearly so.

Key to genera

1. Precostal vein absent or almost obsolete 4
   Precostal vein very short, directed basally 2
2. Fore wing with the margin between veins R_4-R_5 and M_1 acutely pointed..... *Dercas* Doubleday
   Fore wing with the margin not thus pointed, but rounded..... 3
3. Precostal vein very short, stout ..... *Catospilia* Hübner
   Precostal vein slender ..... *Gandaca* Moore
4. Fore wing with vein R_2 emitted from cell 5
   Fore wing with vein R_2 from the stem of veins R_4-R_5 and R_3 .... *Colias* Fabr
5. Hind wing produced to a tooth at vein M_3 in the margin..... ..... *Gonepteryx* Leach
   Hind wing margin not thus dentate, but rounded.. *Eurema* Hübner

DERCAS DOUBLEDAY

Precostal vein short, stout, turned basally; margin dentate between the ends of veins R_4-R_5 and M_1; cell not quite 0.50 of wing length; outer margin angulate, with a short tail at end of vein M_3. The genus is distributed in mountainous areas of China, Burma, Sumatra Borneo and is represented by two species in the Himalaya.

Dercas verhuelli doubledayi Moore
(Plate XVI)

Fore wing above yellow, with a large apical dark patch, reaching behind to vein M_2; outer narrow dark border, crenulated inside; wing span 60-70 mm. Distributed from north Burmese mountains to East Himalaya.

Dercas lycorias lycorias Doubleday

Fore wing usually with large dark spot in front of vein Cu_{1a}; hind wing not produced at vein M_3; wing span 50-60 mm. The species occurs in China, Tibet, Indo-China and Assam including East Himalaya.

GONEPXTERYX LEACH

Fore wing (Fig. 10 B) with costa strongly arched before wing tip, which is falcate; cell more than 0.50 of wing length; veins R_1 and R_2 from cell; hind wing with the outer margin dentately produced at end of vein Cu_{1a}; precostal vein absent. A Palaearctic genus, extending through the Himalaya to the mountains of Burma.

Gonepteryx rhamni Linnaeus
(Plate XVII)

A widely distributed Palaearctic species, occurring in Japan, Burma and the Himalaya, is yellow above and pale yellowish-green below; above with an orange discocellular spot on both wings; hind wing with the outer margin not dentate between vein M_3 and anal vein, but with a projection at end of M_3; wing span 60-70 mm; both wings with marginal reddish-brown vein dots. The nominotype occurs in the whole of Europe and extends east to Siberia, Baluchistan, Middle Asia and extreme northern end of Northwest Himalaya. The subspecies *G. rhamni nepalensis* Doubleday is somewhat smaller, but deeper yellow and with larger and brighter discocellular spots extends from Northwest Himalaya eastwards to the mountains of Burma. *G. rhamni gilgitica* Tytler and *G. rhamni burmensis* Tytler are two other subspecies reported respectively from Northwest Himalaya and the Burmese mountains.

Gonepteryx farinosa Zeller

This species is deeper yellow in fore wing than on the hind wing and is somewhat smaller than the foregoing species. It is a Turkmenian form that extends to Chitral in Northwest Himalaya.

Gonepteryx mahaguru Gistel

This is a Palaearctic species that occurs also in Japan, Taiwan, China, Yunnan and north Burma and is represented by the nominotype in Northwest Himalaya, which extends to Kumaon. Wing span 50-55 mm; fore wing above yellow; with marginal reddish-brown vein dots only in the anterior area; below dark cream-coloured, with some green tint and somewhat paler behind; hind wing cream-coloured, with reddish-brown vein dots on outer margin.

CATOSPILIA HÜBNER

This is largely an Indo-Australian genus, with some species occurring in Africa, recognised by the characters given in the key to genera above. Stragglers of the mainly lowland species *Catospilia crocale* (Cramer), distributed from the Solomon Islands to south China, Philippines, Sunda

Islands and the whole of India, Burma and Ceylon, may be commonly found in the low hills of the outer Himalaya in the east.

GANDACA MOORE

This is also apparently an Indo-Australian genus with *G. harina* (Horsfield) reported from Sikkim and Assam hills.

EUREMA HÜBNER

An Indo-Australian genus of small-sized butterflies, with the cell in fore wing not quite 0.50 of wing length; veins R_1 and R_2 free; vein R_4-R_5 and R_3 short, but with long stalk. A number of species are reported from Africa, south of Sahara, South and parts of North America. The following Himalayan forms are not very easily separated, because of the occurrence of transitional forms and the following species are perhaps more or less recognisable.

Eurema andersoni andersoni Moore

Fore wing above greenish-yellow; margin bordered black and inside with 3 curves; below somewhat paler than above; hind wing with narrow outer black border; wing span 45 mm. Extending from north Borneo through the Sunda Islands and Burma to East Himalaya (Sikkim).

Eurema jordani Corbet & Pendlebury

Wing span 42 mm; fore wing as in the foregoing species, but the black border behind continued along the inner margin for almost 0.50 of wing length; black border in wing becoming wider from wing apex to the anal angle. Reported from East Himalaya.

Eurema hecabe fimbriata Wallace
(Plate XVII)

Wing span 40-50 mm; fore wing above with very narrow black border; hind wing with marginal dots. Reported from West and Northwest Himalaya.

Eurema hecabe contubernalis Moore

E. hecabe is represented by this variable subspecies in the Malay Peninsula, Burma and East Himalaya. Fore wing above yellow, but differing in tone according to locality and season; black outer border narrowly continued along costal margin to wing base; black border in hind wing narrowed both in front and behind; in dry localities the black border is somewhat narrower than from moist localities or during the wet season.

Eurema laeta sikkima Moore

This subspecies of *E. laeta* (Boisduval), widely distributed from Japan through China, Philippines, Sunda Islands, Borneo, Malaya and Burma, India and Ceylon, is somewhat larger than the typical form, with the fore wing black in the apical 0.33, extending along costa narrowly to base, with the inner edge oblique and sinuate; hind wing with the black marginal border uniform. Examples from dry localities have fore wing somewhat more pointed than the typical form; wing span 30-40 mm; reported from Thailand, Java, Burma and East Himalaya.

COLIAS FABRICIUS

Club gradually thickened, but distinct; third palpal segment short; tarsi long, spiny, without paronychia or pulvilli; cell about 0.50 of wing length; fore wing (Fig. 4 B), (Fig. 15 B) with vein R_1 from cell; veins R_4-R_5, R_3 and R_2 stalked; precostal vein in hind wing very minute or absent; generally above yellow or orange or orange-red coloured. This is a Holarctic genus, extending along the Andes and also occurring in Africa and widely distributed in the Indo-Australian areas and in the hills of South India. Nearly fifteen species are known from the Himalaya.

Key to species

1. Fore wing above yellow, orange-yellow or sometimes also white...2
   Fore wing above orange or orange-red 10
2. Discocellular spot on hind wing below white; without a pale centre on fore wing below 3
   Discocellular spot on hind wing below not wholly white; pale centred on fore wing below 5
3. Discocellular spot absent in fore wing above .....*Colias macropolo* ..... Gr.-Grsh.
   Discocellular spot dark on fore wing above 4
4. Fore wing above yellow or orange in female and yellowish-orange in male; hind wing with a large orange discocellular spot; costa and cilia of fore and hind wings pale red ..... *Colias wiskotti* Stgr.
   Fore wing above white or sometimes pale green; discocellular spot on hind wing above white; cilia and costa of fore and hind wings white ..... *Colias alpherakyi* Stgr.
5. Hind wing above broadly with a pale border or with a complete row of pale spots; below with a reddish-brown patch beyond the white cell spot 6
   Hind wing above not as described above, below yellow, dusted black; fore wing above with or without submarginal spots..... ..... *Colias erate* (Esp.)

6. Fore wing above yellow or orange-yellow 8
   Fore wing above white to greenish-yellow 7
7. Discocellular spot in fore wing above large ..... *Colias cocandica* Ersch.
   Discocellular spot in fore wing above small ..... *Colias montium* Oberthür
8. Marginal spots in fore wing above complete ..... *Colias ladakensis* C. & R. Feld.
   Marginal spots in fore wing above not complete 9
9. Discocellular spot on hind wing above orange; pale submarginal spots separated; fore wing above orange-yellow ..... *Colias nina* Fawc.
   Discocellular spot on hind wing above yellow; marginal pale border continuous; fore wing above yellow in male, orange in female ... *Colias berylla* Fawc.
10. Hind wing above in male with a sex mark .... *Colias electo* (Linn.)
    Hind wing above without sex mark 11
11. Hind wing below bluish-green, without a red patch alongside cell spot ..... *Colias leechi* Gr. Grsh.
    Hind wing below green, with a red patch alongside the white cell spot ..... 12.
12. Hind wing below with veins pale ..... *Colias eogene* C. & R. Feld.
    Hind wing below with veins not pale 13
13. Hind wing above entirely black ..... *Colias stoliczkana* Moore
    Hind wing above black only in the discal area .. *Colias dubia* Elwes

Colias macropolo Grum-Grshimailo

Fore wing above yellow; black border traversed by yellow veins in fore and hind wing; discocellular spot mostly absent in fore wing, but present in hind wing above; fore wing below yellow, bordered grey-green, hind wing dark greyish-green, with white discocellular spot; wing span 40-45 mm. Distributed in the Alai-Pamirs and also reported from Gilgit in Northwest Himalaya.

Colias alpherakyi Staudinger

Fore wing above yellow, dusted with black scales; below light yellow; discocellular spot black above and below; hind wing above with outer border narrow or also without outer black border. A Turkmenian species, represented by *C. alpherakyi chitralensis* Verity, with wing span 50-55 mm in Chitral in Northwest Himalaya.

Colias wiskotti Staudinger

Fore wing above in male greenish-yellow to deep yellow, orange in female; black border in fore and hind wings; discocellular spot black in fore

wing above; wing span 50-55 m. Turkmenian species, occurring in the Pamirs, extends to Northwest Himalaya.

Colias montium Oberthür

Fore wing above greenish-yellow, with outer black border, enclosing 5 submarginal spots; discocellular spot small; fore wing above in female paler yellow than in male; wing span 45-55 mm. *C. montium irma* Evans is reported from eastern Tibet and Bhutan (East Himalaya) at elevations of 4260 m.

Colias cocandica Erschoff

Fore wing above in male greenish-yellow, in female sometimes greyish-white; outer border black, broad, enclosing submarginal spots; fore wing below grey-yellow; hind wing below yellowish-green, yellow border; discocellular spot in fore wing black in fore wing both above and below; wing span 35-45 mm. Distributed from west China to Turkestan, Hindu Kush, Tibet, the species is represented by *thrasibulus* Fruhstorfer at elevations of 4500-5180 m in Ladakh.

Colias ladakensis C. & R. Felder

Fore wing above bright yellow in male and orange in female; hind wing basally with yellow hairs above; submarginal spots not touching margin in fore wing; apical 0.25 of fore wing black from the front to the hind margin; discocellular spot orange above in hind wing and sometimes absent; wing span 45-50 mm. The species occurs in the Himalaya from Kashmir to Kumaon.

Colias berylla Fawcett

Fore wing above yellow, with base behind and inner margin black; discocellular spot black, ovate; apical 0.33 black; below orange, with some green tint; with 3 post-discal and a discocellular spot below on fore wing; wing span 45-55 mm. Reported from eastern Tibet and Sikkim.

Colias nina nina Fawcett

Fore wing above orange-yellow; below greenish-yellow, with black discocellular spot, 2-4 black submarginal spots below; otherwise generally like *Colias berylla;* wing span 45-55 mm. Reported from east Tibet and Sikkim at elevations of 3960-4270 m.

Colias erate (Esper)

Fore wing above in male yellow, in female sometimes white, without submarginal spots in male, but with them in female; hind wing above with outer black border; a Turkmenian species extending east to Japan and

China, and represented in the Himalaya by the nominotype; wing span 45-55 mm; variable in different localities and also showing some seasonal dimorphism; extending from the Hindu Kush through to Kumaon. The species occurs discontinuously also in the Nilgiri Mountains in South India.

Colias eogene C. & R. Felder

Fore wing above pale red, with broad black border; below yellow, basally somewhat orange-red; hind wing below greenish-yellow, with broad black border above; wing span 40-50 mm. The species is distributed in Middle Asia, Pamirs and the Himalaya. The nominotype occurs from the eastern Karakoram to Kumaon; *C. eogene shandura* Evans is reported the west Karakoram to Chitral; *C. eogene francesca* Watkins is somewhat larger, reported from Northwest Himalaya.

Colias leechi Grum-Grshimailo

Fore wing above in male orange, veins dark; costa yellow basally; discocellular spot small; below pale orange; fore wing in female with yellow submarginal spots; fore wing below pale orange; wing span 40-50 mm. Reported at elevations of 4500-5485 m in the Karakoram.

Colias stoliczkana Moore

Fore wing above in male orange-yellow, below more or less dusted green; fore and hind wings with broad black outer border, but without yellow veins; discocellular spot in hind wing below red; wing span 40 mm. Reported at elevations 3960 m in Ladakh; the subspecies *C. stoliczkana miranda* Fruhstorfer, with relatively narrow black border, is reported at elevations of 4500-5180 m in East Himalaya, near Mt Everest.

Colias dubia Elwes

Fore wing in male above orange, with narrow black basally and on costa, outer margin broadly black, below orange-yellow, costa and outer margin green; hind wing behind above green, below dark green almost to 0.20 apically from base; discocellular spot orange; wing span 40 mm; reported from eastern Tibet and East Himalaya, up to elevations of 5790 m.

Colias electo (Linnaeus)
(Plate II)

This is a south Palaearctic species, occurring in North Africa, whole of Europe, extending eastward to west China and Tibet and represented in the Himalaya by the subspecies *C. electo fieldi* Menetr. Wing span 45-55 mm; fore wing above deep orange-yellow; with a patch of dark green scales at base; discocellular spot black; outer border black; below orange-yellow;

hind wing above basally with fine hairs and dusted black scales; discocellular spots double, silvery, circled by red ring. The subspecies extends from Baluchistan through to Sikkim and north Burmese mountains.

CHAPTER VII

Family Lycaenidae

This family differs from Pieridae in the absence of precostal vein in hind wing; fore wing usually without vein R_4; hind wing often with tails filamentous; eyes usually glabrous; legs normally developed; fore legs sometimes in male with a number of hooklets at tip; wings generally blue or purple coloured, sometimes brown.

The family represents hardly 15 per cent of the total Himalayan forms.

Key to subfamilies

1. Legs with either tibia or tarsi abnormally elongated ..... *Gerydinae*
   Legs not as described above 2
2. Fore wing with veins M_1 and M_2 approximate basally, or vein M_1 emitted from vein R_5 beyond the cell 3
   Fore wing with veins M_1 and M_2 not approximate basally 4
3. Fore wing with vein R_1 fused with Sc ..... *Poritiinae*
   Fore wing with veins R_1 and Sc not anastomosed ..... *Arhopalinae*
4. Fore wing with vein R_5 ending before or at wing tip 5
   Fore wing with vein R_5 ending beyond wing tip 6
5. Hind wing without lobe ..... *Lycaeninae*
   Hind wing lobed or nearly so ..... *Theclinae*
6. Fore wing without vein R_4 ..... *Curetinae*
   Fore wing with vein R_4 ..... *Liphyrinae*

Subfamily GERYDINAE

Wings elongate, usually dull coloured butterflies; fore wing without vein R_3; third palpal segment slender, elongate; metatarsus elongate, often also flattened; tibiae sometimes swollen. The family is represented in the Himalaya by the genera *Gerydus* Boisduval with the metatarsus elongate and compressed; and *Allotinus* Felder with metatarsus not compressed.

Gerydus boisduvali Moore

Wing span 35-38 mm; fore wing above brown, with white discal spot

above; below silky-brown to purple-brown. This is distributed from Thailand, Burma, Malaya, Java and occurs in East Himalaya and the Assam mountains.

Allotinus drumila Moore

Wing span 45-50 mm; fore wing above brown; acute apex; dull white at costa basally and a broad outward discal patch from beyond apex of cell; below dull pale brown, front margin and disc mottled dark brown. The species is reported from Assam hills and East Himalaya.

Allotinus multistrigatus de Nicéville

Wing span 50 mm; fore wing not or only slightly dentate at termen; tornus obtuse; diffuse curved discal spot above. Reported from the Assam hills and East Himalaya.

The genus *Allotinus* Felder is distributed in Borneo, Sunda Island, Malaya and Burma.

Subfamily LYCAENINAE

Key to genera

1. Hind wing without tail 2
   Hind wing with one or more filamentous tails 12
2. Fore wing with veins R_1 and Sc anastomosed 3
   Fore wing with veins R_1 and Sc not anastomosed 5
3. Hind wing with costa arched 4
   Hind wing with costa straight ..... *Orthomiella*
4. Fore and hind wings below with terminal, but without discal markings ..... *Pithecops*
   Fore and hind wings below with discal markings; eyes hairy ..... *Azanus*
5. Wings above brown, never blue 6
   Wings above blue or purple 8
6. Fore and hind wings below with terminal, but without discal markings ..... *Neopithecops*
   Fore and hind wings below with discal markings 7
7. Antennae with distinct spatulate club ..... *Megisba*
   Antennae gradually thickened, but without a distinct spatulate club 9
8. Fore and hind wings below with transverse strigae; fore tibiae not very stout ..... *Spalgis*
   Fore and hind wings below with rounded dark spots; fore tibiae stout ..... *Taraka*
9. Fore wing with veins R_5 and M_1 well separated basally 10

Fore wing with the veins R_5 and M_1 closely approximated basally 11

10. Hind wing with veins M_3 and Cu_{1a} separate basally; vein Cu_{1a} emitted from cell before vein M_3 ..... *Lycaena*
Hind wing with veins M_3 and Cu_{1a} approximated basally; emitted close together from the hind apex of cell ..... *Chilades*
11. Antennae long ..... *Niphanda*
Antennae short ..... *Cyaniris*
12. Hind wing with 3 tails ..... *Lycaenesthes*
Hind wing with a single tail 13
13. Eyes hairy ..... *Nacaduba*
Eyes not hairy 14
14. Hind wing with veins Cu_{1a} and M_3 emitted together or vein M_3 emitted from Cu_{1a} beyond the posterior apex of cell ..... *Tarucus*

PITHECOPS

Pithecops hylax Fabr.

Wing span 11-13 mm; wings above brown. Distributed from Malaya and Burma and occurring on Assam hills and Sikkim (East Himalaya).

NEOPITHECOPS

Neopithecops zalmora Butler

Wing span 16-28 mm; wings above purple-brown. Distributed in Malaya, Burma, South India and Ceylon and reported from East Himalaya.

SPALGIS

Spalgis epius Westwood

Wing span 22-28 mm; wings above dull brown. Distributed in Burma and Assam hills, South India and Ceylon; reported from East Himalaya.

THARACA

Taraka hamada Druce

Wing span 20-28 mm; wings dull brown above. Distributed from Japan through China, Burma and Assam hills to Sikkim (East Himalaya).

MEGISBA

Megisba malaya Horsf.

Wing span 23-33 mm; wings above pale to dark brown. Distributed in

Malaya, Burma, Assam hills and South India, the species extends on the Himalaya from Sikkim to Kumaon-Garhwal.

CYANIRIS

Key to species

1. Wings above black or brownish-black 2
   Wings above blue or violet 3
2. Wings black above ..... *Cyaniris marginata* de Niceville
   Wings above brownish-black ..... *Cyaniris albocoerula* (Moore)
3. Wings above violet ..... *Cyaniris placida* de Nicéville
   Wings above blue or pale blue 4
4. Fore wing with costa black 6
   Fore wing with costa not black 5
5. Wings pale blue, wing span 30-34 mm ..... *Cyaniris dilecta* (Moore)
   Wings blue above; wing span 33-36 mm .. *Cyaniris coelestina* (Kollar)
6. Wing span 40-42 mm; costa, apex and termen broadly black ..... *Cyaniris vardana* (Moore)
   Wing span 26-34 mm; costa narrowly black; apex and terminal margin black ..... *Cyaniris transpecta* (Moore)

Cyaniris vardana (Moore)

Wing span 40-42 mm; fore wing with costa, apex and termen broadly black; otherwise pale blue. The species occurs from Northwest Himalaya to Kumaon.

Cyaniris marginata de Niceville

Wing span 30-35 mm; wings black, with subtriangular blue patch behind on fore wing. The species extends from the north Burmese mountains to West Himalaya.

Cyaniris albocoerula (Moore)

Wing span 33-35 mm; wing above blackish-brown. Distributed throughout the Himalaya; apparently restricted to the Himalaya.

Cyaniris transpecta (Moore)

Wing span 26-34 mm; fore wing with costa narrowly, apex broadly and terminal border black. The species is restricted to Burma, Assam and Sikkim.

Cyaniris placida de Niceville

Wing span 28-35 mm; wings above violet. Occurs from Malaya through Burma and Assam hills to the East Himalaya.

Cyaniris dilecta (Moore)

Wing span 30-34 mm; wings above pale blue. The species seems to be restricted to north Burmese mountains and the Himalaya up to Kumaon-Garhwal.

Cyaniris coelestina (Kollar)

Wing span 33-36 mm; wings above blue. This species is restricted to the Himalaya west of the Sutlej Defile.

LYCAENA

Lycaena astrarche Bergstr.

Wing span 26-29 mm; wings above brown, with a black discocellular spot. This is a Palaearctic species occurring up to Kumaon in the Himalaya.

Lycaena iris Staud.

Wing span 30 mm; wings above brown. The species is typical of Middle Asia and Northwest Himalaya.

Lycaena youngshunsbandi Elwes

Wing span 34 mm; wings above brown. The species occurs in eastern Tibet and East Himalaya.

Lycaena icarus (Rottenb.)

Wing span 32-36 mm; wings above purple-blue. This is a Palaearctic species of Northwest Himalaya.

Lycaena eros Ochs.

Wing span 28-32 mm; represented in Baluchistan by the subspecies *balucha* Moore, with wings above purple-blue.

Lycaena stoliczkana Feld.

Wing span 31-42 mm; wings above purple-blue. The species is restricted to the Himalaya and occurs from Kashmir to Sikkim.

Lycaena loewii Zell.

Wing span 30-38 mm; wings above purple-blue. This is a Mediterranean species extending into Northwest Himalaya.

Lycaena devanica (Moore)

Wing span 34-38 mm; wings above brown. Reported to occur in Ladakh.

Lycaena sarta Alpheraky

Wing span 34-37 mm; wings above dark brown. This is a Turkmenian species occurring in Northwest Himalaya.

Lycaena christophi Staud.

Wing span 30-33 mm; wings above pale blue. Restricted to Northwest Himalaya.

Lycaena omphisa Moore

Wing span 26-33 mm; wings above dark brown. Restricted to Northwest Himalaya.

Lycaena galathea Blanch.

Wing span 35-40 mm; wings above dark violet. Occurs from Kashmir to Kumaon.

Lycaena orbitulus (Esp.)

Wing span 28-30 mm; wings above brown, with metallic-blue reflections. Restricted to Northwest Himalaya.

Lycaena hylas (Fabr.)

Wing span 28-31 mm; wings above greyish-blue. This species is widely distributed in Europe and Middle Asia and also occurs in Northwest Himalaya.

Lycaena pheretes lehana Moore

Wing span 28-30 mm; wings above purple-blue. Occurs in the Ladakh Range of Northwest Himalaya.

AZANUS

Azanus ubaldus (Cramer)

Wing span 21-24 mm; wings above purple-brown, with some dark blue basally, The species extends from Northwest Himalaya eastward to Burma and also occurs in South India and Ceylon.

CHILADES

Chilades laius (Cramer)

Wing span 28-32 mm; wings above bluish-purple. The species occurs from Northwest Himalaya through to the Assam hills, Burma and South India.

ORTHOMIELLA

Orthomiella pontis (Elwes)

Wing span 30-32 mm; wings above purple-brown. The species seems to be restricted to the north Burmese mountains and East Himalaya.

NIPHANDA

Niphanda cymbia de Nicéville

Wing span 35-39 mm; wings above violet. Restricted to East Himalaya.

LYCAENESTHES

Lycaenesthes emolus (Godart)

This species is reported from Malaya, Burma, Assam hills and East Himalaya.

Lycaenesthes lycaenina Felder

This species is reported from Thailand, Borneo, Malaya, Burma, Assam hills, East Himalaya; it also occurs in South India and Ceylon.

NACADUBA

Nacaduba macrophthalma (Felder)

Wing span 30-33 mm; wings above purple-brown. The species ranges from nearly Australia, through Malaya, Burma, Assam hills to East Himalaya; South India and Ceylon.

Nacaduba pavana (Horsf.)

Wing span 30 mm; wings above purple. The species extends from Java through Burma and Assam hills to East Himalaya.

Nacaduba bhutya de Nicéville

Wing span 32 mm; wings above purplish-brown. The species is restricted to East Himalaya.

Nacaduba dana de Nicéville

Wing span 26-30 mm; wings above bluish purple. The species occurs from north Burma to the whole of Himalaya through Assam hills.

Nacaduba coelestis de Nicéville

Wing span 27-30 mm; wings above blue. The species extends from the north Burmese mountains through the Assam hills to East Himalaya.

Nacaduba hermus Felder

Wing span 26-28 mm; wings above purplish-brown. The species extends from Burma through Assam to East Himalaya and occurs discontinuously in the Nilgiri Hills in South India.

TARUCUS

Tarucus theophrastus (Fabr.)

Wing span 22-31 mm. This is a widely distributed Mediterranean species, occurring in Northwest Himalaya, Assam, Burma, South India and Ceylon.

Tarucus venosus Moore

Wing span 25-32 mm; wings above darker purple than *T. theophrastus* and occurs in the whole length of the Himalaya and also sometimes in the plains of Bengal

Tarucus plinius (Fabr.)

Wing span 22-31 mm; wings above dark violet. The species is distributed from Ethiopia to West Himalaya, plains of North India, Assam, Burma, China, Malaya, Java and Ceylon.

Curetis bulis Doubleday & Hewitson

Wing span 46-50 mm; wings above black, with orange-red patch. The species is distributed in the whole of the Himalaya, Assam, Burma and South India.

LIPHYRA

Liphyra brassolis Westwood.

Wing span 85-92 mm; wings above black, with an oblique spot. The species extends from Australia through Malaysia to East Himalaya.

PORITIA

Poritia hewitsoni Moore

Wing span 35-40 mm; wings above black. The species occurs in the Himalaya, Assam and Burma.

CHAPTER VIII

Family Satyridae

The Satyridae are a large family, representing about 35 per cent of the Himalayan butterflies. It was formerly placed as a subfamily among the Nymphalidae, but is quite distinct in several important respects.

The Satyrids are readily recognised by well marked characters; fore legs in female degenerate, without claws; in male usually with terminal tuft of only hairs; wings generally short, with the outer margin often scalloped, sinuate or also dentate; hind wings tailed, without cross-veins, so that the cell is open; with two distinct anal veins; fore wing with vein R_5 forked; Sc always and anal veins, and often Cu_1 greatly swollen basally; antennae closely approximated basally; club gradually thickened; palpi large, stout, rounded.

Most Satyrids are sombre-coloured butterflies, with the sexes often very strongly dimorphic; seasonal dimorphism often conspicuous in the Himalayan forms.

The Himalayan species belong to the genera *Mycalesis, Lethe, Rhaphicera, Pararge, Coenonympha, Maniola, Hipparchia, Aulocera, Oeneis, Erebia,* etc.

The typical mountain species have usually localised distribution in small isolated areas. Species from humid localities or specimens found in the rainy season have often large ocellar spots in wings, but these may be absent in the dry-season forms or in material from arid localities; transitional forms are common in the Himalaya, especially in the Kumaon-Garhwal regions. *Mycalesis franscisa sanatana* Moore for example, is remarkable for minute ocellar spots below in semi-arid localities, but absent in arid areas.

Key to genera

1. Eyes hairy 2
   Eyes not hairy 5
2. Anal vein 2-3 swollen ..... *Mycalesis* Hübner
   Anal veins not swollen 3

3. Hind wing symmetrical, outer margin rounded 4
Hind wing not symmetrical, outer margin excurved behind veins M_1 and M_3, being tailed at tip of the latter ..... *Lethe* Hübner
4. Fore wing with the veins M_1 and M_2 approximated at origin; anterior discocellular and middle discocellulars subequal; hind wing with the vein Cu_{1a} emitted before the posterior discocellular ..... *Rhaphicera* Moore
Fore wing with the veins M_1 and M_2 arising together; anterior discocellular shorter than the middle one; hind wing with vein Cu_{1a} arising at or nearly at the angle of posterior discocellular .. *Pararge* Hübner
5. Fore wing median vein swollen basally 6
Fore wing with the median vein not thus swollen 14
6. Fore wing cell outer margin not longer than the hind margin 7
For wing with the outer margin of cell longer than the hind margin 13
7. Fore wing with anal veins, median and Sc swollen ..... *Coenonympha* Hübner
Fore wing with the anal vein not swollen 8
8. Median vein swollen 9
Median vein not swollen 10
9. Front angle of cell acute ..... *Maniola* Schr.
Front angle of cell a right angle ..... *Hipparchia* Fab.
10. Hind wing margin crenulate; fringe checquered 11
Hind wing outer margin not crenulate; fringe not usually checquered 12
11. Wings above tawny-brown ..... *Oeneis* Hübner
Wings above black ..... *Aulocera* Butler
12. Fore wing with the posterior discocellular curved outward; vein R_2 emitted from cell ..... *Erebia* Dalm.
Fore wing with the posterior discocellular straight or curved inward; vein R_2 emitted from R_5 ..... *Ypthima* Hübner
13. Fore wing with the vein R_2 emitted from R_5 .... *Ragadia* Westwood
14. Cell right-angled; posterior discocellular straight; vein R_2 free from cell ..... *Ethiope* Moore
Cell acute-angled 15
15. Anal vein ending in outer margin ..... *Melanitis* Fab.
Anal vein ending about the middle of the inner margin ..... *Cyllogenes* Butler

MYCALESIS HÜBNER

Eyes hairy; fore wing (Fig. 15D) with costa arched; rounded at apex or sometimes acute; outer margin straight or somewhat concave; cell short, 0.50 of wing

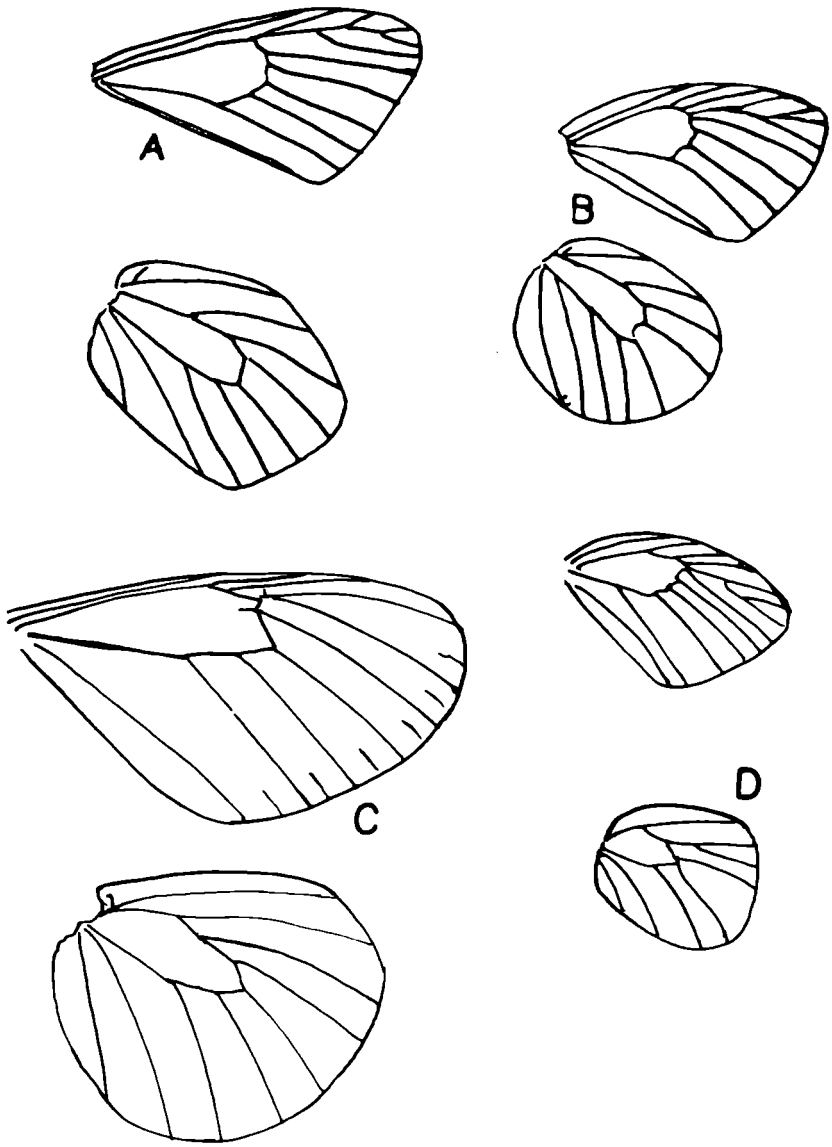

Fig. 15. Butterfly wings. (A) *Euchloe*, (B) *Colias*, (C) *Euploea doubledayi*, (D) *Mycalesis*.

length (Fig. 4D) veins R_2 and R_5 emitted before the apex of cell; anal and median veins and Sc swollen basally; hind wing ovate; outer margin sometimes slightly scalloped; cell less than 0.5 of wing length; veins M_3 and Cu_{1a} stalked together.

The genus is widely distributed in the Indo-Australian area and also occurs in China, Japan and Africa. Seven species are typically Himalayan.

Mycalesis francisa (Stoll)
(Plate XVII)

Fore wing in male above with a groove, covered by hair tuft along anal vein; ocellar spot in front of vein Cu_{1b} below, without ocellar spot in front of vein Cu_{1a}. The species occurs from Japan through Taiwan, China, Burma and is represented in Burma and the Himalaya by the subspecies *M. francisca sanatana* Moore; wing span 48-55 mm; wings dark brown above, with the outer border pale brown; black ocellus, centred white and ringed in front of vein Cu_{1b}; ocellar spot in front of M_2 smaller. The subspecies occurs throughout the Himalaya; specimens from Northwest Himalaya correspond to the dry-season form.

Mycalesis gotama Moore

Ocellar spots present as in *francisa,* but vein R_5 closer to M_1 than to R_4; vein Cu_{1a} emitted before the cell apex; posterior discocellular swollen. This species is distributed from Japan, Taiwan, China, Burma and the Himalaya. In material from East Himalaya the ocellar spots are typical, but those from Northwest Himalaya have the ocellar spots reduced to white-centred black spots.

Mycalesis perseus blasius (Fabricius)

Wing span 45-55 mm; hind wing below with the ocellus in front of vein Cu_{1a} somewhat more basal than others; discal line edged white outside; hind wing above without ocellar spot; fore wing with a small ocellar spot; hind wing with seven ocellar spots, encircled by pale line. Specimens from the semi-arid Northwest Himalaya paler brown than from East Himalaya and with the ocelli semi-obsolescent. The species extends from north Burmese mountains to the Kangra Valley in Northwest Himalaya.

Mycalesis visala Moore

Wing span 45-55 mm; ocellar spot large in fore wing above short discal line distinct; fore and hind wings below with greyish-white discal line. The species occurs in Burma, Malaya, Assam, Vindhya-Satpura and the Himalaya up to Kumaon-Garhwal; the species occurs also in South India and Ceylon; the nominotype is distributed in the Himalaya.

Mycalesis mestra mestra Hewitson

Wing span 60-70 mm; ocellar spot small; below basally mottled; cilia white; vein Cu_{1a} arising before the apex of cell in hind wing. Reported from the north Burmese mountains, Assam hills and East Himalaya.

Mycalesis heri Moore

Wing span 60-70 mm; somewhat reddish-brown; basally pale brown;

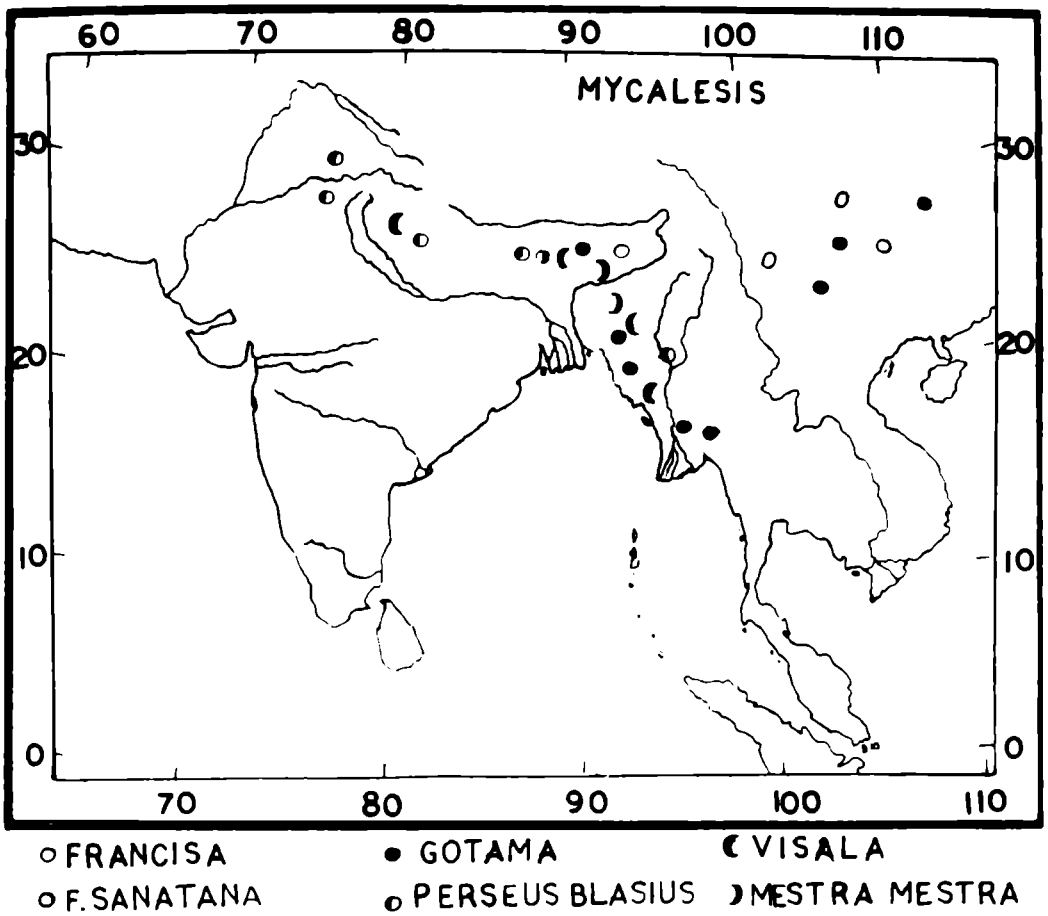

Fig. 16. Distribution of *Mycalesis*.

fore wing ocellus large; hind wing with three ocellar spots above and seven below. The species is reported from Bhutan to Kumaon.

Mycalesis lepcha lepcha (Moore)

Wing span 45-50 mm; ocellar spots absent or very minute in hind wing above, below with seven ocellar spots; cilia brown; post-discal narrow line evanescent near costa below. The species is reported from Burma, India and Kumaon Himalaya.

LETHE HÜBNER

Fore wing triangular; cell short; veins R_1 and Sc coincident in fore wing for at least 0.50 of the length (Fig. 3C); veins R_1 and R_2 emitted from a little before the apex of cell; vein Sc swollen basally; hind wing ovate, not symmetrical, outer margin scalloped, tailed at the tip of vein M_3. The genus is distributed from Borneo through the Sunda Islands, Japan, Siberia and

the Himalaya. The genus is well represented in the Himalaya, with many subspecies. Most species occur at elevations of 1500-2700; some species ascend above 3300 m and rarely up to 4200 m.

Key to species

1. Hind wing with vein R_1 about half of R_2; no ocellar spot in front of R_1 2
   Hind wing with R_1 subequal to R_2; ocellar spot present in front of vein R_1 34
2. Fore wing with the front angle of cell rounded; hind wing with more than one band in cell 3
   Fore wing with the front angle of cell acute angled 17
3. Hind wing with vein Cu_{1a} emitted before the end of cell 4
   Hind wing with vein Cu_{1a} emitted from the cell-end 15
4. Hind wing tail very short 5
   Hind wing tailed prominently at end of vein M_3 13
5. Hind wing markings below pale 6
   Hind wing markings below brown 12
6. Hind wing below with some ocellar spots larger than the others ... 7
   Hind wing below with all ocellar spots equal 11
7. Hind wing below with the ocellar spots in a straight line 8
   Hind wing below with ocellar spots in an arc 9
8. Hind wing above with dark spots edged white on the outer side .... *Lethe visrava* (Moore)
   Hind wing above without dark spots ..... *Lethe siderea* Marsh.
9. Fore wing below with apical dots 10
   Fore wing below without apical spots .. *Lethe nicetella* de Nicéville
10. Fore wing below with a white post-discal band near costa .... *Lethe dakwana* Tytler
    Fore wing below with the post-discal band not wholly white .... *Lethe sidonis* (Hewitson)
11. Hind wing below with the ocellar spots large and diffuse .... *Lethe maitrya* deNicéville
    Hind wing below with ocellar spots small and sharply defined .... *Lethe nicetas* (Hewitson)
12. Fore wing below with subapical white spots from front of vein M_3 extending to costa ..... *Lethe tristigmata* Elwes
    Fore wing below with subapical white spots from front of vein M_1 extending to costa ..... *Lethe ocellata* (Pouj.)
13. Hind wing below brown behind the dark band at cell apex 14
    Hind wing below yellow behind the dark band at cell apex..... ..... *Lethe atkinsoni* (Hewitson)
14. Fore wing below with one to two apical spots .....

..... *Lethe jalaurida* de Nicéville
Fore wing below without apical spots ..... *Lethe moelleri* (Elwes)
15. Hind wing below with the discal band wider in front than behind ..
.....16
Hind wing below with the discal band not wider in front than behind
Lethe goalpara (Moore)
16. Hind wing below with the discal band straight between veins M_1 and M_3 on the inside ..... *Lethe sura* (Doubleday)
Hind wing below with the discal band angled .....
..... *Lethe dura* (Marsh.)
17. Hind wing with vein Cu_{1a} emitted at or near the cell apex 18
Hind wing with vein Cu_{1a} emitted before the cell apex 30
18. Hind wing with the vein Cu_{1b} emitted near the end of cell than vein M_2
.....19
Hind wing with the veins Cu_{1b} and M_2 equidistant from cell end ..
.....20
19. Fore wing below with a pale bar at end of cell; hind wing below with sub-basal marking across the cell extending to costa .....
..... *Lethe baladeva* (Moore)
Note as described above; brown below; discal ocellar spot with a pale line on the outer side in fore wing..... *Lethe ramadeva* (de Nice.)
20. Fore wing cilia chequered 21
Fore wing cilia not chequered.....22
21. Fore wing above without white band in male and without ocellar spot below in female .....*Lethe rohria* (Fabr.)
Fore wing above with white band .....*Lethe confusa* Auriv.
22. Hind wing below with incomplete ocelli.....23
Hind wing with complete ocelli.....24
23. Hind wing below with the sub-basal line straight .....
..... *Lethe mekara* (Moore)
Hind wing below with the sub-basal line irregular .....
..... *Lethe chandica* (Moore)
24. Fore wing apex not produced 25
Fore wing apex produced.....28
25. Fore wing below without or with only faint markings in cell; hind wing below without discal band..... *Lethe margaritae* Elwes
Fore wing below with a mark in cell 26
26. Fore wing below with the outer line in cell straight 27
Fore wing below with the outer line in cell curved .....
..... *Lethe serbonis* (Hewitson)
27. Fore wing below with a sinuous discal line in the male and a discal band above wide in the female ..... *Lethe insana* (Kollar)
Fore wing below with the discal straight line in the male and a narrow discal band above in the female ..... *Lethe brisanda* de Nicéville

28. Fore wing above with small spots, in the female with postocellar spots 29
Fore wing above with a discal line in the female ..... *Lethe vindhya* (C. Felder)
29. Hind wing above with a spot in front of vein M_3 *Lethe kansa* (Moore)
Hind wing above without a spot in front of vein M_3 ..... *Lethe sinorix* (Hewitson)
30. Hind wing above in the male with sex-brand in the basal part of vein Cu_{1b} covered by a hair tuft 31
Hind wing above in the male with dark sex-brand basally in front of vein M_1, extending into the cell and in front of the veins M_1 and M_2 ..... *Lethe verma* (Kollar)
31. Fore wing below pale in between the bars within the cell ..... *Lethe scanda* (Moore)
Fore wing below not pale in between the bars within the cell 32
32. Fore wing below with dark discal line across vein Cu_{1b} nearer its end than origin ..... *Lethe latiaris* (Hewitson)
Fore wing below with the discal line across vein Cu_{1b} just beyond the middle 33
33. Hind wing below with dark basal line irregular ..... *Lethe gulnihal* de Niceville
Hind wing below with the dark basal line regular ..... *Lethe bhairava* (Moore)
34. Fore wing above and below with a number of large white or yellow spots in front of the vein Cu_{1a} 35
Fore wing above and below without a number of large white or yellow spots in front of the vein Cu_{1a} ..... *Lethe yama* (Moore)
35. Fore wing above with two spots in front of vein Cu_{1b} 36
Fore wing above with only a single spot in front of vein Cu_{1b} ..... *Lethe bhadra* (Moore)
36. Fore wing below with the costal bar oblique... *Lethe pulaha* (Moore)
Fore wing below with the costal bar not oblique ..... *Lethe pulahina* Evans

Lethe visrava (Moore)

Wing span 50-55 mm; blackish-brown; fore wing with the ocelli below showing through above; submarginal line white; in female above white; fore wing with the cell, spot behind cell apex and another behind it brown; hind wing with a post-discal series of black blind ocellar spots, bordered pale on the inside and broadly white on the outside. This species occurs from the north Burmese mountains through the Assam hills on East Himalaya.

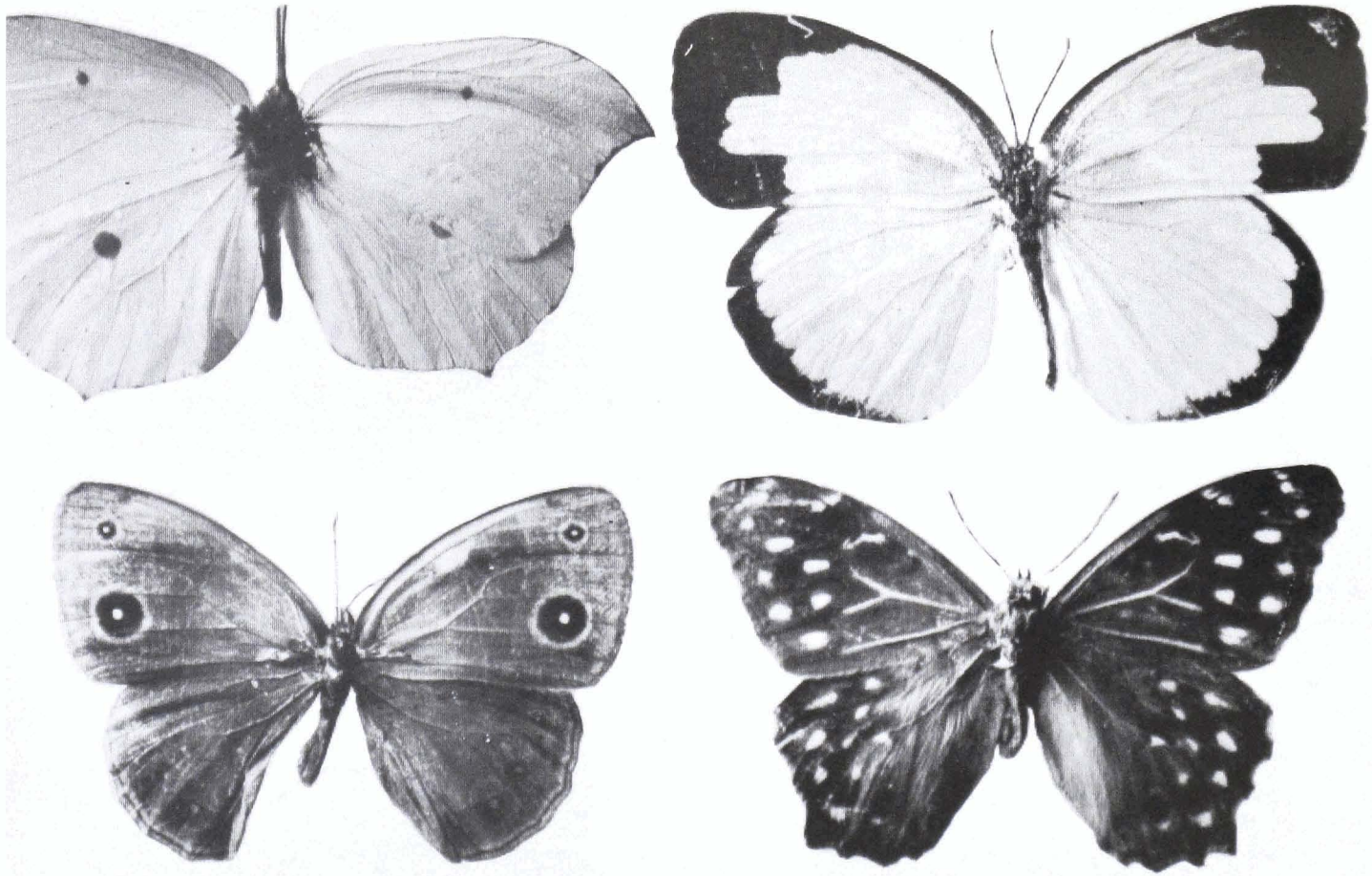

PLATE XVII. Top row left: *Gonepteryx rhamni*
right: *Eurema hecabe*

Bottom row left: *Mycalesis francisa*
right: *Lethe pulaha*

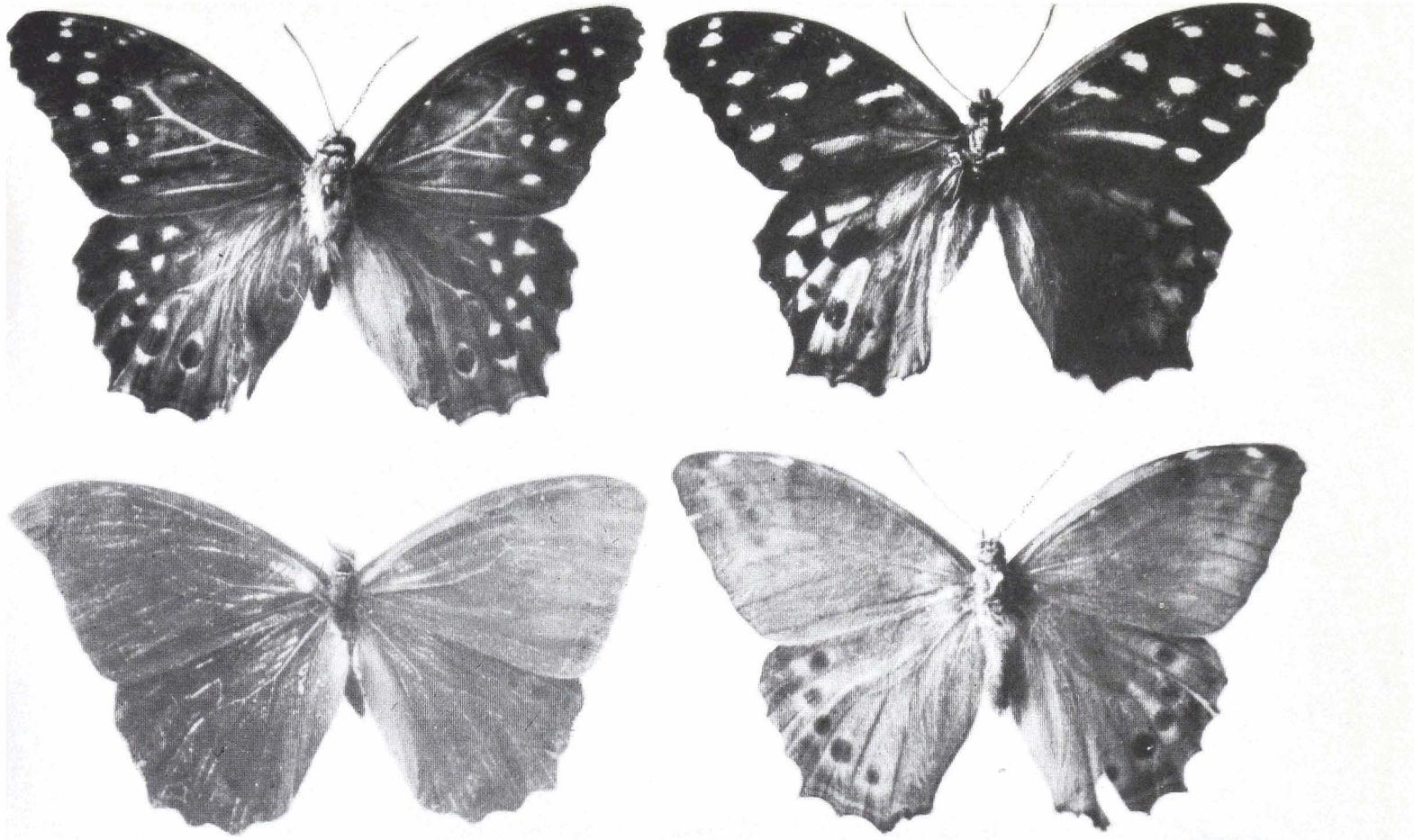

PLATE XVIII. Top row left: *Lethe pulahina*
right: *Lethe bhadra*

Bottom row left: *Lethe sidonis*
right: *Lethe yama*

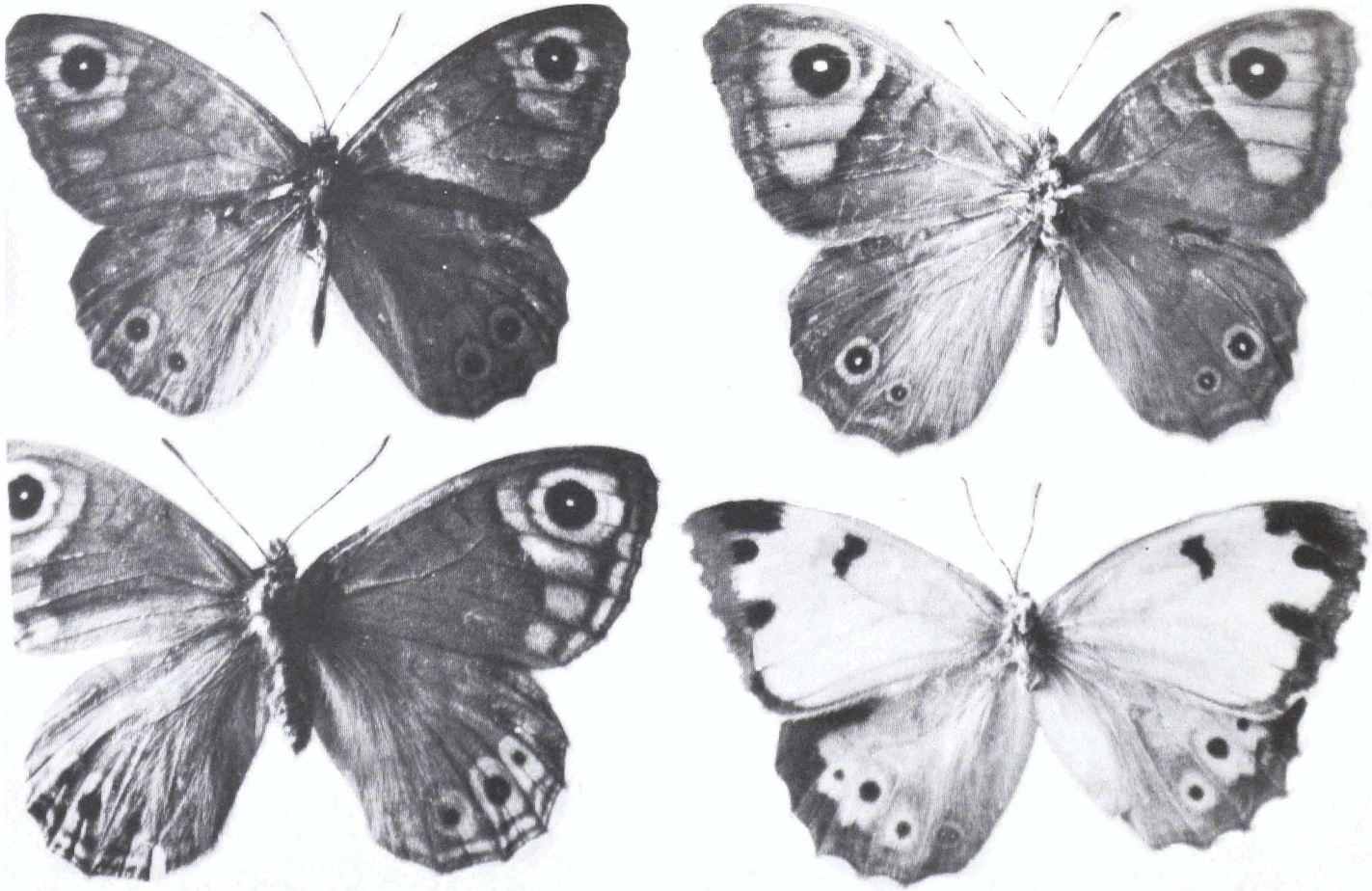

PLATE XIX. Top row left: *Pararge maerula*
right: *Pararge (menaua) maeroides*

Bottom row left: *Pararge schakra*
right: *Pararge eversmanni*

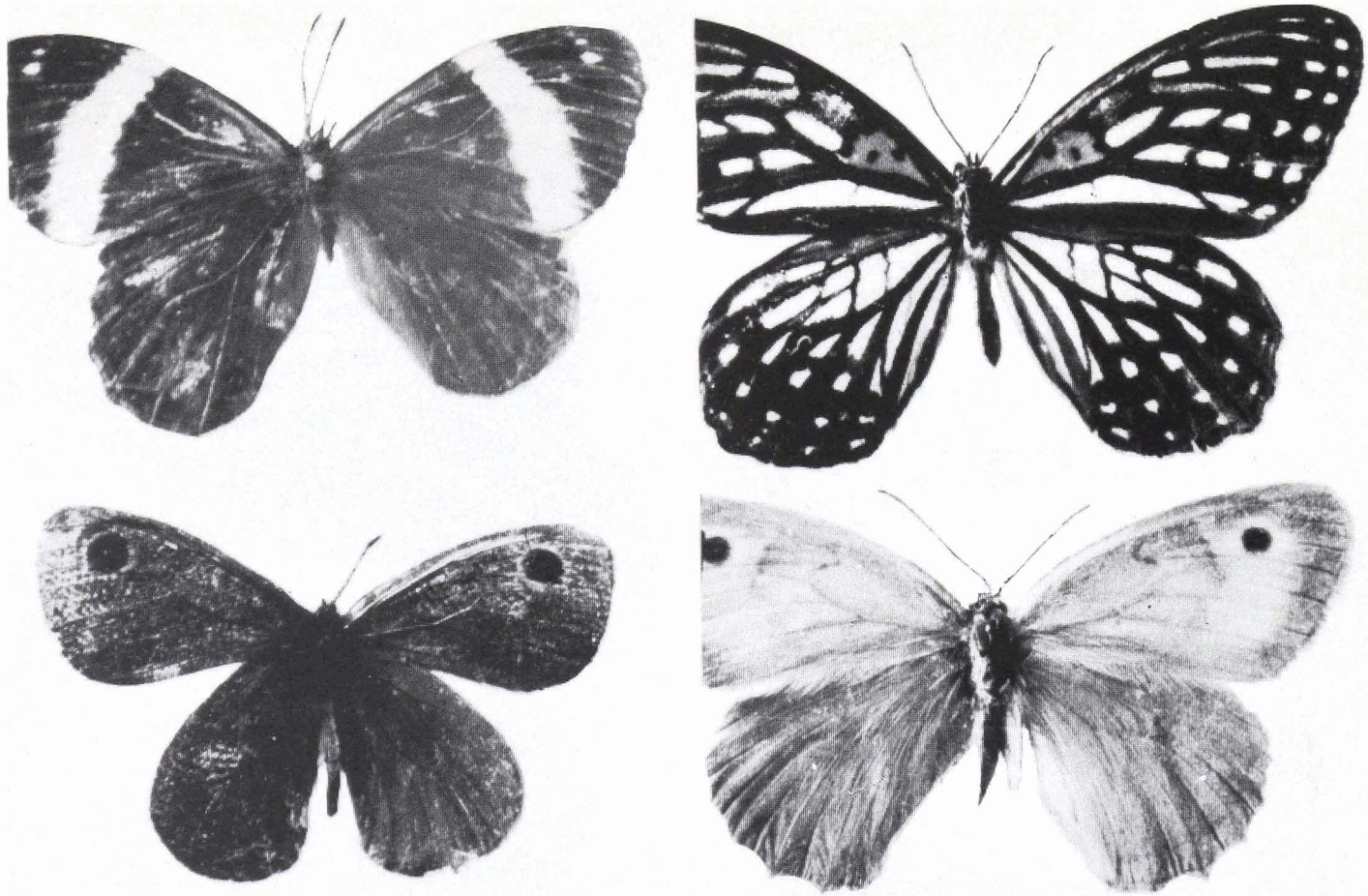

PLATE XX. Top row left: *Pararge masoni*
right: *Orinoma damaris*

Bottom row left: *Coenonympha myops*
right: *Maniola pulchra*

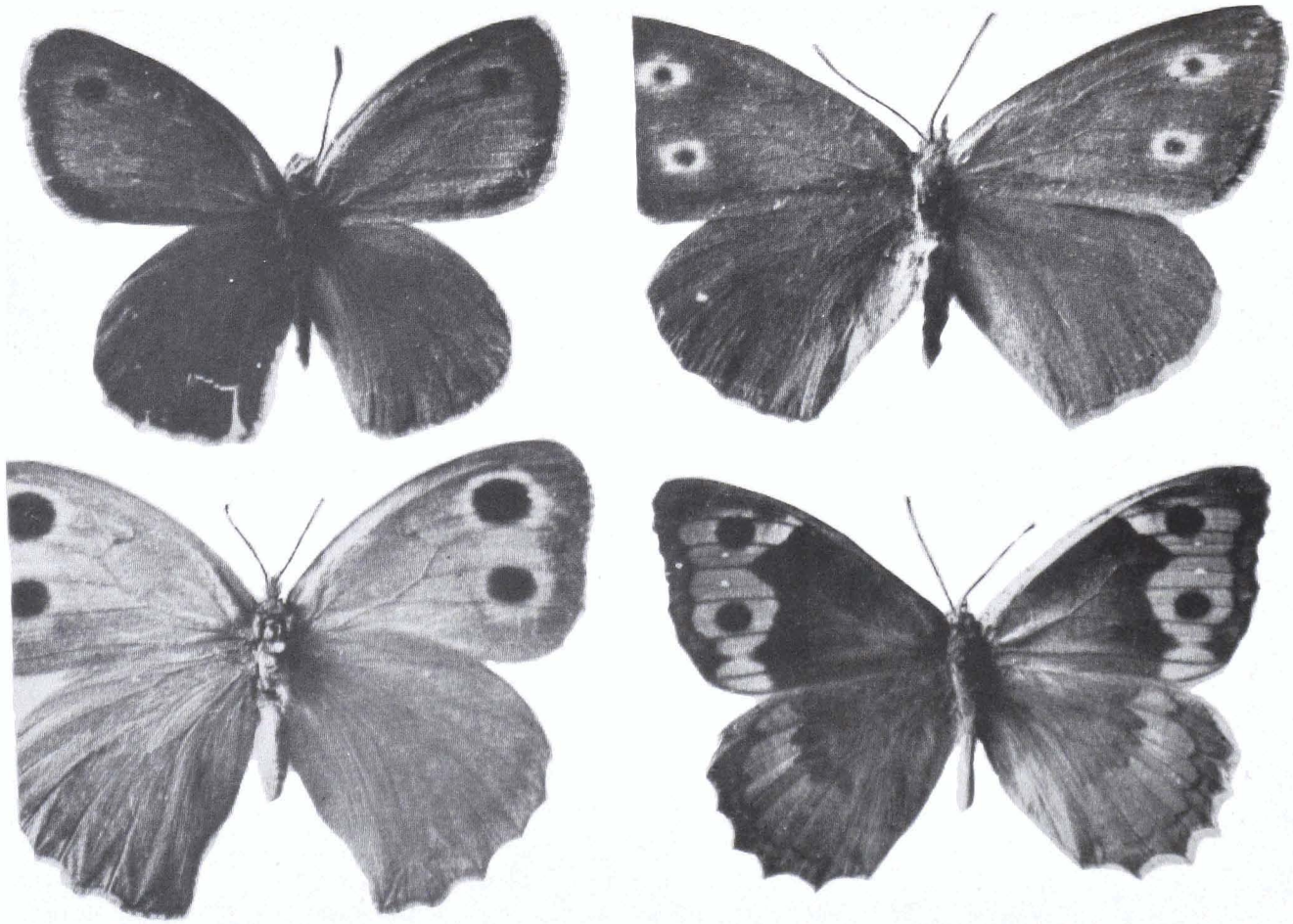

PLATE XXI. Top row left: *Maniola puchella*
right: *Maniola coenonympha*
Bottom row left: *Maniola lupinus*
right: *Hipparchia mniszechii*

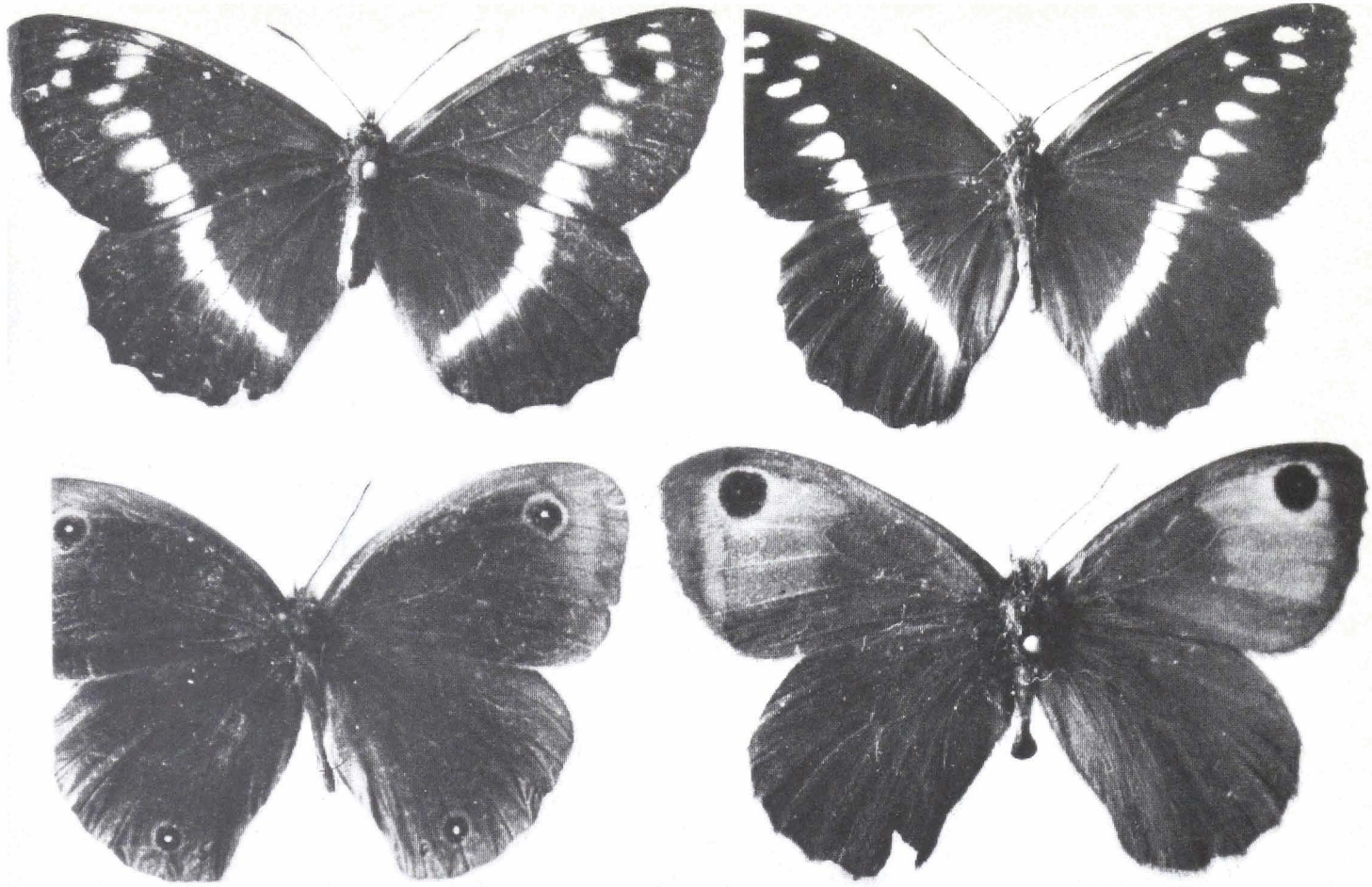

PLATE XXII. Top row left: *Aulocera brahminus*
right: *Aulocera padma*

Bottom row left: *Erebia scanda*
right: *Erebia mani*

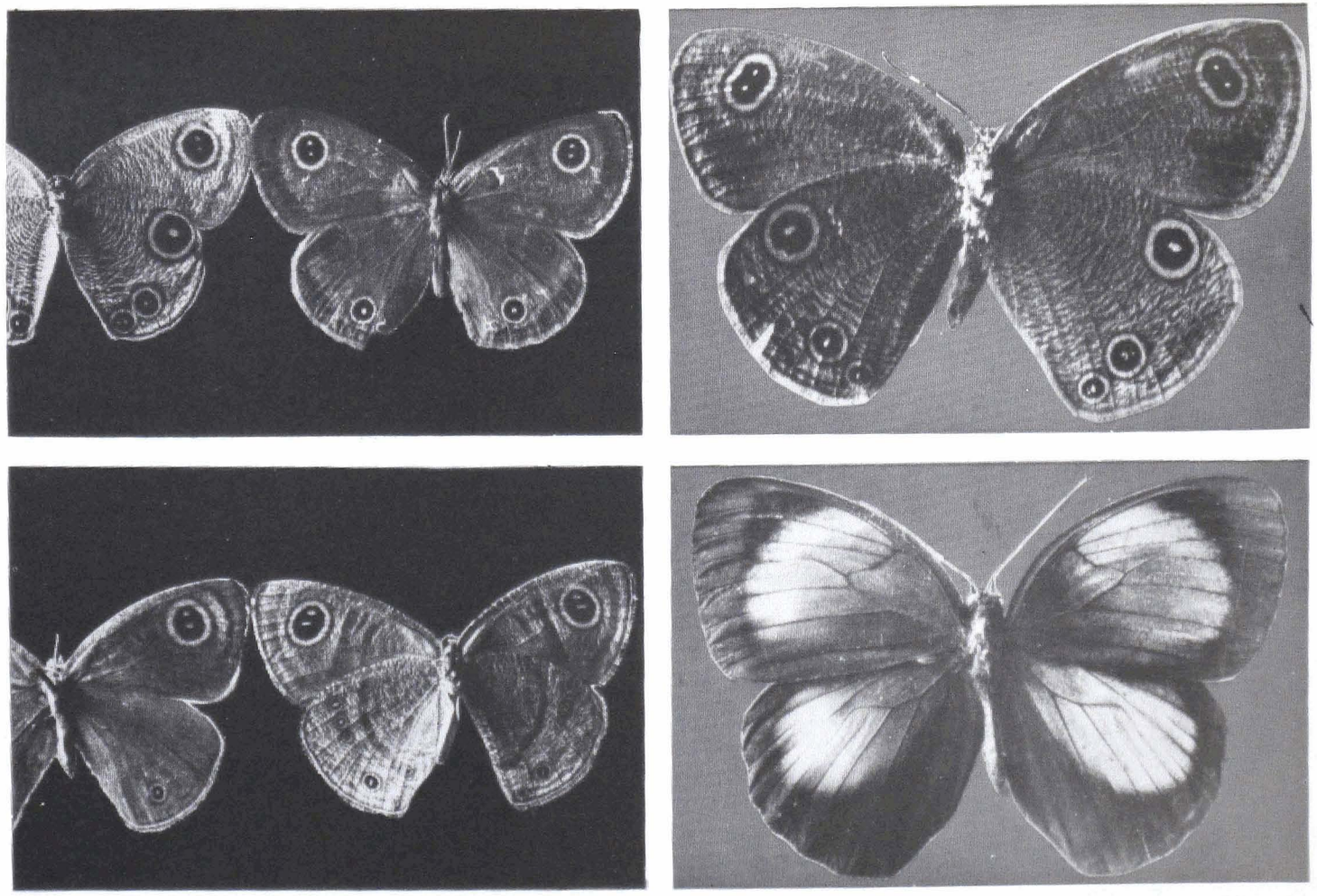

PLATE XXIII. Top row left: *Ypthima narada* (under side)
right: *Ypthima narada* (upper side)

Bottom row left: *Ypthima bolanica*
right: *Thaumatis diores diores*

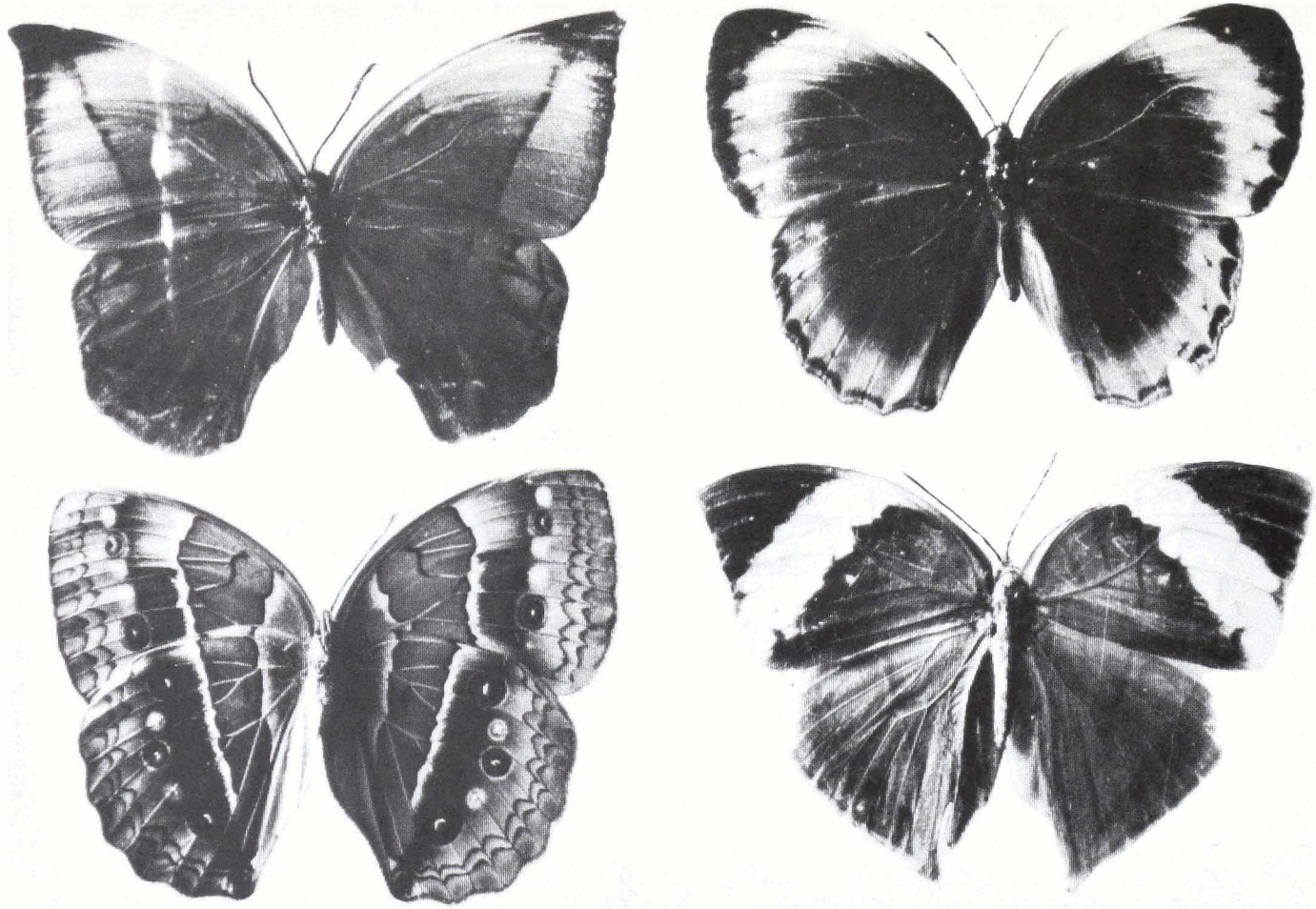

PLATE XXIV. Top row left: *Aemona amathusia*
right: *Stichophthalma nourmahal* (upper side)

Bottom row left: *Stichophthalma nourmahal* (lower side)
right: *Amathuxidia amythaon*

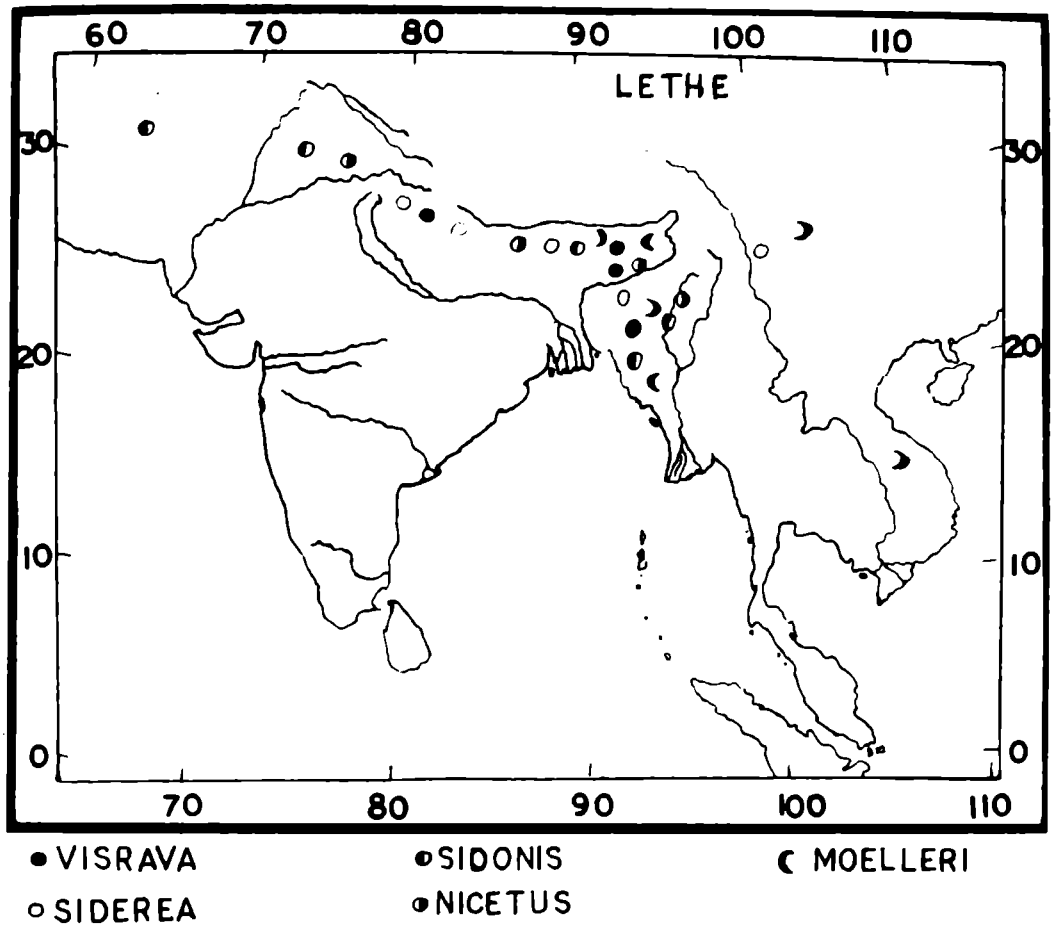

Fig. 17. Distribution of *Lethe*.

Lethe siderea Marshall

Wing span 48-55 mm; above dark bronzy-green and brown below; fore and hind wings below with an ashy-white narrow line submarginally; cilia alternately pale and brown; fore wing in female with the cell darker than outside. The species is distributed from Yunnan through the north Burmese and Assam hills to the Himalaya, where it nearly extends to Kumaon-Garhwal and is found at elevations of 2200 m.

Lethe sidonis (Hewitson)
(Plate XVIII)

This is a variable species with a wing span of 45-60 mm; Examples from humid localities with black spots on hind wing, which are absent in forms from arid or semi-arid localities; intermediate forms are common. Fore wing with an obscure post-discal line and subapical pale costal spot; hind wing with three small black post-discal spots; below dirty brown; with an obscure pale curved bar in cell; hind wing below with lilacine four wavy

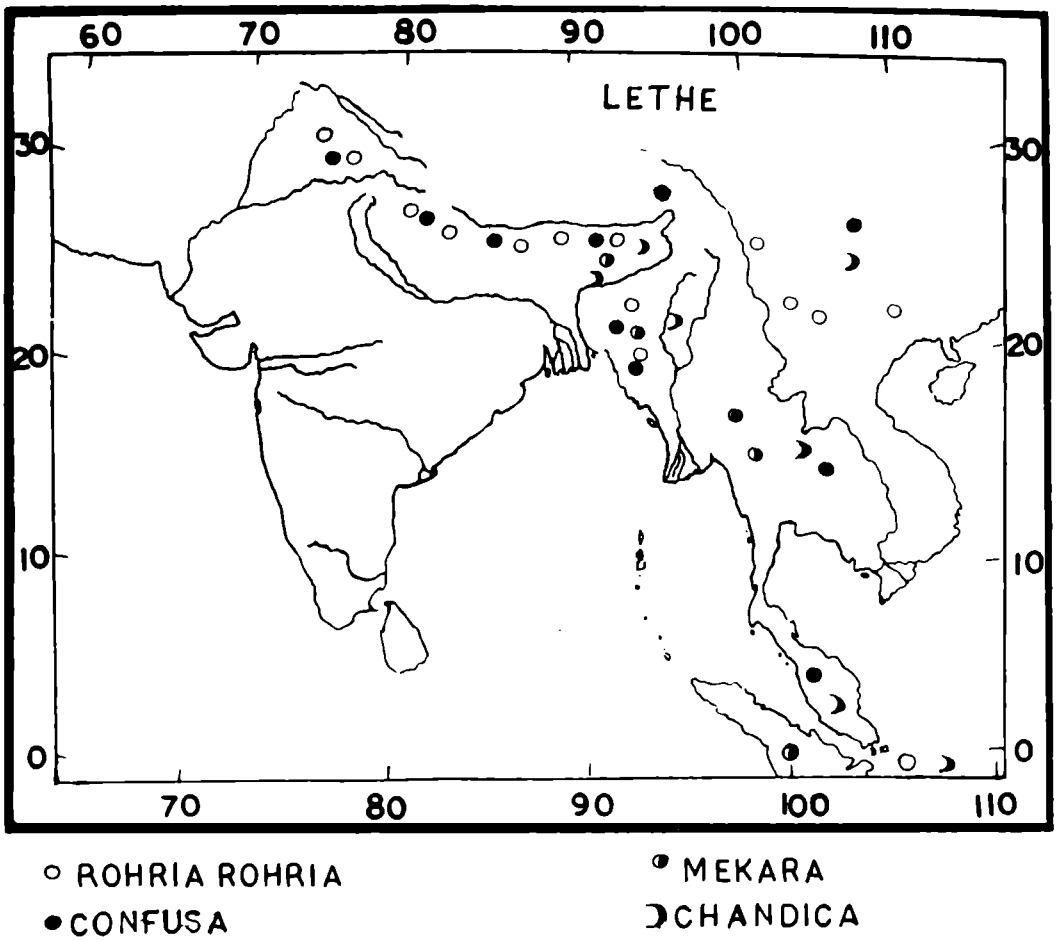

Fig. 18. Distribution of *Lethe*.

lines; six ocellar spots and submarginal lilac line narrow in front and behind. The species extends from the Hindu Kush through the Himalaya to southeast Tibet and north Burmese mountains. In the Himalaya it occurs at elevations of 1000-3300 m.

Lethe dakwana Tytler

This species is reported from the Garhwal Himalaya (2800 m) and is somewhat like *Lethe sidonis*, but much paler and with the submarginal black spots clearly defined; the submarginal ocellar spots on hind wing below smaller.

Lethe nicetella de Nicéville

Wing span 45-50 mm; brown above and smaller than *Lethe sidonis*, without subapical spot in male, with a medial and a subapical spot in female large and white; hind wing with distinct post-discal series of black

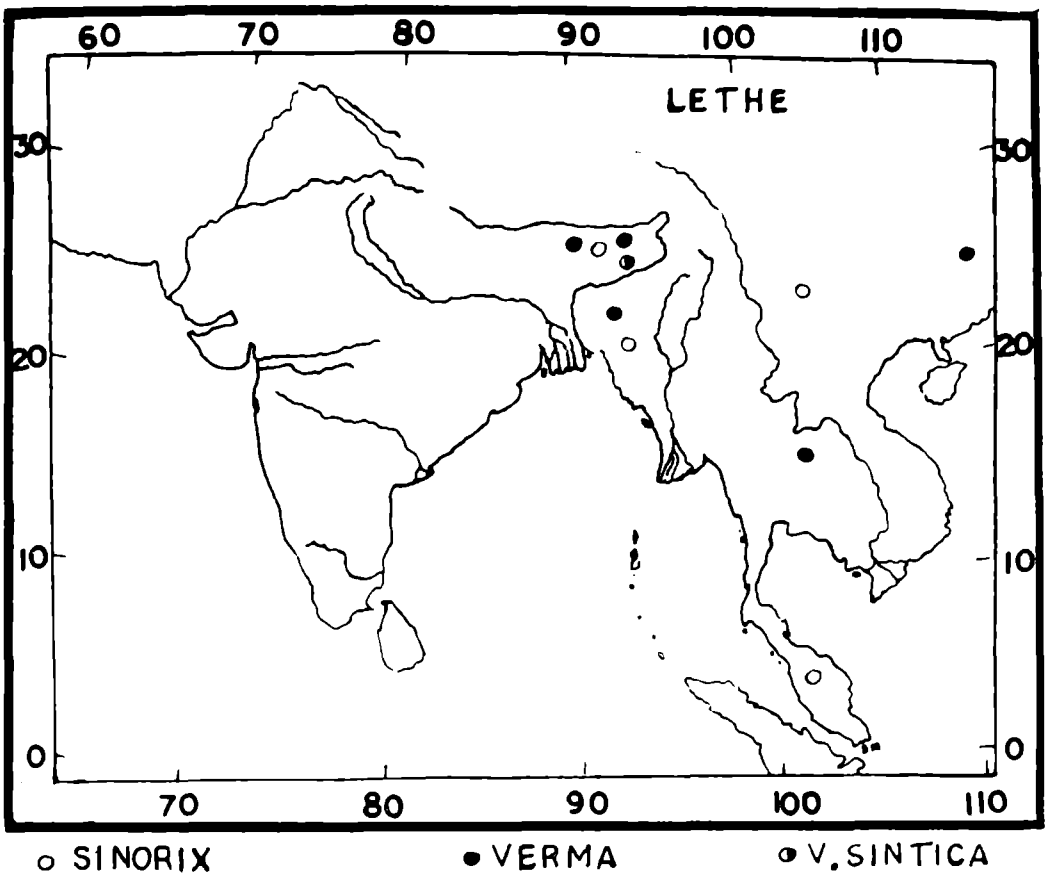

Fig. 19. Distribution of *Lethe*.

spots. The species is reported from East Himalaya, at elevations of 1500-2700 m.

Lethe maitrya de Nicéville

Wing span 45-55 mm; darker than *L. nicetas* and with the post-discal band of the underside visible above; hind wing with silvery lines transversely in base. The species occurs throughout the Himalaya, at elevations from 1500 to 3300 m.

Lethe nicetas (Hewitson)

Wing span 48-55 mm; above golden-brown in male; cilia alternately brown and white; hind wing with a curved post-discal series of five blind ocellar spots black; hind wing below with irregular sinuate silvery lines basally; ocellar spots irregularly bordered ochre inside; submarginal faint white markings. The species occurs from north Burmese mountains through Assam hills to Kulu in Northwest Himalaya.

Lethe tristigmata Elwes

Wing span 55-60 mm; brown above; cell crossed by two brown bars; oblique, sinuous brown discal band; hind wing tailed at end of vein M_3, with a discal sinuous dark line; post-discal curved brown ocellar spots five in male and six in female; hind wing below with a sub-basal curved narrow brown band; post-discal series of six white-centred black ocellar spots, with the front four spots ringed silvery outside. Reported at elevations of 2700-3000 m from Sikkim.

Lethe ocellata (Poujade)

Wing span 55-60 mm; above brown, with bronzy shine; brown submarginal band; irregular discal dark brown band in fore wing from costa to anal vein; hind wing below irregular, sub-basal dark band margined outside yellow; submarginal black ocellar spots, with white pupils and yellow iris. Reported from the Assam hills and East Himalaya.

Lethe jalaurida (de Niceville)

Wing span 50-55 mm; brown above, with a broad cross-bar across the cell in fore wing above and white discal patch; hind wing with dusky post-discal band, above; with two irregular lines across cell and oblique discal white band below. The nominotype occurs at elevations of 2100-3300 m in West and Northwest Himalaya and the subspecies *elwesi* (Moore) is reported from East Himalaya at elevations of 2700-3600 m. The species occurs also in parts of China.

Lethe moelleri (Elwes)

Wing span 50-55 mm; without cross band in cell above; without also the apical ocellar spot; hind wing with inverted Y-band and yellow or white beyond. The species occurs in Burma and East Himalaya; the nominotype is reported from Sikkim at elevations of 1500-3000 m.

Lethe atkinsonia (Hewitson)

Wing span 48-55 mm; above ochre-brown; cell crossed by short, broad band bordered dark brown; discal and post-discal bands irregular; hind wing above with post-discal black spots on red band; fore wing below yellow; hind wing below dusted brown behind, with basal and sub-basal ochre-brown bands and submarginal silvery and marginal line. Reported at elevations of 1800-3000 m from Sikkim and Bhutan.

Lethe goalpara (Moore)

Wing span 65-80 mm; light brown above with a broad band; fore wing below with dark bands in cell; ocelli absent; hind wing with the sub-basal band irregular. Occurring at an elevation of 3000 m in Northwest Himalaya

and in Garhwal and represented by subspecies *gana* Talbot in East Himalaya. The species is also distributed on the Assam hills.

Lethe sura (Doubleday)

Wing span 65-85 mm; brown above; fore wing with obscure subapical costal cohre spot; discal band irregular faint; cilia alternately brown and white; hind wing with the post-discal band irregular; submarginal band above; below basally crossed by interrupted and irregular silvery lines and bands; post-discal round black ocellar spots; marginal ochre line; ocelli centred white. Reported from western China, north Burmese mountains and Sikkim.

Lethe dura (Marshall)

Wing span 70-85 mm; wings above with borders pale; hind wing with a post-discal pale brown band, and with small black spots below. The species is reported from west and central China, the Philippines, Indo-China, Taiwan, Burma and East Himalaya. Two subspecies *L. dura dura* (Marshall) and *L. dura gammiei* (Moore) are reported from East Himalaya.

Lethe baladeva (Moore)

Wing span 67-70 mm; fore wing below with a pale bar on cell apex; hind wing in the male with dark sex brand, with a pale sub-basal mark from costa across cell; hind wing outer margin tailed at tips of veins M_3 and Cu_{1b}; discal and post-discal bands silvery-white; both wings above brown, with marks below visible. The species is restricted to the Himalaya and is represented by the nominotype at elevations of 2000-2300 m in east Himalaya, *L. baladeva aisa* Fruhstorfer, somewhat smaller, at elevations of up to 3000 m in Kumaon.

Lethe ramadeva (de Nicéville)

Wing span 60-70 mm; the species differs from *L. baladeva* in the dark brown colour of wings below; discal ocellar spot of fore wing and presence of a pale line beyond the ocellar spot; hind wing tailed at veins M_3 and Cu_{1b}; fore wings with white markings basally and cell apex. The species is reported from northeast Burma and East Himalaya.

Lethe rohria rohria (Fabricius)

Wing span 60-70 mm; above brown, somewhat darker apically in the female than in the male; with a trifid spot in costa and subapical white spots; in female with an oblique white discal band extending back to behind vein Cu_{1b}; hind wing below with ocellar spots in front of Cu_{1a} and M_3 elongate; fore wing below with a post-discal narrow white band forming a V with the discal band. The species occurs in southern China,

Taiwan, Sundaland, South India, Burma, Yunnan and the Himalaya; the nominotype extends the whole length of the Himalaya.

Lethe confusa Aurivillius

Wing span 50-55 mm; examples from East Himalaya brown, but those from Northwest Himalaya have smaller ocelli; fore wing above with an oblique discal curved white line, two obliquely placed white spots; hind wing with irregular, angulate discal white line. The species is reported from China, southeast Tibet, Malaya, Thailand, Burma and the whole of Himalaya.

Lethe mekara (Moore)

Wing span 65-75 mm; brown in humid localities and paler brown from arid localities; fore wing with a white costal bar; hind wing reddish in apical area above and discal line not very angulate below. The species occurs from Borneo through Sumatra, Thailand, Burma and East Himalaya.

Lethe chandica (Moore)

Wing span 65-75 mm; variable species with wings above brownish-black and pale greyish-brown below; cilia alternately white and brown; fore wing with four to six pale ocellar spots; hind wing with six ocellar spots; submarginal and marginal narrow dark lines on both wings. The species occurs in Thailand, Burma, Assam, China, Philippines, Sundaland, Taiwan, Malaya and East Himalaya.

Lethe margaritae Elwes

Wing span 85-95 mm; tail of hind wing in the male broad; dark brown above; narrow submarginal and marginal lines; fore wing with an oblique discal white band. The species is reported from the north Burmese mountains and at elevations of 1500-4875 m in East Himalaya.

Lethe insana (Kollar)

Wing span 55-60 mm; fore wing above greyish-brown, with two minute subapical spots; hind wing above with four black spots and below with post-discal series of ocellar spots. The species is reported from Northwest and West Himalaya at elevations of 1800 mm; the subspecies *L. insana dinarbas* (Hewitson) is reported to be distributed from the Kumaon Himalaya through Assam hills to north Burmese mountains and at elevations of 3000 m in Sikkim.

Lethe brisanda de Nicéville

Wing span 55-60 mm; wings brown above and pale brown below; hind

wing with 6 submarginal faint black ocellar spots. The species is reported from northeast Burma, the Assam hills and East Himalaya.

Lethe serbonis (Hewitson)

Wing span 66-74 mm; wings above brown; with a large triangular brand from the middle of the inner margin to the veins Cu_{1a} or M_3; hind wing with five ocellar spots above, the last one pupillated; cell crossed by three dark sinuate lines. The species restricted to East Himalaya, the Assam hills, and neighbouring western China; in East Himalaya two subspecies the nominotype and *teesta* Talbot are reported at elevations of up to 4877 m.

Lethe vindhya (C. Felder)

Wing span 65-70 mm; wings above dark brown, sometimes suffused red; basal 0.50 abruptly darker than the apical; hind wing with post-discal black spots, ringed brown. The species occurs in Malaya, Burma and East Himalaya.

Lethe kansa (Moore)

Wing span 65-75 mm; brown above, with obscure band from the inner margin to vein M_3 or M_2; hind wing with curved series of five black ocellar spots, with the second and fourth spots larger than others; hind wing below with six white-centred black ocellar spots. The species occurs in Thailand, Burma and the Himalaya up to Kumaon.

Lethe sinorix (Hewitson)

Wing span 70-78 mm; ochre-red above; fore wing with discal white band, subapical white spot; hind wing with curved post-discal series of black spots. The species is distributed in southeast China, Malaya, Burma and East Himalaya.

Lethe scanda (Moore)

Wing span 58-65 mm; indigo-blue above, with some broad silvery hue in outer margin; hind wing with three obscure black ocellar spots above; below fore and hind wings with submarginal and marginal brown to yellow lines; hind wing with post-discal series of white pupillated ocellar spots. The species is reported from the Assam hills and East Himalaya.

Lethe latiaris (Hewitson)

Wing span 55-65 mm; brown above, pale brown below; fore wing below with two dark lines across cell; hind wing with sub-basal straight, narrow brown band, six ocellar spots. The species is reported from the north Burmese mountains, the Assam hills and East Himalaya.

Lethe gulnihal de Nicéville

Wing span 58-64 mm; brown above, without spots; generally like *L. bhairava,* but smaller. Reported from the north Burmese mountains and Bhutan in East Himalaya.

Lethe bhairava (Moore)

Wing span 65-75 mm; brown above, basally darker than apically; hind wing with post-discal four blind ocellar spots. Reported from the Assam hills and Sikkim.

Lethe verma (Kollar)

Wing span 55-60 mm; brown above; in front with dark band, with broad white band in fore wing; hind wing with a post-discal small, faint black ocellar spot; below with two irregular brown lines. The species occurs in Taiwan, China, Thailand, Malaya, Burma and the Himalaya; the nominotype occurs in West and Northwest Himalaya and the subspecies *sintica* Fruhstorfer is reported from the north Burmese mountains, the Assam hills and East Himalaya.

Lethe pulaha (Moore)
(Plate XVII)

Wing span 66-72 mm; variable species, mottled below and with submarginal ocellar spots in the fore and hind wings. The species is distributed from Taiwan and China through Burma and Assam to the whole Himalaya; the nominotype occurs up to 3000 m in East Himalaya and the subspecies *pandyia* Talbot is reported from Northwest Himalaya.

Lethe pulahina Evans
(Plate XVIII)

Wing span 60-70 mm; differs from *L. pulaha pulaha* in the spots being ochre-coloured; hind wing darker than fore wing; ocellar spots larger. The species is reported from the Burmese mountains, the Assam hills and East Himalaya.

Lethe bhadra (Moore)
(Plate XVIII)

Wing span 80-100 mm; brownish-black above, with three oblique lines of white spots outside of cell; cilia alternately white and brown, hind wing with post-discal curved line of nine ocellar spots. Reported from Burma, Assam and East Himalaya.

Lethe yama (Moore)
(Plate XVIII)

Wing span 70-85 mm; brown above, with discal and submarginal dark

bands; hind wing with post-discal series of brown-ringed dark ocellar spots above. The species is distributed in China, Burma and the whole of Himalaya. The examples from Northwest and Kumaon Himalaya are distinctly paler than those from East Himalaya.

PARARGE HÜBNER

Eyes hairy; middle femora with long hairs; fore wing triangular, rounded apically, outer margin somewhat curved inward, cell more than 0.50 of wing length; anterior discocellular oblique outward, middle discocellular 2 times the anterior; posterior discocellar long; posterior veins subparallel; hind wing oval, veins Cu_{1a} and M_3 emitted from cell apex, arched forward; veins M_1 and R_2 widely separated.

Key to species

1. Fore wing above with a large pupillate ocellus 2
   Fore wing without pupillate ocellus 4
2. Hind wing below with the discal line broken by vein M_3 3
   Hind wing below with the discal line not interrupted ..... *Pararge menava maeroides* (Feld.)
3. Hind wing below with the discal line interrupted between the veins M_1 and R_2 ..... *Pararge maerula* (C. & R. Feld.)
   Hind wing with the discal line below complete ..... *Pararge schakra* (Kollar)
4. Wings above dark brown; fore wing above with a broad white band and two apical spots ..... *Pararge masoni* (Elwes)
   Wing above yellow; fore wing below with two dark lines in cell .... *Pararge eversmanni* Eversmann

Pararge menava maeroides (Feld.)
(Plate XIX)

Wing span 50-60 mm; wings above dark brown; subapical ocellar spot in fore wing black, white-centred and ringed yellow, hind wing with two ocellar spots behind above. Distributed in the Hindu Kush, Karakoram and Northwest Himalaya at elevations of up to 2700 m.

Pararge schakra (Kollar)
(Plate XIX)

Wing span 55-60 mm; wings above silky brown; below pale grey; fore wing with subapical ocellar spot broadly ringed yellow and with two to three patches behind; hind wing with three to six ocellar spots above, below with orange lines, two sub-basal short lines and an irregular discal line, brown submarginal and marginal lines. The species extends from the

Hindu Kush eastward to the Kumaon Himalaya and occurs almost up to 3600 m.

Pararge maerula (C. & R. Felder)

Wing span 55-60 mm; closely resembling the fore-species, but fore wing below with larger discal yellow. The nominotype occurs in West and Northwest Himalaya and another subspecies *tarbena* Talbot is reported from extreme west of the Northwest Himalaya.

Pararge eversmanni Eversmann
(Plate XIX)

Wing span 55-60; fore wing above ochre-yellow; paler below; outer border above black; discocellular black spot in fore wing above; hind wing with 2-5 ocellar spots above. The species is distributed in the Turkmenian subregion and extends south to Northwest Himalaya, where it is represented by the subspecies *cashmirensis* Moore.

Pararge masoni Elwes
(Plate XX)

Wing span 60-65 mm; black-brown above, with post-discal white band in fore wing; small, white, subapical spot, with small black ocellus in front of vein M_2; hind wing with 6 large, white-centred black ocellar spots. The species is reported from southeast Tibet and East Himalaya.

RHAPHICERA BUTLER

This genus is like *Pararge,* but the veins M_1 and M_2 are much closer together; vein Sc is swollen basally; vein Cu_{1a} in hind wing emitted before the posterior discocellular; fore wing without sex brand in the male.

Rhaphicera moorei Butler

Wing span 55-60 mm; hind wing below with two dark lines in cell; ochre-yellow above in fore wing, darkened in hind wing; fore wing basally darker brown; hind wing below with six ocellar spots. The species is restricted to the Himalaya; the nominotype occurs in Northwest Himalaya and the subspecies *mantra* Talbot is reported at elevations of 3000-4500 m from East Himalaya.

Rhaphicera satricus (Doubleday)

Wing span 60-65 mm; hind wing below without dark lines in cell; wings above ochre-brown, marked and spotted black; hind wing with median bar and four ocellate spots near outer margin. The species occurs in the Assam hills and on East Himalaya.

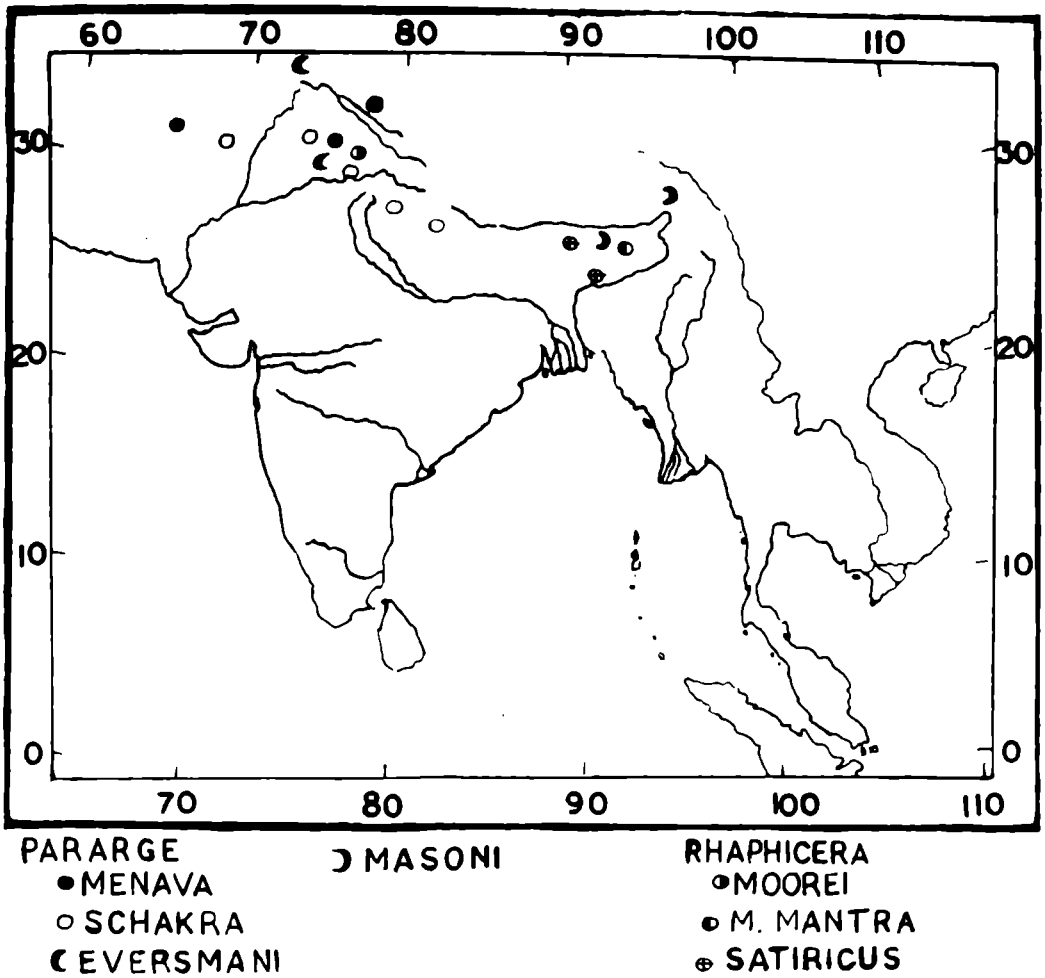

Fig. 20. Distribution of *Pararge* and *Rhaphicera*.

ORINOMA GRAY
(Plate XX)

Fore wing with cell a little more than 0.50 of wing length; vein Cu_{1a} emitted well before vein M_3, veins M_3 and M_2 parallel or nearly so, vein Sc swollen basally; hind wing with outer margin somewhat scalloped; veins R_3 and M_1 close together. The genus is restricted to Burmese mountains, Assam hills and the Himalaya and is represented by a single species *Orinoma damaris* Gray, with a wing span of 75-80 mm; dirty black above, cell red basally; hind wing with discal, post-discal, submarginal pale green streaks and spots.

COENONYMPHA HÜBNER
(Plate XX)

This is a Holarctic genus with glabrous eyes, long erect palpus, and anal

vein and vein Sc swollen basally. The genus is represented by a single species *C. myops* Staudinger with a wing span of 35-40 mm, dark brown above, with small subapical blind black ocellar spot, ringed yellowish-brown, distributed in the Hindu Kush, and Middle Asiatic mountains.

MANIOLA SCHRANK

This is a Palaearctic genus, with trianglular wing, cell shorter than 0.50 of wing length, median vein and Sc swollen basally, anterior discocellular minute, middle discocellular curved inward and posterior discocellular oblique outward; veins from Cu_{1b} to M_1 parallel and equally spaced; hind wing ovate, cell more than 0.50 of wing length; vein Cu_{1a} emitted from apex of cell; vein M_1 midway between veins R_5 and M_2.

Key to species

1. Hind wing with the outer margin crenulate 2
   Hind wing with the outer margin not crenulate 5
2. Hind below without ocellar spot 3
   Hind wing below with ocellar spot, ringed white 4
3. Wings above yellowish-brown..... *Maniola narica* (Hübn.)
   Wings above brown ..... *Maniola lupinus* (Costa)
4. Apical ocellar spot in fore wing above elongate .....
   ..... *Maniola wagneri* (Herrich-Schäf.)
   Apical ocellar spot in fore wing above rounded .....
   ..... *Maniola davendra* (Moore)
5. Fore wing with a single apical ocellar spot 6
   Fore wing rarely with a subapical faint, rounded black spot, ringed pale ..... *Maniola coenoympha* (C. & R. Felder)
6. Fore wing below with distinct discal line.....
   ..... *Maniola pulchra* (C. & R. Felder)
   Fore wing below without discal line or almost without one .....
   ..... *Maniola pulchella* (C. & R. Felder)

Maniola narica (Hübner)

Wing span 48-50 mm; wings above greyish-brown; below without discal line; subapical ocellar spot yellow bordered inside; hind wing with irregular discal and submarginal reddish-brown bands, without ocelli. This is a Turkmenian species reported from the Hindu Kush and western end of Northwest Himalaya.

Maniola lupinus (Costa)
(Plate XXI)

Wing span 45-60 mm; wings above greyish-brown; subapical ocellar

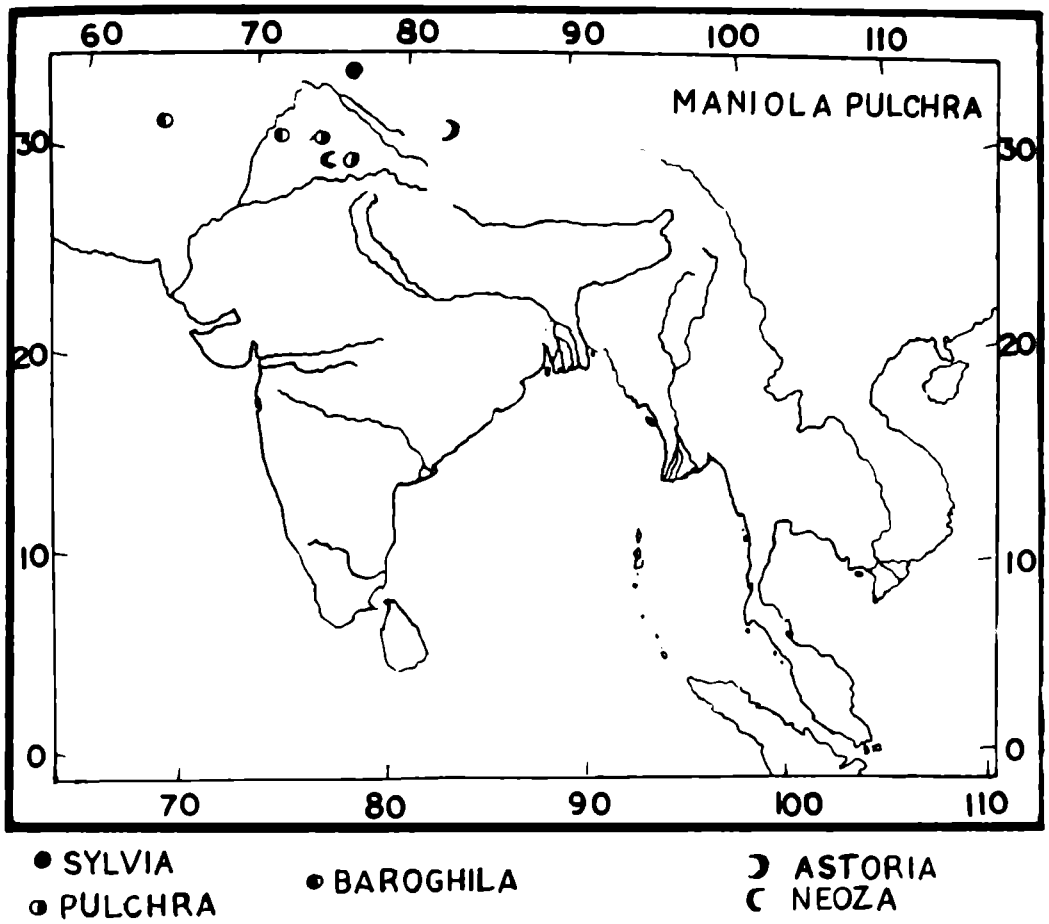

Fig. 21. Distribution of *Maniola pulchra* and subspecies.

spot small; hind wing with distinct post-discal irregular line below. This is Mediterranean species represented by the subspecies *iskander* Hemming at elevations of 2400-2700 m in Northwest Himalaya, *kashmirica* Moore in Kashmir and *cheena* (Moore) from West Himalaya to Central Himalaya up to elevations of 3600 m.

Maniola wagneri (Herrich-Schäffer)

Wing span 50 mm; with a subapical ocellus in front of M_2 black and elongate; hind wing with the outer margin markedly crenulate, with short tails at tips of veins M_3 and Cu_{1a} and below with two ocellar spots without white pupil, but white ringed. Reported from Iran and Baluchistan.

Maniola davendra (Moore)

Wing span 50-55 mm; fore wing above greyish-brown to ochre-yellow, with subapical black ocellus; hind wing below not marked. The species is distributed from Middle Asia to Kumaon in the Himalaya. *M. davendra*

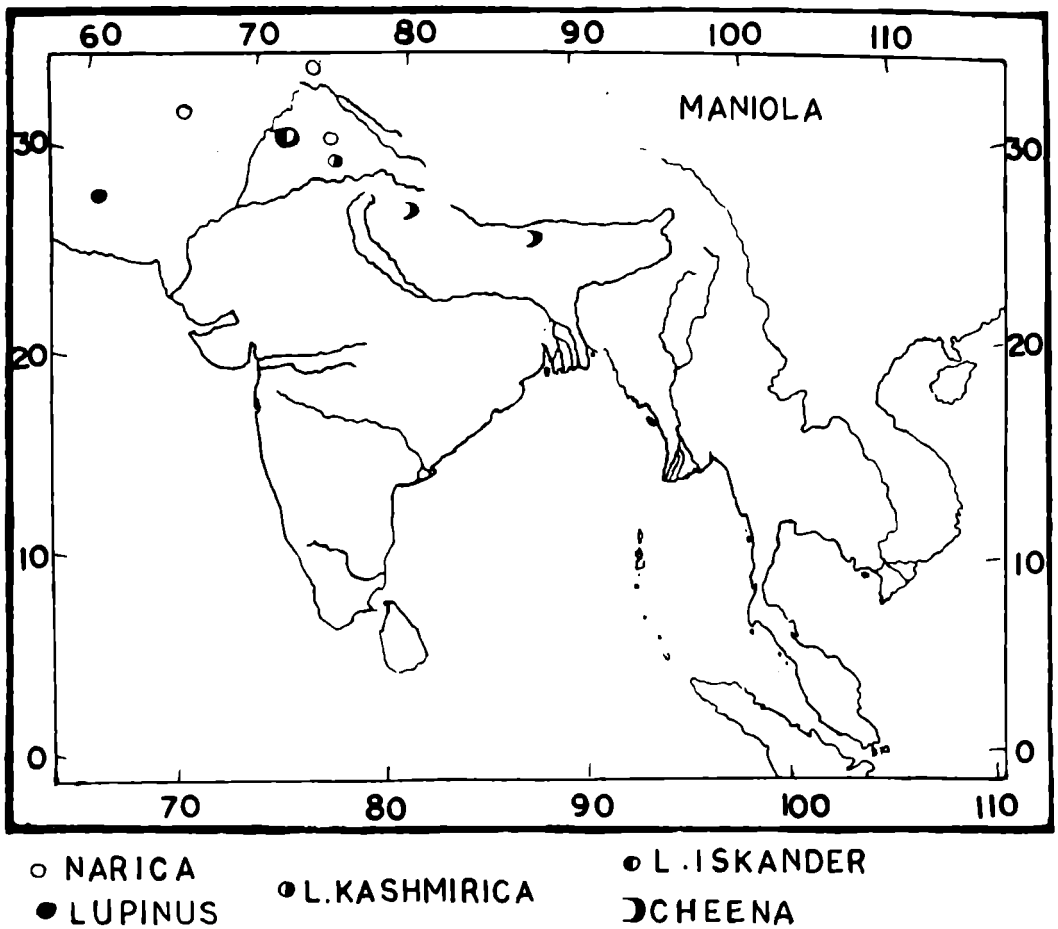

Fig. 22. Distribution of *Maniola* species.

davendra (Moore) with fore wing orange-yellow above occurs in Northwest Himalaya and sparsely in Kumaon; *latistigma* Moore, *brevistigma* Moore and *chitralica* (Evans) are reported from the Hindu Kush and Northwest Himalaya.

Maniola pulchella (C. & R. Felder)
(Plate XXI)

Wing span 38-45 mm; fore wing above largely yellow; with subapical rounded nonpupillate ocellar spot. Reported from Northwest Himalaya.

Maniola coenonympha (C. & R. Felder)
(Plate XXI)

Wing span 35-45 mm; wings above brown, with scattered coppery scales; below ochraceous-orange; fringe brown; fore wing often with a subapical obscure round black spot, ringed pale; hind wing below basally dark brown, apically ochraceous. Northwest Himalaya.

Maniola pulchra (C. & R. Felder)
(Plate XX)

Wing span 40-48 mm; a somewhat variable species of the Turkmenian Subregion, occurring at elevations of nearly 3000 m in Northwest Himalaya.

Maniola pulchra pulchra (C. & R. Felder) occurs from Northwest Himalaya to Kumaon Himalaya; *M. pulchra sylvia* Hemming occurs in the Pamirs and Northwest Himalaya at elevations of 4200 m, *M. pulchra baroghila* Tytler extends from the Hindu Kush to Northwest Himalaya and, *M. pulchra astoria* Tytler is reported at elevations of 3300 m from Ladakh and *M. pulchra neoza* (Lang) from Ladakh to the Pir Panjal in Kashmir.

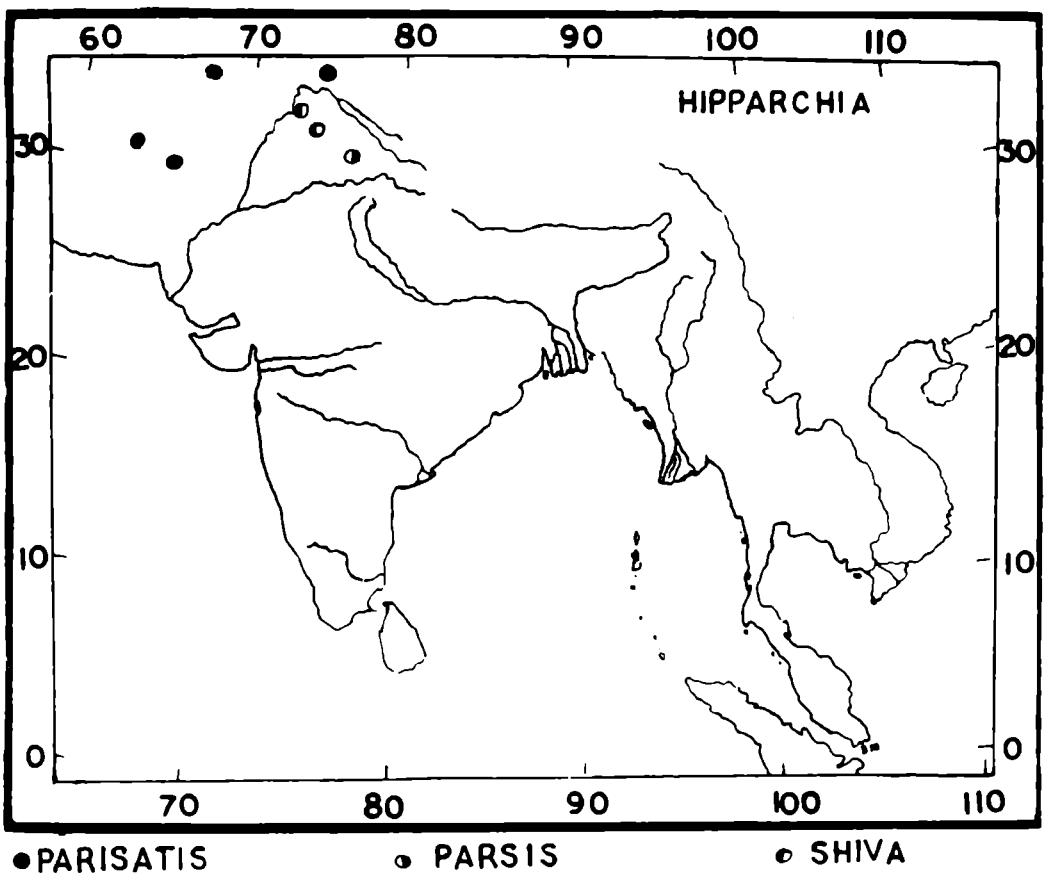

Fig. 23. Distribution of *Hipparchia* species.

HIPPARCHIA FABRICIUS

Eyes glabrous; third palpal segment short; wings narrow or rounded; fore wing cell more than 0.50 or at least 0.50 of wing length; anterior discocellu-

lar minute, middle angled or curved inward, posterior longer; veins R_1 and R_2 emitted before the cell apex; Sc swollen basally; hind wing with cell about 0.50 of wing length; vein Cu_{1a} emitted much before cell apex; vein M_3 emitted from the cell angle; vein M_1 closer to R_2 than M_2. About ten species are known from the Himalaya.

Key to species

1. Hind wing below with the submarginal line not dentate, sometimes even obscure 2
   Hind wing below with the submarginal line dentate 6
2. Wings above without discal band..... *Hipparchia parisatis* (Kollar)
   Wings above with yellowish-brown or white discal band..... 3
3. Fore wing with the discal band above continuous 5
   Fore wing with the discal band above broken up into separate streaks 4
4. Fore wing above with the cell dark brown..... *Hipparchia persephone* (Hübner)
   Fore wing above with the cell white basally ..... *Hipparchia heidenreichi* Led.
5. Fore wing below with the apical ocellar spot ringed..... *Hipparchia mniszechii* (Herrich-Schäffer)
   Fore wing below with the apical ocellar spot not ringed ..... *Hipparchia thelephassa* (Hübner)
6. Fore wing above with two to three ocellar spots..... 8
   Fore wing above with a single ocellar spot 7
7. Fore wing above with broad discal band and with non-pupillate ocellar spot ..... *Hipparchia digna* Marsh.
   Fore wing above without discal band, but with pupillate ocellar spot ..... *Hipparchia actaea* (Esp.)
8. Fore wing above with the veins darker in the yellowish-brown parches 9
   Fore wing above with the veins not darker in the yellowish-brown parches ..... *Hipparchia hübneri* (C.R. Felder)
9. Fore wing below with discal line and non-pupillate ocellar spot.... *Hipparchia boloricus* (Grum-Grsh.)
   Fore wing below without discal line, but with pupillate ocellar spot ..... *Hipparchia moorei* (Evans)

Hipparchia parisatis (Kollar)

Wing span 65-70 mm; wings above dark brown; outer border white; hind wing with the white border wider than on fore wing; with two white centred black ocellar spots.

The species occurs in Middle Asia, the Pamirs, Hindu Kush and the

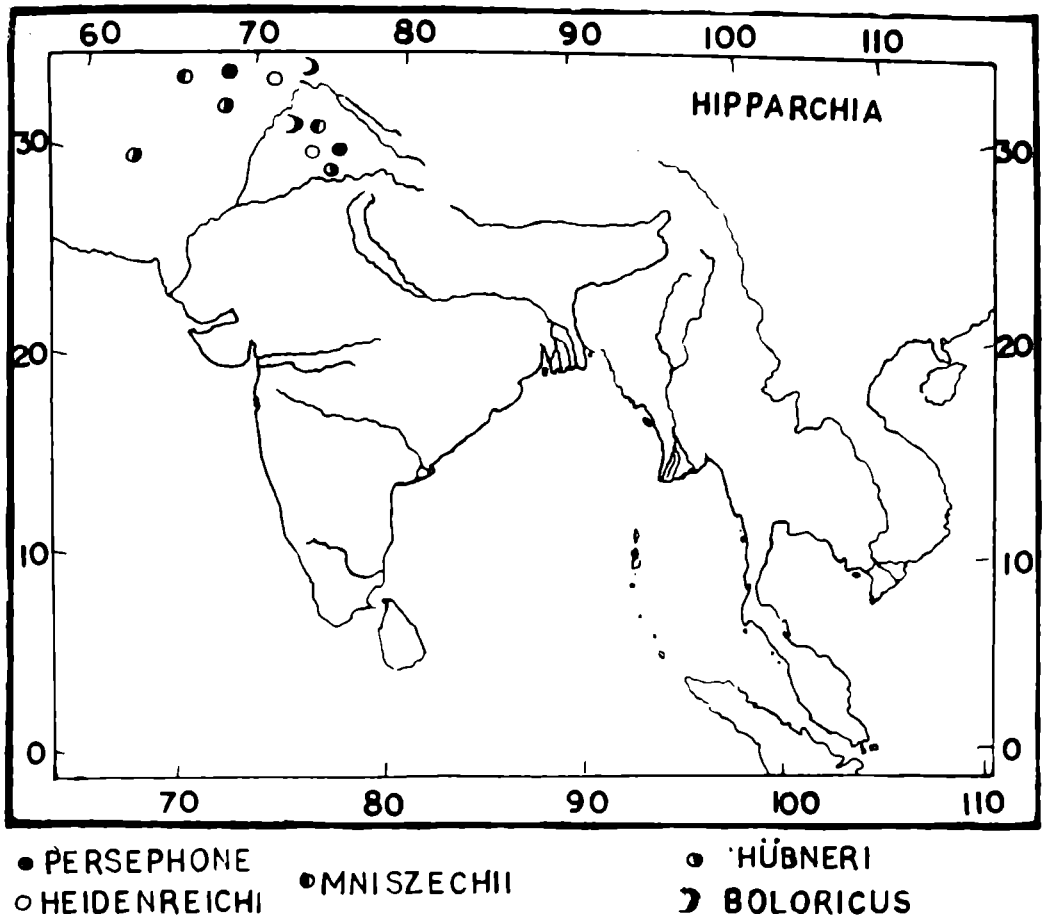

Fig. 24. Distribution of *Hipparchia* species.

Himalaya; two subspecies *parsis* (Le Cerf) and *shiva* (Le Cerf) are reported from Northwest Himalaya.

Hipparchia persephone (Hübner)

Wing span 60-70 mm; wings above greyish-brown and below pale ochre; fore wing without white in cell above; hind wing with a curved post-discal band.

This is a Turkmenian species, represented by the subspecies *enervata* (Staudinger) in the Pamirs-Northwest Himalaya.

Hipparchia heidenreichi Lederer

Wings dirty-black above; cell in fore wing below white and subapical black bar; fore wing with a broad sex brand from the inner margin to the hind cell angle; hind wing above with cell apex white; fore wing above with the cell white basally. A Turkmenian species, represented by the subspecies *shandura* Marshall in the Pamirs-Northwest Himalaya.

Hipparchia mniszechii (Herrich-Schäffer)
(Plate XXI)

Wing span 50-56 mm; wings above pale brown; and below greyish-white; fore wing with two white pupillated ocellar spots in ochraceous patch. This is a Turkmenian species, represented by *balucha* (Evans), *droschica* (Tytler), *gilgitica* (Tytler), *lehana* Moore and *baldiva* (Moore) in Northwest Himalaya.

Hipparchia hübneri (C.R. Felder)

Wing span 42-50 mm; wings above pale brown; cilia alternately brown and white; broad, ochre-coloured discal band extending on both wings, but not reaching the costal and inner margins; two ocellar spots without white centres above; hind wing below greyish-brown, freckled black; hind wing above with the band curved. This is a Turkmenian species, distributed in the Hindu Kush and Northwest Himalaya; *H. hübneri hübneri* (C. & R. Felder) *H. hübneri safeda* (Tytler) and *H. hübneri pupilata* (Tytler) occur at elevations of up to 3500 m.

Hipparchia moorei (Evans)

Wing span 50-55 mm; fore wing above with dentate band; otherwise mostly as in *H. hübneri.* Two subspecies *moorei* (Evans) and *gilgitica* (Tytler) are reported from Northwest Himalaya.

Hipparchia bolоricus Grum-Grshimailo

Wing span 38-50 mm; the species resembles *moorei* but with the white markings above tinged reddish. The species occurs in the Pamirs-Northwest Himalaya and is represented by the nominotype and the subspecies *chitralica* (Tytler) at elevations of 3000-3300 m.

Hipparchia thelephassa Hübner

Wing span 55-65 mm; wings above pale brown, below greyish-white; cilia alternately white and brown; broad post-discal ochre coloured band across both wings, with outer margin darker; fore wing cell with black band; hind wing below with irregular curved band. Reported from Northwest Himalaya.

Hipparchia digna Marshall

Wing span 52-55 mm; wings above dark brown, with ochre coloured band in both wings, but without hind ocellar spot. Reported at elevations of 2700 m in Northwest Himalaya.

Hipparchia actaea (Esper)

Wing span 50-65 mm; wings above blackish-brown; subapical white-

centred black ocellar spot in the fore wing above; hind wing unmarked. A Palaearctic species with three subspecies in Northwest Himalaya: *H. actaea magna* (Evans), *H. actaea pimpla* (C. & R. Felder) and *H. actaea ziara* Talbot occur up to elevations of nearly 2700 m.

OENEIS HÜBNER

A Holarctic genus, with triangular fore wings, cell long, vein M_3 straight, veins R_5 and M_1 closely approximated; Sc not swollen basally; hind wing with vein M_1 closer to R_3 than M_2.

Oeneis buddha Grum-Grshimailo

Wing span 50 mm; wings above brown, below fore wing pale ochre-coloured and hind smoky-brown; three ocellar spots small, black, with white pupil. Distributed in Tibet and Northwest Himalaya up to Garhwal at elevations of 4115 m.

Oeneis pumilus (C. & R. Felder)

Wing span 40-45 mm; wings above ochre-coloured; often also ochre-yellow, blackish-brown on outer margin; six post-discal ochre spots. The nominotype is reported at 4880 m in Northwest Himalaya and the subspecies *bicolor* (Seitz) occurs at elevations of 3900 m in southeast Tibet and East Himalaya.

Oeneis palaearcticus sikkimensis Staudinger

This subspecies of the Turkmenian form, with wing span 40-45 mm, is reported at elevations 3900-5180 m in eastern Tibet and East Himalaya.

AULOCERA BUTLER

Eyes glabrous; palpi compressed; cell in fore wing a little longer than 0.50 of wing length; fore wing with vein M_3 emitted from hind angle of cell; veins M_1 and M_2 parallel; vein R_2 emitted a little before anterior angle of cell; Sc much swollen basally; hind wing with vein Cu_{1a} much before cell apex, M_3 emitted from cell apex; veins M_1 and M_2 well separated; veins R_3 and M_1 approximated.

Key to species

1. Fore wing below dark coloured 2
   Fore wing below pale coloured ..... *Aulocera saraswati* (Kollar)
2. Fore wing with discal spots not in a line 3
   Fore wing with discal spots in a line .. *Aulocera brahminus* (Blanch.)
3. Hind wing above with the band narrowed behind and not reaching

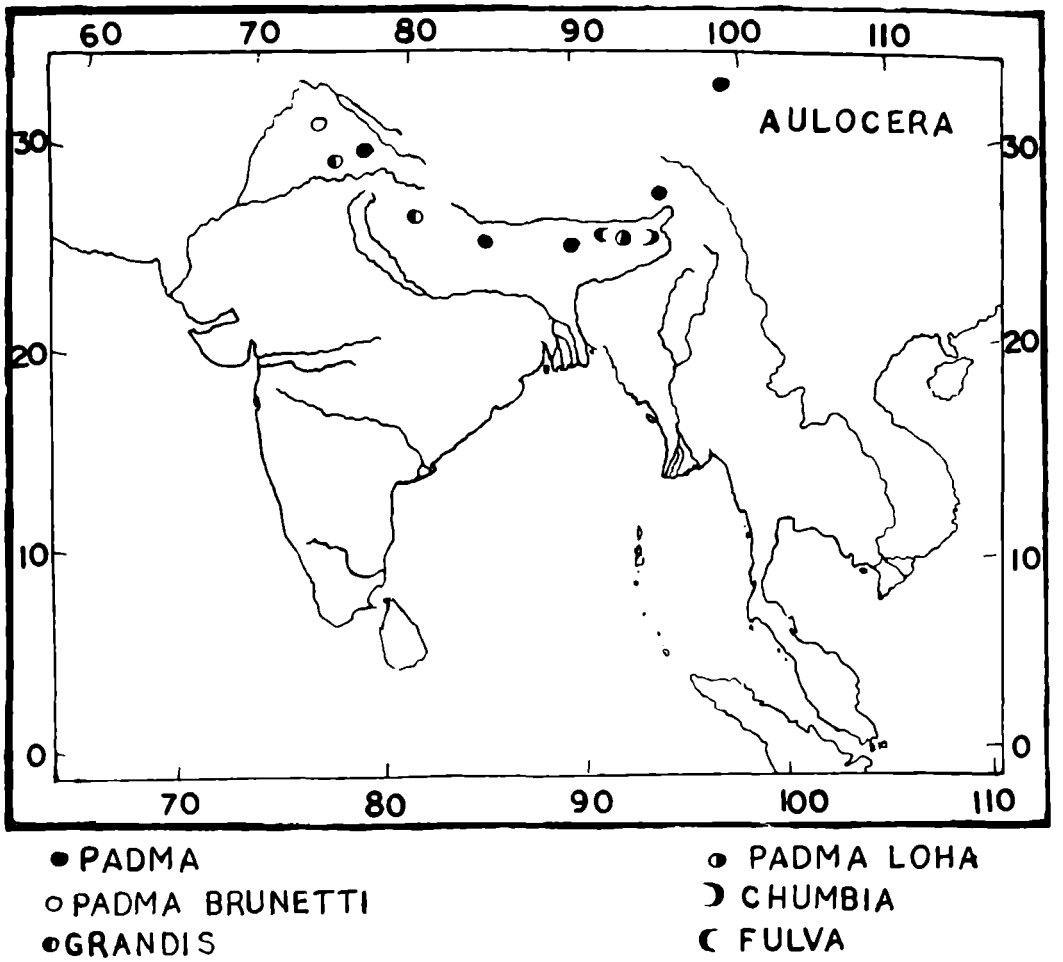

Fig. 25. Distribution of *Aulocera* species.

inner margin, with the veins not darker . . *Aulocera swaha* (Kollar)
Hind wing above with the band uniformly wide, veins across dark . .
. . . . . *Aulocera padma* (Kollar)

Aulocera padma (Kollar)
(Plate XXII)

Wing span 70-98 mm; a variable species with the discal spots above in fore wing not in a line; hind wing with the band uniformly wide. The species is distributed in west China, southeast Tibet and the Himalaya. The nominotype *padma* occurs throughout the Himalaya at elevations of 1500-2500 m; *brunetti* Evans is reported from Northwest Himalaya; *loha* occurs from West to East Himalaya; *grandis* the largest subspecies with wing span 80-98 mm comes from Northwest Himalaya and *chumbica* Moore and *fulva* Evans are reported from East Himalaya almost up to 3000 m.

Aulocera swaha (Kollar)

Wing span 65-75 mm; fore wing with post-ocellar spot in front of vein M_2; veins across the hind wing band not darker than the background. The species seems to be restricted to the Himalaya; the nominotype *swaha* (Kollar) extends the whole length of the Himalaya and ascends almost to elevations of 3000 m and the subspecies *gilgitica* Tytler *garuda* Fruhstorfer are reported from Northwest Himalaya.

Aulocera brahminus (Blanchard)
(Plate XXII)

Wing span 55-65 mm; a small species black above, crossed by post-discal oblique series of white spots on both wings; hind wing below darker basally. The nominotype extends from Northwest to the Garhwal Himalaya; *dokwana* Evans extends from the Garhwal to Nepal Himalaya and *brahminoides* Moore is reported from East Himalaya.

Aulocera saraswati (Kollar)

Wing span 65-75 mm; discal white band on fore wing above uniformly wide and reaching behind to the inner margin of hind wing; below with many white striations. The species is reported from Northwest to East Himalaya almost up to 3000 m.

EREBIA DALMAN

A South Palaearctic genus of European mountains, Turkmenian Subregion, China, Tibet and the Himalaya, with broadly triangular wing, cell in fore wing more than 0.50 of wing length; veins R_5 and M_1 approximated basally; veins R_1 and R_2 emitted before cell apex; Sc swollen basally; hind wing with vein Cu_{1a} before cell apex, vein M_3 from cell apex; vein M_1 closer to R_5 than M_2 basally; wings generally brown, with the submarginal band continuous or interrupted; club spatulate or also gradually thickened.

Key to species

1. Club spatulate 2
   Club subcylindrical 4
2. Fore wing above with subtriangular yellow patch ..... *Erebia mani* de Nićeville
   Fore wing above without subtriangular yellow patch 3
3. Fore wing with the pre-apical ocellus ringed broad yellow ..... *Erebia kalinda* Moore
   Fore wing without ring or with only an obscure red ring in the pre-apical ocellus ..... *Erebia shallada* Lang
4. Fore and hind wings below with dissimilar ground colour or irrorated

.....5

Fore and hind wings below with like ground colour .....
..... *Erebia daksha* (Moore)

5. Hind wing below with 2 large pre-apical and two tornal ocelli .....
.....*Erebia hyagriva* (Moore)

Hind wing below without pre-apical ocelli or with a continuous series of five to six ocelli 6

6. Hind wing below with transverse post-discal sinuous bands.....7

Hind wing below without transverse post-discal sinuous bands.....
..... *Erebia scanda* Kollar

7. Hind wing below without grey irroration or ocelli two to six .....
..... *Erebia nirmala* (Moore)

Hind wing below densely irrorated; ocelli never more than two; fore wing with pre-apical ocellus narrowly ringed anteriorly .....
..... *Erebia annada* Moore

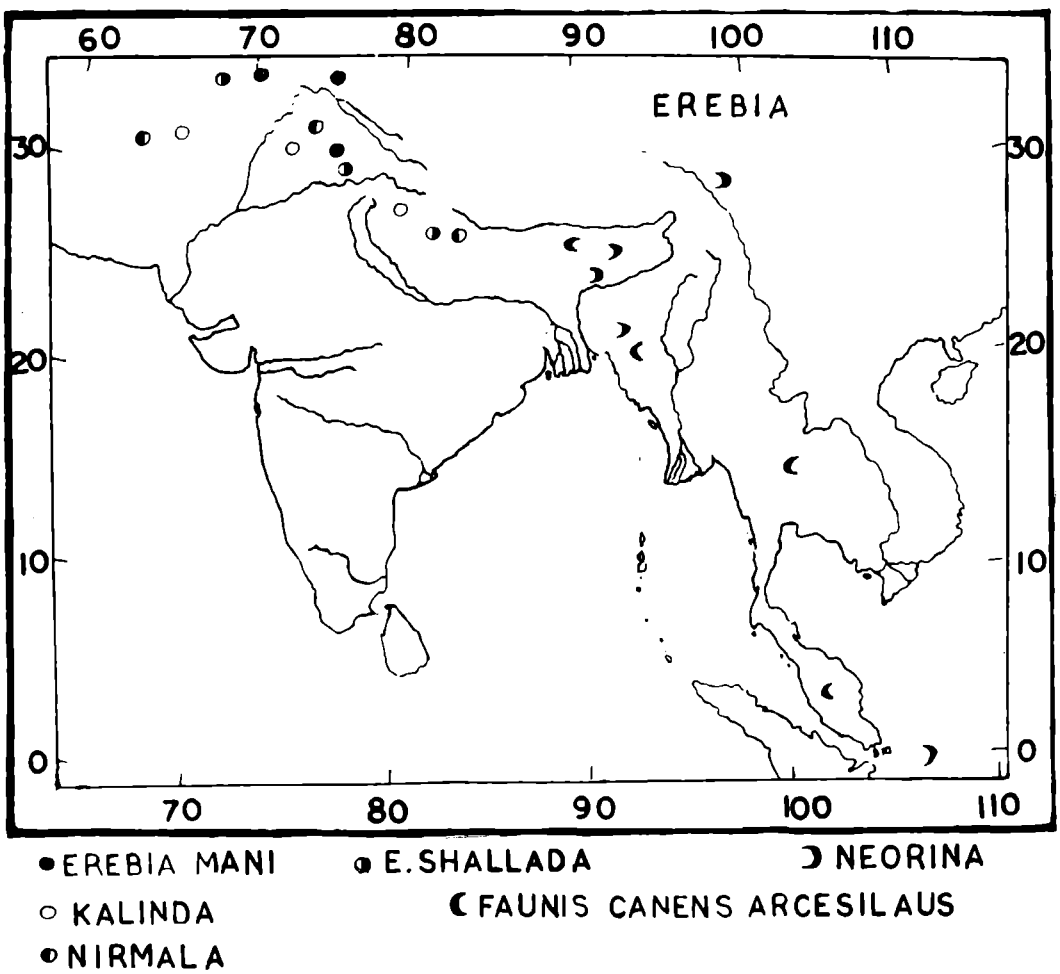

Fig. 26. Distribution of *Erebia* species.

Erebia mani de Nicéville
(Plate XXII)

Wing span 45-50 mm; antennae with spatulate club; wings above dark brown; also blackish-brown; fore wing with large, black, white-centred subapical ocellar spot, hind wing greyish-brown. A Turkmenian species represented in Northwest Himalaya and Pamirs by *mani* (de Nicéville), *shandura* Tytler and *lorimeri* Tytler.

Erebia kalinda Moore

Wing span 45-50 mm; fore wing not yellow above distally; a post-distal brown patch; ocellar spot with yellow ring, black and pupillated; hind wing without ocelli above but below with seven post-discal series of white spots. The species occurs from the Hindu Kush to Garhwal Himalaya up to 4270 m; three subspecies are known *kalinda* Moore, *chitralica* Evans and *kashmiriana* Tytler.

Erebia shallada Marshall & de Nicéville

Wing span 45-55 mm; fore wing above obscurely brown not reaching ocellar spot. Nominotype extends from the Alai-Pamirs to Northwest Himalaya and West Himalaya up to elevations of 3600-3900 m.

Erebia nirmala nirmala Moore

Wing span 50-55 mm; wings above uniformly dark brown; fore wing in male without sex brand; subapical ocellar spot small, but below large, round and ringed; fore wing below ochre-red; hind wing above with a broad discal line, below without striations and submarginal brown line; post-discal row of white dots. Distributed in the east Hindu Kush and Northwest Himalaya and represented by nominotype extending from Kangra to Kumaon; *materta* (Fruhstorfer) in Northwest Himalaya; *daksha* (Moore), *kala* Evans and *scandina* (Fruhstorfer) from Northwest Himalaya.

Erebia scanda Kollar
(Plate XXII)

Wing span 50-76 mm; wings above dark brown; below brown; below fore wing with ocellar spot with an obscure wide ring; hind wing below without submarginal brown band two ocellar spots. The species is restricted to the Himalaya; the nominotype occurs through the whole length of the Himalaya; *optima* (Watkins) is reported from Sikkim.

Erebia hybrida (Butler)

Wing span 50-60 mm; wings above somewhat paler brown than in the foregoing species; ocellar spot yellow-ringed. The species seems to be restricted to the Garhwal-Kumaon Himalaya.

Erebia annada Moore

Wing span 60-70 mm; general colour above like *E. scanda*, but the ocellar spot ringed brownish-orange; wings below with the submarginal band ending in ocellar spot. The species is distributed from Assam hills and northern Burmese mountains through the whole Himalaya; the nominotype is reported from Bhutan; the subspecies *caeca* (Watkins) occurs the whole length of the Himalaya at elevations of nearly 2000 m.

Erebia hyagriva (Moore)

Wing span 40-45 mm; wings above dark brown; below ochre-brown; submarginal dark band on fore wing above well-developed; subapical ocellar spot black, yellow-ringed and with two pupils; hind wing below with short dark striae and with post-discal series of four large black, yellow-ringed, white-pupillated ocellar spots. The species occurs in Northwest and West Himalaya up to elevations of 1800-2400 m.

YPTHIMA HÜBNER

Fore wing triangular; hind wing ovate; cell wide, 0.50 of wing length; fore wing with veins R_1 and R_2 emitted beyond cell apex; vein R_2 issuing from R_5; hind wing discocellulars oblique; precostal vein short, knobbed.

Key to species

1. Hind wing below often without ocelli 2
   Hind wing below with ocelli 4
2. Fore wing below with dark submarginal band ..... *Ypthima nareda* (Kollar)
   Fore wing below without dark submarginal band 3
3. Hind wing ocelli small ..... *Ypthima asterope* (Klug)
4. Hind wing below with the tornal ocelli in a straight line 5
   Hind wing below with tornal ocelli not in a straight line 6
5. Hind wing below with two subtornal ocelli ..... *Ypthima bolanica* Marshall
   Hind wing below with three subtornal ocelli ..... *Ypthima lisandra* (Cramer)
6. Hind wing below with two apical ocelli larger than others 7
   Hind wing below with two apical ocelli not larger than others ..... *Ypthima sakra* Moore
7. Small species with wing span less than 45 mm 8
   Large species with wing span exceeding 45 mm ..... *Ypthima methora* Hewitson.
8. Hind wing above with distinct discal line .. *Ypthima baldus* (Fabr.)
   Hind wing above with the discal line obscure or absent .....

Ypthima nareda (Kollar)
(Plate XXIII)

Wing span 40-45 mm; above pale brown, below pale ochre; hind wing with large subapical ocellar spot; submarginal dark bands on fore and hind wings below faint. Reported from Kashmir to Kumaon Himalaya, at elevations of up to 2100 m; one subspecies occurs in Burma; *Y. nareda, newara* Moore occurs in Nepal.

Ypthima asterope (Klug)

Wing span 30-37 mm; variable species, brown above and striated below; ocelli in hind wing small in humid localities or in wet-season forms and almost absent in dry forms. This is a South Palaearctic species, extending to China and Hindu Kush and extreme west of Northwest Himalaya, through the rest of the Himalaya almost to Assam hills.

Ypthima bolanica Marshall
(Plate XXIII)

Wing span 35-40 mm; brown above and below; fore wing ocellus large, black surrounded by paler patch, with brown ring and two pupils; hind wing subtornal ocellus single, with three other similar ocelli in front. The species is reported from Baluchistan to Northwest Himalaya at elevations up to 1800 m.

Ypthima lisandra (Cramer)

Wing span 32-45 mm; variable form, brown above and brownish-white below; discal line in both wings below distinctly marked; hind wing with three hind and two subapical ocelli; tornal ocelli in a straight line. The species is distributed in Taiwan, Sundaland, China, Burma, Malaya, India and Ceylon; the subspecies *avanta* Moore occurs in the Himalaya from Kashmir to Sikkim.

Ypthima sakra Moore

Wing span 45-55 mm; wings above yellowish-brown; oval, large, yellow-ringed, bipupillate ocellus in fore wing above; hind wing with four nonpupillate ocelli above and five below. The species is distributed in Burma, Assam hills, southeast Tibet and the Himalaya; *sakra* Moore comes from Sikkim, *nikaea* Moore from Northwest to Kumaon Himalaya.

Ypthima baldus (Fabr.)

Wing span 35-45 mm; variable species, above brown and below ochre-white and coarsely white striate; subapical ocellus in fore wing above large,

oblique, oval, black, ringed yellow and with two pupils; hind wing above with two small post-discal non-pupillate ocelli. The species is distributed in the Indo-Malayan area and is represented by the nominotype in the Himalaya.

Ypthima indecora Moore

Wing span 35-40 mm; hind wing below with ocelli in twos, but almost obsolete in arid localities; with distinct discal and submarginal brown bands in the fore and hind wings below. Occurs from Kashmir to Kumaon Himalaya.

Ypthima methora Hewitson

Wing span 34-55 mm; dark brown above and pale yellowish-brown below; fore wing with large, yellow-ringed, bipupillate black ocellus; hind wing with three to five small post-discal ocelli above and below with six ocelli in twos. The species occurs in Yunnan, Burma, Assam and Sikkim.

ORSOTRIOENA WALLENGREN

Fore wing with a fold near anal vein, with a tuft of yellow or black setae; Sc swollen only basally; vein R_1 and R_2 issuing from before cell apex; hind wing with M_3 and Cu_{1a} closely approximated and M_3 issuing before cell hind angle; fore wing cell about 0.50 of wing length. This is an Indo-Australian genus with a single species in the Himalaya.

Orsotrioena medus medus (Fabr.)

Wing span 42-55 mm; brownish-black above and dark below; fore wing with marginal, hind wing with a submarginal and marginal narrow white lines; two ocelli in fore wing below and hind wing with three ocelli. The species ranges from Australian area through Sundaland, Burma and Himalaya up to Nepal.

RAGADIA WESTWOOD

Fore wing cell more than 0.50 of wing length; vein M_2 closer to M_1 than M_3 basally; R_2 emitted beyond cell apex; R*1* from cell apex; Sc much swollen basally. Indo-Malayan genus.

Ragadia crisilda Hewitson

Wing span 42-46 mm; brownish-black above, below with five white bands; hind wing with submarginal curved narrow white band. Burma and East Himalaya.

NEORINA WESTWOOD

Fore wing with cell not 0.50 of wing length; anterior and middle discocellulars very short, posterior discocellular bent inward; veins R_1 and R_3 from before cell apex; Sc not or only very slightly swollen basally; hind wing oval, outer margin scalloped, produced at end of vein M_3; veins M_3, M_{21}, M_1 and R_5 at about equal spaces; precostal vein directed basally. The genus is distributed in the Sundaland, Burma, west China and East Himalaya.

Neorina patria Leach

Wing span 100-110 mm; hind wing with a short tail at tip of vein Cu_{1a}; fore wing above with broad white discal band; without ocelli in hind wing above; above wings very dark brown; hind wing tailed at tip of vein M_3. The species extends from western China and northern Burmese mountains through Assam to East Himalaya.

Neorina hilda Westwood

Wing span 80-95 mm; above dark brown; fore wing with broad, yellow discal band above, but without tail at tip of vein Cu_{1a}; hind wing with faint, incomplete submarginal and marginal lines above; both wings with two submarginal dark lunular lines. The species is reported from the Assam hills and East Himalaya.

ETHIOPE MOORE

Fore wing cell with the front angle right-angled, broad, not quite 0.50 of wing length; Sc hardly swollen basally; veins R_1 and R_2 free; hind wing without precostal cell; eyes glabrous. The genus occurs in Thailand and Burma and is represented by a single species in the Himalaya.

Ethiope himachala (Moore)

Wing span 60-85 mm; above dark brown, with a row of seven black, ringed, white-pupillate ocellar spots in pale area near outer margin; hind wing with only six ocellar spots. The species is reported from the north Burmese mountains to Sikkim.

MELANITIS FABRICIUS

This widely distributed Indo-Australian and Ethiopian genus has glabrous eyes; fore wing with veins M_2, M_1 and R_5 approximated basally; veins R_2 and R_1 emitted before the cell apex; hind wing outer margin pointed at tip of vein M_3; posterior discocellular in fore wing curved in.

Melanitis phedima (Stoll)

Wing span 60-85 mm; variable species, with the fore wing apex not produced. Widely distributed in the Philippines, Taiwan, Sundaland, Burma, India and Ceylon and extending to west China, represented by the subspecies *galkissa* Fruhstorfer in Northwest and West Himalaya and by *bela* Moore in the north Burmese mountains and Sikkim.

Melanitis zitenius zitenius (Herbst)

Wing span 80-95 mm; variable species without ash-coloured wing margin above, large black subapical spot above in the fore wing; hind wing with 2 white, black-edged dots instead of ocellar spots behind above. The species extends from the Sundaland through Burma to the Himalaya up to Kumaon.

CYLLOGENES BUTLER

Fore wing with very short anal vein; hind wing broadly tailed at tip of vein M_3; otherwise like *Melanitis*.

Cyllogenes suradeva (Moore)

Wing span 75-85 mm; above brown,with subapical, narrow yellow band from costa to just behind vein Cu_{1a}, not reaching outer margin; hind wing without markings above, but below with post-discal dark band and obscure, incomplete white small ocellar spots. The species is reported from East Himalaya.

Cyllogenes janetae de Nicéville

Wing span 90-95 mm; fore wing above with subapical yellow band, broad and curved. Reported from Assam and Bhutan.

ELYMNIAS HÜBNER

Wing outer margin usually scalloped; cell short and broad, less than 0.50 of wing length; veins M_2 and M_3 emitted from hind angle of cell; veins R_1 and R_2 emitted from before the front angle of cell; Sc swollen basally; hind wing with veins Cu_{1a} and M_3 from the hind angle of cell. This is largely an Indo-Australian genus, with about four species in the Himalaya.

Key to species

1. Wings above black 2
   Wings above dark brown 3
2. Wings below irregularly striated..... *Elymnias neaea* (Linn.)
   Wings below mottled ..... *Elymnias vasudeva vasudeva* Moore

3. Fore wing with stripes distally ... *Elymnias patna patna* (Westwood)
   Fore wing distally with a shiny blue patch .....
   ..... *Elymnias malelas* (Hewitson)

Elymnias nesaea (Linn.)

Wing span 75-85 mm; above black, with green or blue marks; below purple-white, irregularly striated, blotched dark brown. Reported from north Burmese mountains and Sikkim.

Elymnias malelas (Hewitson)

Wing span 80-100 mm; wings above dark brown and light brown below; distally with a shiny blue patch above in fore wing; post-discal blue spots 2; submarginal curved series of blue spots. Reported from Burma and Sikkim; the subspecies *nilamba* Fruhstorfer extends from Nepal to Kumaon Himalaya.

Elymnias patna patna (Westwood)

Wing span 80-100 mm; wings dark brown above and pale brown and somewhat striated below; fore wing with blue stripes distally; hind wing with post-discal curved series of 4 pale blue discal spots. The species extends from north Burmese mountains westward to the Kumaon Himalaya.

Elymnias vasudeva vasudeva Moore

Wing span 80-90 mm; black above, with the fore wing broadly striped blue-grey; below white, mottled black. Mainly a Burmese mountain form that has extended through Assam hills to Sikkim.

CHAPTER IX

Nymphalidae and Other Related Families

Family AMATHUSIIDAE

Wings broad; cell closed; vein R_1 free R_2 emitted from R_5 beyond the cell apex; R_1 sometimes anastomosed with Sc, R_2 often with R_1; hind wing with cell open. Two subfamilies Amathusiinae and Discophorinae are recognised.

Key to genera

1. Fore wing with vein R_2 2
   Fore wing without vein R_2 6
2. Fore wing with vein Sc swollen basally ..... *Faunis* Hübner
   Fore wing with vein Sc not swollen basally 3
3. Hind wing with cell open 4
   Hind wing with cell appearing to be closed by a fold of the wing membrane ..... *Amathuxidia* Staud.
4. Fore wing with vein R_2 anastomosed with vein R_1 ..... *Discophora* Boisd.
   Fore wing with vein R_2 not anastomosed with vein R_1 5
5. Fore wing tip rounded ..... *Thaumantis* Hübner
   Fore wing tip acutely produced ..... *Aemona* Hewitson
6. Fore wing with veins M_1 and M_2 approximated basally ..... *Enispe* Doubleday
   Fore wing with veins M_1 and M_2 well separated basally ..... *Stichophthalma* C. & R. Felder

FAUNIS HÜBNER

Fore wing with vein R_2 emitted beyond 0.50 of vein R_5, but sometimes also absent; R_1 anastomosed with Sc; veins R_2, R_3 and R_4 arise close together.

Faunis canens arcesilaus (Fabr.)

Wing span 65-75 mm; wings above ochre, below somewhat browned; narrow dark sub-basal and discal bands on both wings below; minute yellow post-discal series of spots below. Reported from Malaya, Thailand, Burma and Sikkim.

Faunis faunula (Westwood)

Wing span 110 mm; dark grey above; with a cell spot below in fore wing; irregular discal band; post-discal band straight. Occurs in Indo-China, Malaya, Thailand, Burma and Bhutan Himalaya.

AEMONA HEWITSON

Cell short, broad; fore wing with vein R_1 emitted much before the anterior angle of cell and anastomosed with Sc; veins R_2, R_3 and R_4 emitted from R_5; hind wing with outer margin subangulate at tip of vein M_3.

Aemona amathusia (Hewitson)
(Plate XXIV)

Wing span 75-90 mm; wings above brownish-red, with the veins not darker; apically small and outer marginally narrow brownish-black; hind wing with post-discal dentate blackish-brown line. Distributed from south China, through Burma and Assam to East Himalaya.

STICHOPHTHALMA C. & R. FELDER

Wings broadly triangular, with broad and short cell; vein M_3 emitted from hind angle of cell; vein R_2 absent; hind wing outer margin scalloped, cell open. The genus occurs in Taiwan, China, Indo-China, Burma and East Himalaya.

Stichophthalma nourmahal nourmahal (Westwood)
(Plate XXIV)

Wing span 95-105 mm; wings above chocolate-brown; dark ochre below; fore wing with subapical broad, curved band from costa to outer margin; hind wing with yellow margin, enclosing paired brown lunules. Reported from Burma, Assam and Sikkim.

Stichophthalma camadeva (Westwood)

Wing expanse 125-150 mm; fore wing above basally chocolate-brown, apically pale blue; with a broad discal irregular white bar and a post-discal series of two to three brown spots; below ochre, speckled green and with sub-basal and discal sinuate dark brown line; below dark ochre ocellar spots; hind wing above with submarginal row of lunular white marks. The

species occurs in Thailand, Burma, Assam hills and Sikkim.

THAUMANTIS HÜBNER
(Plate XXIII)

Fore wing with short cell; M_3 obtusely angled forward; vein R_1 emitted from 0.33 before cell apex and anastomosed with Sc; vein R_2 arising from R_5 far beyond cell apex and anastomosed with R_1; veins R_3 and R_4 not anastomosed; hind wing with cell open; vein M_3 strongly obtuse angled in front. The genus is distributed from Borneo through Sundaland, Thailand, Burma, south Tibet to East Himalaya. *Thaumantis diores* Doubleday, with a wing span of 95-115 mm; and blackish-brown above, is reported from Sikkim and Burma.

AMATHUXIDIA STAUDINGER*
(Plate XXIV)

Fore wing with R_1 and Sc anastomosed; hind wing cell more or less closed; with a hair tuft near the base of anal vein; fore wing with vein M_3 bent in front and without a spur; vein M_2 emitted far away from M_1. The genus is distributed from the Philippines, southward through Borneo, Sundaland, Malaya, Burma, with a single species *Amathuxidia amythaon amythaon* (Doubleday), with wing span 110-130 mm, brownish-black above and pink below fore wing above with broad, curved pale-blue discal band, from Sikkim.

DISCOPHORA BIOSDUVAL
(Plate XXV)

Fore wing without middle discocellular; veins R_1 and R_2 anastomosed with Sc; hind wing with the outer margin convex or angulate at tip of vein M_3. This is a widely distributed Oriental genus, with *Discophora sondaica* Boisduval represented by the subspecies *indica* Staudinger (wing span 80-90 mm) extending from Burma to Sikkim.

ENISPE DOUBLEDAY
(Plate XXV)

Fore with vein R_1 anastomosed with Sc, vein R_2 absent. This is an Indo-Malayan genus, with *E. cycnus* Westwood (wing span 80-95 mm) and *E. euthymius euthymius* (Doubleday) ochre-orange with black marks above and reported from Burma and East Himalaya.

* *Amathusia* Fabr.

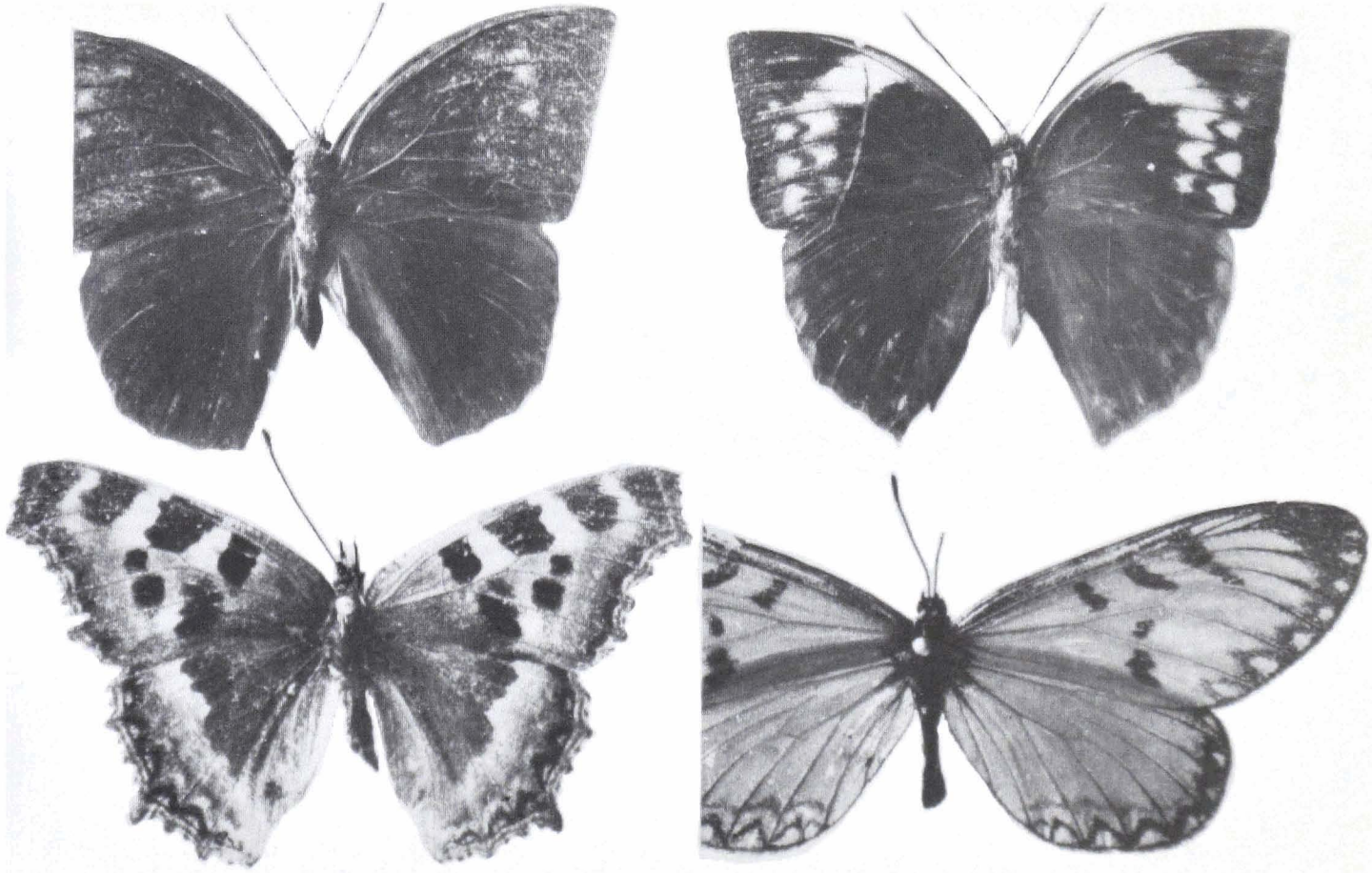

PLATE XXV. Top row left: *Discophora sondaica*
right: *Enispe cyconus*

Bottom row left: *Vanessa cashmiriensis*
right: *Acraea issoria*

Family ACRAEIDAE
(Plate XXV)

A small family with elongate wings, cell closed in both wings; outer margin entire; wings most often diaphanous or sparsely scaled; with vein R_1 emitted before cell apex and veins R_{2-5} stalked and vein M_1 emitted from cell apex and far apart from M_2. The genus *Acraea* Fabr. is represented by *Acraea issoria issoria* (Hübner) (wing span 50-70 mm) and *A. issoria anomala* Kollar (wing span 45-55 mm) being reported respectively from Sikkim and West and Northwest Himalaya.

Family NYMPHALIDAE

This is a large and widely distributed family, richly represented in the Himalaya. The nymphalid butterflies are readily recognised by the following characters: antennae closely approximated basally, more or less scaled, with the club gradual or abrupt; eyes hairy or also naked; wings generally wide, sometimes narrow; cell often open; hind wing with the inner margin channelled to fit abdomen; fore legs reduced.

Subfamily NYMPHALINAE

Antennae aproximated basally, more or less scaled, with the club variable; wings generally broad; cell open or closed obscurely in the fore wing.

Key to genera

1. Fore wing with costa serrated 2
   Fore wing with costa not serrated 3
2. Cell of fore and hind wings closed ..... *Charaxes* Ochs.
   Fore wing with cell closed; hind wing with cell open .. *Eulepis* Moore
3. Cell closed in fore and hind wings 4
   Fore wing with cell closed; hind wing with cell open 17
4. Eyes hairy 5
   Eyes glabrous 8
5. Fore wing with vein R_2 emitted from R_5, not free .... *Dilipa* Moore
   Fore wing with vein R_2 emitted from Sc, free 6
6. Fore wing with veins M_3 and Cu_{1a} emitted from hind angle of cell ... 7
   Fore wing with vein Cu_{1a} issuing well before cell apex and vein M_3 issuing from cell apex ..... *Vanessa* Fabr.
7. Hind wing with short cell ..... *Stibochiana* Butler
   Hind wing with long cell ..... *Dichorragia* Butler
8. Fore wing with vein Cu_{1a} emitted before cell apex, vein M_3 from cell apex 9

Fore wing with veins Cu_{1a} and M_3 emitted from cell apex.....13
9. Hind wing with vein Cu_{1a} and M_3 issuing from cell apex.....10
Hind wing with veins Cu_{1a} and M_3 stalked together, branching off beyond cell apex 12
10. Club short and abruptly thickened..... *Argynnis* Fabr.
Club long, gradually swollen.....11
11. Hind wing with precostal vein curved inward .....
..... *Penthema* Doubleday
Hind wing with precostal vein curved outward .....
..... *Neurosigma* Westwood
12. Fore wing with cell shorter than 0.50 of wing length; middle discocellular concave..... *Hypolimnas* Hübner
Fore wing with cell 0.50 of wing length; middle discocellular straight
..... *Lebadea* Felder
13. Hind wing with veins Cu_{1a} and M_3 emitted from cell apex 14
Hind wing with veins Cu_{1a} and M_3 stalked together and branching off beyond cell apex.....16
14. Fore wing with vein R_2 free..... *Dophla* Moore
Fore wing with vein R_2 emitted from R_5 15
15. Fore wing vein R_1 emitted before cell apex ..... *Issoria* Hübner
Fore wing with vein R_1 emitted from cell apex ..... *Cethosia* Fabr.
16. Fore wing with vein Cu_{1a} branching off well before hind angle of cell; with a long tail at tip of anal vein..... *Kallima* Doubleday
Fore wing with vein R_2 emitted from R_5; vein R_2 not free.....
..... *Chersonesia* Dist.
Fore wing with vein R_2 free..... *Pseudergolis* Felder
17. Fore wing with closed cell; hind wing cell open 19
Fore and hind wings cells open or apparently closed 18
18. Fore wing cell closed, hind wing cell apparently closed though really open ..... *Cynthia* Fabr.
Fore and hind wing with cells open 26
19. Fore wing with vein R_2 emitted from R_5, not free 20
Fore wing with vein R_2 emitted from Sc, free 21
20. Fore wing with veins Cu_{1a} and M_3 emitted from cell apex.....
..... *Araschnia* Hübner
Fore wing with vein Cu_{1a} emitted well before and vein M_3 from cell apex.....*Melitaea* Fabr.
21. Fore wing with veins Cu_{1a} and M_3 emitted from cell apex.....22
Fore wing with vein Cu_{1a} emitted from before cell apex, M_3 from apex, or both stalked 24
22. Fore wing with vein R_2 emitted from cell apex. . . .*Pantoporia* Hübner
Fore wing with vein R_2 emitted before cell apex 23
23. Eyes hairy .....*Liminitis* Fabr.

Eyes naked ..... *Arrota* Moore

24. Fore wing with vein Cu_{1a} emitted before hind angle (apex) of cell 25

Fore wing with veins Cu_{1a} and M_3 stalked together and branching off much beyond the cell apex ..... *Cirrochroa* Doubleday

25. Fore wing with vein R_2 emitted from cell apex .... *Symphaedra* Hübner

Fore wing with vein R_2 emitted before cell apex .... *Symbrenthia* Hübner

26. Fore wing with vein R_2 emitted from Sc 27

Fore wing with vein R_2 issuing from R_5 33

27. Hind wing with vein R_3 closer to M_1 than to R_2 basally 28

Hind wing with vein R_3 equidistant between M_1 and R_2 basally or even closer to R_2 than to M_1 29

28. Fore wing with vein R_3 emitted from R_5 before middle 31

Fore wing with vein R_3 emitted from beyond middle of R_5 30

29. Fore wing with vein R_2 emitted before cell apex ..... *Apatura* Fabr.

Fore wing with vein R_2 emitted from anterior angle of cell apex.... ..... *Herona* Doubleday

30. Hind wing not lobed or not tailed ..... *Hestina* Westwood

31. Fore wing with vein R_3 before middle of R_5 or if issuing from the middle, then vein R_1 anastomosed with Sc ..... *Euthalia* Hübner

Fore wing with vein R_3 beyond middle of R_5 32

32. Palpi wide, densely scaled ..... *Athyma* Westwood

Palpi slender, loosely scaled ..... *Neptis* Fabr.

33. Eyes hairy ..... *Parhestina* Moore

Eyes not hairy 34

34. Hind wing outer margin entire ..... *Sephisa* Moore

Hind wing outer margin bimarginate ..... *Euripus* Westwood

CHARAXES OCHSENHEIMER

Third palpal segment short; eyes naked; fore wing with costa widely serrated; cell less than 0.50 of wing length, closed by slender cross vein; anterior discocellular short, middle discocellular about two times the anterior; vein M_3 emitted from hind angle of cell apex; veins R_3 and R_4 emitted from R_5 and approximated basally; R_1 and R_2 free; hind wing outer margin often scalloped, with tails at tips of veins Cu_{1b} and M_3, cell narrow, less than 0.50 of wing length.

This genus is distributed in the Ethiopian, Palaearctic and Indo-Australian Regions, with five species in the Himalaya.

Key to species

1. Fore wing above ochraceous basally 2

Fore wing above black basally ..... *Charaxes fabius* (Fabr.)

2. Fore wing above with a post-discal sublunular cross-band; wings below purple-tawny 3

Fore wing above with a post-discal sublunular cross-band, but below ochraceous-yellow.

3. Fore and hind wings above with short discal, lunular black line .... *Charaxes polyxena* (Cramer)

Fore and hind wings above without black line .... *Charaxes aristogiton* Felder

4. Sinuous transverse lines on wings usually narrow .... *Charaxes marmax* Westw.

Sinuous transverse lines wings generally strongly marked .... *Charaxes kahruba* (Moore)

Charaxes aristogiton Felder

Wing span 95-115 mm; fore wing with post-discal band black the whole of its length; hind wing with submarginal black spots in outer margin forming continuous band below; fore wing purple-brown, without yellow. The species is reported from Burma, Assam and East Himalaya.

Charaxes fabius (Fabr.)

Wing span 80-95 mm; fore wing above brown basally, crossed by discal band of yellow spots separate in fore wing and continuous in hind wing, with outer marginal yellow spots in hind wing. The species occurs in Burma, India, Ceylon and the whole of the Himalaya.

Charaxes kahruba (Moore)

Wing span 90-115 mm; fore wing above reddish-brown, with short, narrow oblique post-discal band. Reported from Burma and occurring in Assam and extending westward along the Himalaya up to Kumaon.

Charaxes marmax Westwood

Wing span 95-120 mm; fore wing above reddish-brown; subcostal spot on discocellular below bright reddish-yellow; wings crossed by sinuous black lines. Reported from Burma, Assam hills and East Himalaya.

Charaxes polyxena (Cramer)

Wing span 90-115 mm; this is a variable species, with fore wing above brown; discocellular with black; black patch from 0.50 of costa to backward; below brown with some iridescence. Reported from Burma, Assam and a smaller form in the Himalaya from Nepal to Kashmir.

EULEPIS MOORE

This is an Indo-Malayan genus with the cell open in hind wing and represented by the following species in the Himalaya: *E. arja* (Feld.) wing

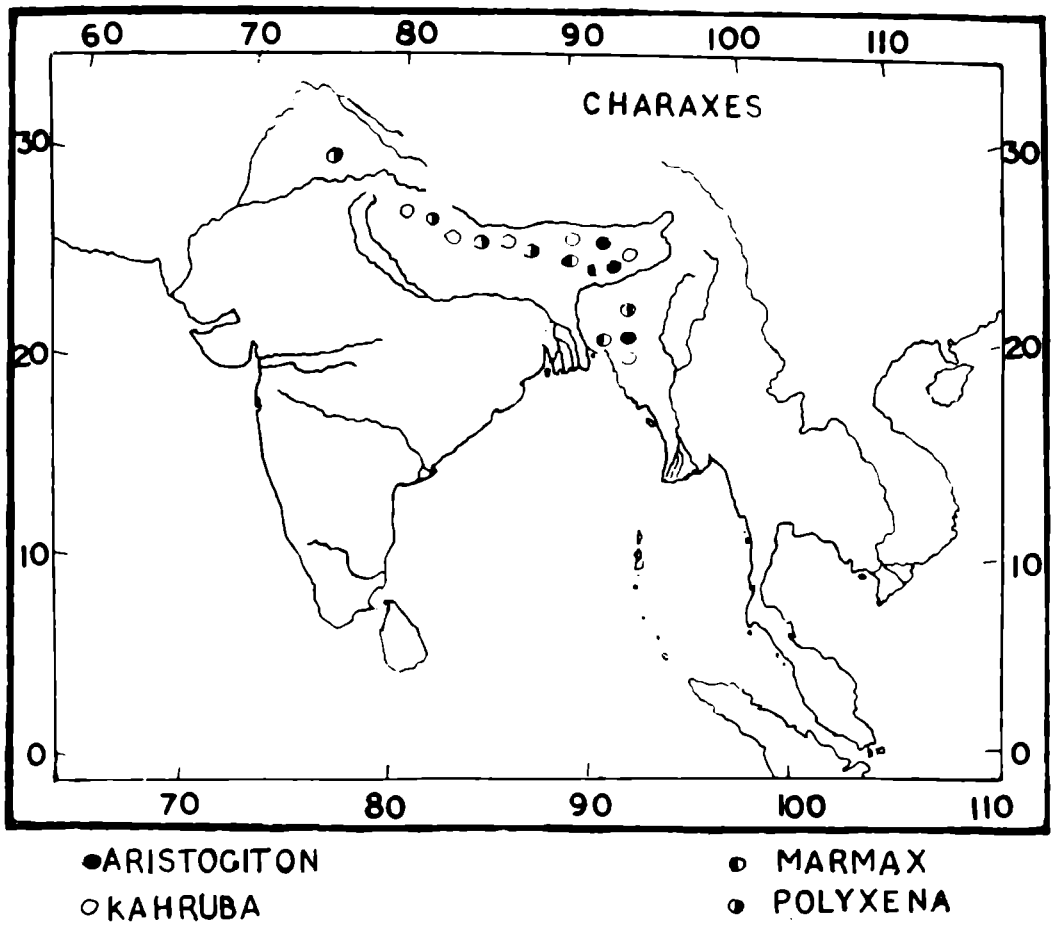

Fig. 27. Distribution of *Charaxes* species.

span 75-90 mm, discal area white to pale white green, extending from Burma through Assam to East Himalaya; *E. athamas* (Drury) wing span 65-85 mm; fore and hind wings above black, distal band transverse; distributed from Malaya, Burma, Assam, the Eastern Ghats, South India, Ceylon and the whole of the Himalaya; *E. dolon* (Westwood) wing span 90-125 mm, fore wing above yellowish-white, with oblique post-discal band of pale yellow spots, hind wing with post-discal brown band parallel to the outer margin, distributed in Malaya, Burma Assam and East Himalaya; and *E. eudamippus* (Doubleday) wing span 95-120 mm, fore wing above pale yellow, costa, cell in front, cross-bar at apex, apical 0.50 of wing purple-black, hind wing with post-discal black band narrow behind, with three brownish-yellow cross-bands, occurring in Burma and Assam and reported from East Himalaya.

DILIPA MOORE

Fore wing with cell not quite 0.50 of wing length; anterior discocellular

minute, middle discocellular short and concave, posterior discocellular straight, vein R_2 emitted from cell apex, R_1 free. A small genus with only a single species *D. morgiana* (Westwood) wing span 75-80 mm, black with golden scales basally of cell, a wide bar at cell apex, hind wing with broad transverse discal yellow area, reported from Burma and Assam and occurring in the Himalaya up to Kangra valley.

VANESSA FABRICIUS

Fore wing with cell about 0.50 of wing length; vein Cu_{1a} emitted before cell apex; M_3 emitted at cell apex; R_3 issuing from the middle of R_5; veins R_2 and R_1 free; hind wing with cell short, with veins M_3 and Cu_{1a} emitted from hind angle of cell apex; discocellulars oblique, with the anterior and middle subequal; eyes hairy; third palpal segment short, obtuse apically. The genus occurs nearly all over the world. Ten species occur in the Himalaya.

Key to species

1. Fore wing with inner margin straight or only very slightly convex ..2
   Fore wing with inner margin sinuate 8
2. Fore wing with costa armed with stiff setae 7
   Fore costa without stiff setae 3
3. Hind wing with outer margin not toothed or tailed at end of vein M_3 ..... *Vanessa cardui* (Linn.)
   Hind wing with outer margin toothed or with tail at end of vein M_3 4
4. Hind wing above with a series of outer submarginal blue spots ...5
   Hind wing below without such spots .. *Vanessa vau-album* (Denis & Schieff.)
5. Fore wing above without yellow discal cross band..... ..... *Vanessa cashmirensis* Kollar
   Fore wing with yellow discal cross band 6
6. Fore wing outer margin angulated between veins M_1 and M_2 .... *Vanessa rizana* Moore
   Fore wing not angulated as described above .... *Vanessa ladakensis* Moore
7. Wings above deep maroon-coloured, with the outer margin broadly white ..... *Vanessa antiopa* (Linn.)
   Wings above deep orange coloured, with the outer margin narrowly brown ..... *Vanessa xanthomelaena* (Denis & Schieffermüller)
8. Wings above dark blue-black..... *Vanessa cance* (Johansen)
   Wings above not blue-black.....9
9. Hind wing above with the inner margin brown, irrorated with grey

scales ..... *Vanessa c-album* (Linn.)
Hind wing above with the inner margin pale brown, irrorated with yellow scales ..... *Vanessa aegea* (Cramer)

Vanessa cardui (Linnaeus)

Wing span 58-68 mm; fore wing basally black, with golden scales; apically and outer margin black; discal area orange-ochraceous, with irregular black markings; three white subquadrate spots in apical black area; with four white spots outwards; narrow submarginal lunules; hind wing brown, with a large spot beyond cell apex. This is a cosmopolitan species, distributed throughout the forested slopes and subalpine zones of the Himalaya.

Vanessa vau-album (Denis & Schieffermüller)

Wing span 67-71 mm; fore wing above basally brown, extending behind to hind wing inner margin; cell with two united spots; hind wing with two short, broad, transverse black bands from costa not reaching behind vein M_3. This is a Palaearctic species, restricted to Northwest Himalaya below the timberline.

**Vanessa cashmirensis* Kollar
(Plate XXV)

Wing span 52-62 mm; fore wing above with costa basally yellow-spotted; outer margin brown; brown at base and also behind; cell with a broad cross-band; hind wing basally brown. Reported from Himalaya up to elevations of 5485 m.

Vanessa rizana Moore

Wing span 47-52 mm; very much like the foregoing species, but with a quadrate black discal spot in front of anal vein; hind wing black in basal 0.66. Occurs above 3000 in the Himalaya.

Vanessa ladakensis Moore

Wing span 46-53 mm; fore wing with outer margin convex, the black discal posterior spot broader than in *Vanessa cashmirensis;* hind wing with outer submarginal series of large conical spots. Himalaya.

Vanessa antiopa (Linnaeus)

Wing span 75-80 mm; fore wing dark reddish-maroon; costa broadly black and white flecked. This is Palaearctic species distributed from Middle Asia, China, Japan and reported from East Himalaya.

* = *Aglaia cashmirensis* (Kollar) of recent authors.

Vanessa xanthomelaena (Denis & Schieffermüller)

Wing span 63-68 mm; fore wing above orange-yellow, costa black and brown flecked basally; cell with two ovate black spots; subquadrate, subcostal black outside of discocellulars; hind wing with a large subcostal black patch; both wings with a continuous transverse sinuous outer submarginal black band. This is a Palaearctic species, occurring in China, Japan and in the Himalaya up to Garhwal from the east.

Vanessa canace (Johansen)

Wing span 61-75 mm; fore wing above blue-black; a post-discal somewhat curved blue band across both wings; hind wing with a white spot apically in cell. The species is distributed in Burma. Assam, South Indian and Ceylon hills and occurs throughout the Himalaya.

Vanessa c-album (Linnaeus)

Wing span 56-60 mm; fore wing with two black spots across cell; three oblique spots in anal and cubital areas; hind wings with a C-shaped white marking above outside of cell apex; a post-discal green ocellar spot. The species occurs in the forests throughout the Himalaya.

Vanessa aegea (Cramer)

Wing span 56-58 mm; this species resembles the foregoing species very closely, but with much smaller black markings; white L-shaped marking outside of cell apex; green ocellar spot absent. Reported from Northwest Himalaya.

STIBOCHIANA BUTLER

This is a Malayan genus that extends to west China, through Burma and Assam and occurs in the Himalaya; it differs from *Dichorragia* in the cell with only 0.30 of wing length. The only species, found in the Himalaya, is *S. nicea* (Gray) with wing span 75-80 mm, black, with three blue cross-lines in cell, series of four discal and five post-distal white minute spots in front.

DICHORRAGIA BUTLER

This is an Indo-Malayan genus, with distribution in China, Malaya, Burma and Assam and Himalaya. Eyes sparsely hairy; club gradual; cell closed, slightly less than 0.50 of wing length; anterior discocellular minute, middle slightly shorter than the posterior, vein Cu_{1a} emitted from hind angle of cell apex, R_3 nearer M_1 than Sc-R_1. *D. nesimachus* Boisduval 75-85 mm; dark green purplish-black apically in fore wing and front part of hind wing; with white spots; hind wing cell apex with bluish-green spots.

ARGYNNIS FABRICIUS

Cell closed, slightly less than 0.50 of wing length; vein R_5 and M_1 emitted from a point, without anterior discocellular; middle and posterior discocellular concave oblique inward; Cu_{1a} much before hind angle of cell hind wing with the posterior discocellular oblique; Cu_{1a} and M_3 emitted from hind angle of cell; R_3 closer to M_1 than to R_2 basally. This is largely Holarctic, but is also widely distributed in the Indo-Malayan and Indo-Australian areas.

Key to species

1. Vein R_2 emitted from Sc 2
   Vein R_2 emitted from R_5 8
2. Hind wing below dark metallic-green basally 3
   Hind wing below brownish-green 6
3. Hind wing below with silvery spots 4
   Hind wing below with silvery cross-bands 5
4. Hind wing below without post-discal ferruginous spots ..... *Argynnis aglaia* (Linn.)
   Hind wing below with post-distal ferruginous spots ..... *Argynnis jainadeva* Moore
5. Hind wing above with the outer margin broadly blue ..... *Argynnis childreni* Gray
   Hind wing above with outer margin not blue ..... *Argynnis kamala* Moore
6. Hind wing below basally brownish-green broken up into patches or spots ..... *Argynnis hyperbius* (Johansen)
   Hind wing below without green 7
7. Hind wing below with the silvery spots large ..... *Argynnis lathonia* (Linn.)
   Hind wing below with the silvery spots small ..... *Argynnis gemmata* Butler
8. Hind wing below suffused green ..... *Argynnis clara* Blanchard
   Hind wing below not green 9
9. Hind wing below with outer marginal series of white or silvery spots ovate or elongate ..... *Argynnis altissima* Elwes
   Hind wing below with the outer marginal series of white or silvery spots quadrate or conical 10
10. Hind wing below with the outer marginal series of silvery spots quadrate 11
    Hind wing below with the outer marginal series of silvery spots conical ..... *Argynnis hegemone* Staudinger
11. Hind wing apex rounded ..... *Argynnis jerdoni* Lang

Hind wing apex angulate 12
12. Hind wing above brown, with large black markings.....
.....*Argynnis pales* (Denis & Schieff.)

Argynnis aglaia (Linnaeus)

Wing span 56-78 mm; a variable species with brownish-yellow and marked black above; represented in the Himalaya by the subspecies *vitatha* Moore; fore wing above with short, transverse sinuous pre-apical broad line in cell; hind wing with a broad line along hind discocellular, below ochre-yellow, with basal area suffused pale green. The species occurs in Northwest Himalaya at elevations of up to 4500 m.

Argynnis jainadeva Moore

Wing span 60-68 mm; differentiated from the foregoing species by the much broader black margins on wings above; hind wing below with a series of transverse discal silvery spots. The species occurs in the Himalaya from Chitral to Kumaon down to elevations of 3000 m.

Argynnis childreni Gray

Wing span 82-95 mm; fore wing with three short transverse bands in cell; a zigzag series of large discal spots; hind wing above with a somewhat black transverse marking in cell apex, below metallic-green, with transverse silvery patches margined black and lines. The forms occurring in East Himalaya, Nepal, Assam and Burma are somewhat larger and also brighter coloured than those collected from Kumaon and Northwest Himalaya.

Argynnis kamala Moore

Wing span 64-68 mm; wings above golden-yellow, spotted and marked black; basally darkened; fore wing with two transverse sinuous lines across cell; hind wing basally with yellow hairs, below metallic-green, with silvery lines and spots. The species occurs from Kumaon to Northwest Himalaya.

Argynnis hyperbius (Johansen)

Wing span 80-95 mm; wings above orange-yellow, with black marks; short transverse basal stripe in cell; discal series of zigzag spots; hind wing above with a transverse lunule across cell; below variegated. The species is variable and widely distributed in Taiwan, China, Sundaland, Burma, India and Ceylon; it occurs throughout the forested slopes and valleys of the Himalaya and ascends sometimes up to the timberline.

Argynnis lathonia (Linnaeus)

Wing span 54-65 mm; fore wing with three short, somewhat sinuous

bands across cell; discal zigzag series of black spots; hind wing with a short cross mark in cell above and below with silvery marks. The species occurs in west China, north Burmese mountains through Assam to the Himalaya up to Chitral.

Argynnis gemmata Butler

Wing span 38-52 mm; brown with some yellow to red mixed; fore wing basally, hind wing up to discal spots brownish-black; hind wing below red, with silvery marks. The species occurs at high elevations, often above the timberline, throughout the Himalaya and is also reported from southeast Tibet.

Argynnis clara Blanchard

Wing span 54-58 mm; wings above ochre-coloured; basally brownish-grey; marked black. The species seems to be typical of high elevations of Northwest Himalaya; a somewhat smaller form of the species has been reported from Sikkim-Bhutan region of East Himalaya.

Argynnis altissima Elwes

Wing span 35 mm; above pale yellow to yellowish-brown; basally darker; with black marks; hind wing below red, with silvery marks. Reported from Sikkim-Bhutan 3000-4500 m and the form *mackinnoni* somewhat larger than East Himalayan type has been reported at elevation of 4500 m in Northwest Himalaya.

Argynnis jerdoni Lang

Wing span 38-50 mm; basally brownish-black with black mark hind wing pale yellow below with two irregular basal and two post-discal patches and silvery marks. The species occurs in Northwest Himalaya.

Argynnis pales (Denis & Schieffermüller)

Wing span 38-50 mm; a variable species; hind wing above with discal zigzag line in front made of narrow transverse spots, below with red and silvery marks. A Palaearctic species distributed from Middle Asia to the Himalaya up to Sikkim-Bhutan and generally occurring at high elevations; the form *generator* Staudinger occurs in the Pamirs-Tien Shah-Northwest Himalaya, Hindu Kush is somewhat larger than the typical form.

Argynnis hegemone Staudinger

Wing span 42-50 mm; yellowish-brown with black marks; fore wing basally brownish-black; cell with one or two minute spots basally; hind wing brownish-black basally and in front; cell with small spot basally and in front; cell with small spot basally and black marked apically; hind wing below with two to three transverse white spots basally. Turkmenian species

reported from Northwest Himalaya, usually at high elevations.

PENTHEMA DOUBLEDAY

Fore wing with the outer margin somewhat concave; cell not quite 0.50 of wing length; anterior and middle discocellulars short, posterior oblique; veins Cu_{1a} emitted before hind angle of cell and M_3 from cell apex; R_{3+4} from apical 0.50 of R_5; hind wing with vein M_3 and Cu_{1a} from hind angle of cell. The genus occurs in China, Burma and Assam and is represented by *Penthema lisarda* (Doubleday), with wing span 120-130 mm, brown and marked white or yellowish-white, at elevations of 1200 m in East Himalaya and extending to Assam hills and Burmese mountains.

NEUROSIGMA BUTLER

This genus, apparently restricted to Burma, Assam and East Himalaya, is related to *Dophla,* but cell longer; fore wing with the posterior discoidal not concave; hind wing with R_3 closer to M_1 basally than to R_1. Two species are known from the Himalaya: *N. doubledayi* (Westwood) with wing span 85-105 mm, white basally behind; cell behind pale orange-red; three black spots and three irregular bars across cell, occurring in north Burma, Assam and East Himalaya; *N. fraterna* Moore wing span 80-100 mm, with orange in fore wing darker and larger than in the foregoing species reported from North Burma, Assam, and East Himalaya.

HYPOLIMNAS HÜBNER

Eyes naked; fore wing with outer margin concave; cell closed, not 0.50 of wing length; anterior discocellular minute, middle concave and posterior slightly concave; vein Cu_{1a} emitted before hind angle of cell; M_3 from cell apex; R_3 from the middle of R_5; R_1 and R_2 free; hind wing with outer margin curved, scalloped. The widely distributed Indo-Malayan species *H. misippus* (Linn.), with wing span 70-90 mm, brownish-black above in male and brown in female, without post-discal white spots; oblique white spot from Cu_{1a} to R_5; smaller pre-apical white spot; female polymorphic. Occurs throughout the Himalaya up to elevations of 1800 m.

LEBADEA FELDER

Eyes naked; club gradual; fore wing narrow and long, anterior discocellular minute, middle short and about 0.25 of the posterior; R_1 and R_2 free; hind wing cell short. *Lebadea martha* (Fabr.), with wing span 68-75 mm, brown above in both wings, with oblique straight white discal bands, reported

from Burma, Assam and East Himalaya.

DOPHLA MOORE

This is Indo-Malayan genus, with glabrous eyes; cell closed; anterior discocellular short, middle and posterior concave; Cu_{1a} emitted just before hind angle of cell; M_3 from cell apex; R_3 emitted from 0.30 of R_5; veins R_1 and R_2 free; hind wing cell closed, hardly 0.30 of wing length; Cu_{1a} and M_3 emitted from hind angle of cell. About half a dozen species are known from the Himalaya.

Key to species

1. Wings with a slightly curved, broad white discal band 2
   Only fore wing with oblique white discal band 3
2. Hind wing with discal band sinuous laterally ..... *Dophla durga* (Moore)
   Hind wing with discal band not sinuous ..... *Dophla duda* (Staud.)
3. Hind wing above broadly yellow in front in male ..... *Dophla nara* (Moore)
   Hind wing above not yellow as described 4
4. Fore wing with spot in front of Cu_{1b} quadrate or rounded ..... *Dophla sahadeva* (Moore)
   Fore wing with the spot longer than wide 5
5. Hind wing below with widely separated white or pale blue spots ..... *Dophla iva* (Moore)
   Hind wing below with almost continuous white spots ..... *Dophla patala* (Kollar)

Dophla durga (Moore)

Wing span 110-123 mm; very dark green; hind wing with short black line and two broad loops in cell. The species is reported from Burma and Sikkim.

Dophla duda (Staudinger)

Wing span 78-80 mm; fore wing spots different from the foregoing species. Reported from Assam hills and East Himalaya.

Dophla nara (Moore)

Wing span 74-97 mm; fore wing above dark green; cell in front with a middle and apical pair of short black, curved, transverse line; hind wing discal shaded area and post-discal band of fore wing continuous. Reported from Assam through to Nepal in the Himalaya.

Dophla sahadeva (Moore)

Wing span 88-110 mm; dark green; rounded black spots at base; cell with curved cross lines; hind wing with three to six separate yellowish-brown spots. Extends from Assam westward up to Nepal.

Dophla iva (Moore)

Wing span 107-120 mm; very dark green; black lines across cell; hind wing with a narrow black loop in cell apex. Reported from Assam and Sikkim (East Himalaya).

Dophla patala (Kollar)

Wing span 100-110 mm; fore wing pale green; black markings basally; oblique discal band from costa to almost tip of vein Cu_{1b}; hind wing quadrate, with a large white spot midway between veins M_1 and R_3. The species occurs in the whole of the Himalayan forests.

ISSORIA HÜBNER

Cell not quite 0.50 of wing length; fore wing with vein R_1 emitted much before from front angle of cell; hind wing with M_3 and Cu_{1a} shortly stalked; tail a little before tip of vein M_3. *I. sinha* (Kollar) 67-70 mm; orange-yellow broad basally and near outer margin, three black cross lines in cell; submarginal lunules; hind wing with obscure post-discal row of brown spots. The species is distributed in Philippines, Malaya, Burma, Assam and the whole length of wooded slopes of the Himalaya.

CETHOSIA FABR.

Fore wing with outer margin scalloped; cell not quite 0.50 of wing; anterior discocellular very short; M_3 and Cu_{1a} emitted from hind angle of cell; R_2, R_3 and R_4 from R_5; R_1 from cell apex; hind wing with outer margin scalloped; M_3 and Cu_{1a} from hind angle of cell; M_1 midway between R_3 and M_2.

Cethosia biblis (Drury)

Wing span 72-92 mm; orange-red; outer margin of fore and hind wings black, with long narrow lunules of white; apical 0.50 black; cell with 3 pairs of black cross lines. The species occurs in Malaya, China, Assam and Himalaya up to Nepal.

Cethosia cyane (Drury)

Wing span 90-100 mm; reddish-brown-black in front and apial 0.60; oblique white broad bar outside cell apex; transverse row of small spots and marginal white lunules; hind wing with 3-4 spots outside cell apex and

marginal lunules. The species occurs in Burma, Assam, Eastern Ghats and the Himalaya.

KALLIMA DOUBLEDAY

This is an Indo-Malayan genus, distributed throughout the Himalayan forests. Fore wing triangular; cell closed, short; veins R_5 and M_1 emitted from hind angle of cell; vein R_3 from 0.50 of R_5; veins R_1 and R_2 free; hind wing triangular, with veins Cu_{1a} and M_3 stalked; veins R_3 and M_1 separate; tails spatulate, long: precostal vein forked apically. Two species: *K. inachus* (Boisduval) with 100-120 mm in wing span, with orange discal band in fore wing above, is widely distributed in Burma, Assam, Himalaya, Eastern Ghats and the Vindhya-Satpura hills and *K. knyvetti* de Nicéville with wing span 108-112 mm, discal band white suffused blue, reported from Burma, Assam and Sikkim.

CHERSONESIA DIST.

Fore wing cell hardly 0.30 of wing length; anterior discocellular minute, middle about 0.33 of the posterior; Cu_{1a} and M_3 stalked; R_2 emitted from R_5; R_1 free; hind wing slightly dentate at end of M_3. A single species *C. risa* (Doubleday) with wing span 40-45 mm, pale to dark red, crossed by narrow black parallel lines, occurs from Burma through Assam hills to Kumaon on the Himalaya.

PSEUDERGOLIS FELDER

Indo-Malayan genus with club gradual; eyes glabrous; fore leg slender in male and normal in female; outer margin of fore wing sinuous, angulate before M_2; cell closed, less than 0.50 of wing; veins R_5 and M_1 emitted from a point, so that the anterior discocellular is absent; middle discocellular concave; veins Cu_{1a} and M_3 stalked; R_1 and R_2 free; hind wing ovate; outer margin arched and scalloped; Cu_{1a} and M_3 emitted just a little beyond the hind angle of cell; veins R_3 and M_1 approximated basally. A single species *P. wedah* (Kollar) is reported from western and central China, north Burmese mountains and Assam hills; it occurs throughout the wooded slopes of the Himalaya. Wing span 55-65 mm, wings golden-brown above, brown below; with black lines.

CYNTHIA FABR.

Fore wing with cell closed, not 0.50 of wing; anterior discocellular minute, middle slightly concave, posterior oblique, longer and concave; Cu_{1a} emit-

ted from a little before hind angle of cell; M_3 from cell apex; R_3 and R_4 emitted from the middle of R_5; hind wing with tail at tip of vein M_3. A single species *C. erota* (Fabr.) from Burma, Assam and East Himalaya, with wing span 78-90 mm, orange-yellow, brown basally, with black markings.

MELITAEA FABR.

Eyes glabrous; club short, abruptly spatulate; cell closed in fore wing, open in hind wing; discocellulars oblique; Cu_{1a} in fore wing from before hind angle of cell and M_3 from cell apex; veins R_2 and R_3 emitted from R_5; R_1 free. A widely distributed genus, represented at high elevations, above the forest, in the Himalaya.

Melitaea sindura Moore

Wing span 35-50 mm; wings above with the veins black; with submarginal black markings on outer border. Specimens from East Himalaya are generally somewhat smaller and darker and occur at elevations above 3000 in Sikkim and eastern Tibet; material from Northwest Himalaya is distinctly larger but also with the black markings not so prominent. *M. sindura balbita* Moore is recognised from Northwest Himalaya and *M. sindura sikkimensis* Moore from Sikkim and Tibet.

Melitaea didyma (Esper.)

Wing span 36-48 mm; veins above not black; ochre coloured with black markings; fore wing costa narrowly black. Widely distributed in the Hindu Kush and Northwest Himalaya.

PANTOPORIA HÜBNER

Cell weakly closed in fore wing; club gradual; eyes usually naked; anterior discocellular minute, middle concave and posterior convex; Cu_{1a} and M_3 emitted from hind angle of cell; R_3 from the middle of R_5; R_1 and R_2 free; hind wing cell open; R_3 equidistant between R_1 and M_1. This is an Indo-Malayan genus with about half a dozen species from the Himalaya.

Pantoporia nefte (Cramer)

Wing span 65-75 mm; wings black with white markings; dark ferruginous discoidal stripe; broad discal band. Distributed in Malaya, Burma, Assam, South India and the Himalaya westward up to Nepal.

Pantoporia cama (Moore)

Wing span 70-85 mm; brownish-black, with broad white band across both wings; discoidal streak in fore wing ferruginous; pre-apical and

subapical orange spots in fore wing. Extends from Burma through to Garhwal in the Himalaya.

Pantoporia selenophora (Kollar)

Wing span 65-70 mm; black with red discoidal streaks; 3 long oval white spots beyond; hind wing with broad white discal band. Occurs in Burma, Assam, South India and the Himalaya.

Pantoporia zeroca (Moore)

Wing span 65 mm; discal spot obscure; 3 oblique white spots of the discal band not always white but diffuse brown above in female. Occurs in Burma, Assam and the Himalaya up to Kumaon.

Pantoporia optima (Kollar)

Wing span 60-70 mm; brownish-black; discal white streak trifid; hind sub-basal band white. Occurs in Burma, Assam and the Himalaya.

Pantoporia ranga (Moore)

Wing span 65-80 mm; black to dark brown; pre-apical white spot in cell; hind wing with sub-basal white band. Occurs in Burma, Assam, South India and East Himalaya.

LIMINITIS FABR.

Eyes often hairy, but also naked; club long, gradual; middle and hind tibiae and tarsi spined; fore wing with outer margin sometimes scalloped, cell closed; anterior discocellular very short, middle concave and posterior oblique; veins Cu_{1a} and M_3 approximate; vein R_4 emitted from the middle of R_5; R_1 and R_2 free; hind wing cordate, with outer margin slightly scalloped, cell open, vein R_3 closer to M_1 than to R_1. A Holarctic genus, extending through the Himalaya to the Burmese mountains.

Key to species

1. Eyes glabrous 2
   Eyes hairy 3
2. Hind wing with the discal band broad ..... *Liminitis trivena* Moore
   Hind wing with discal band narrow ..... *Liminitis ligyes* Hew.
3. Fore wing above with discal band yellow; hind wing above with discal band white ..... *Liminitis zayala* Doubleday
   Fore and hind wings with discal band not differently coloured 4
4. Discal band white 5
   Discal band green ..... *Liminitis daraxa* Doubleday
5. Discal band broken up in front into 3 separate spots .....

..... *Liminitis zulema* Doubleday

Discal band not broken up, but continuous the entire length .....

..... *Liminitis dudu* Westwood

Liminitis trivena Moore

Wing span 60-68 mm; wings above black, basally ochre scaled; pre-apical, short, sinuous cross-band in cell; discal band continuous in hind wing; fore wing below ochre-yellow, pale basally; cell with pre-apical white band. Occurs in Northwest Himalaya.

Liminitis ligyes Hewitson

Wing span 68-72 mm; this species differs from the foregoing species in the narrow discal band; spots separated. Occurs in Northwest Himalaya.

Liminitis zayala Doubleday

Wing span 90-100 mm; brown, basally golden scaled; fore wing with two to three rounded, looped, black marks; cell with median and apical pairs of black lines; hind wing below basally black, with blue line. The species is reported from Assam and East Himalaya up to elevations of 2400 m.

Liminitis dara Doubleday

Wing span 70-75 mm; dark brown; marks obscure; discal band pale green broad, with three detached spots in front. The species extends through the Himalaya from Kumaon to Assam, Burma and Malaya.

Liminitis zulema Doubleday

Wing span 65-82 mm; dark brown; cell with four short, black cross-lines, median and apical red bars. The species is reported from Burma, Assam and East Himalaya.

Liminitis dudu Westwood

Wing span 71-92 mm; dark brown; cell with median and apical short red cross bands; white broad transverse discal band on both fore and hind wings above. The species is reported from Burma, Assam and East Himalaya.

ABROTA MOORE

Eyes naked; fore wing with cell not quite 0.50 of wing; anterior discocellular minute; middle acute-angularly curved basally; Cu_{1a} and M_3 emitted from hind angle of cell; R_1 and R_2 free; hind wing triangular; M_1 and M_2 closely approximated basally; R_3 midway between M_1 and R_1. The genus

seems to be restricted to East Himalaya, with two species: *A. ganga* Moore, with wing span 78-92, ochraceous discal and outer submarginal black, transverse bands, widely separated; yellow cross-bar in female narrow. *A. jumna* Moore, with wing span 80-98 mm; paler; hind wing discal and submarginal bands closer than in the other species.

CIRROCHROA DOUBLEDAY

Eyes naked; club gradual; fore wing broadly triangular; cell closed; anterior discocellular obsolete; middle concave; posterior concave inwards; veins M_3 and Cu_{1a} stalked, branching well beyond cell apex; vein R_3 emitted from apical half of R_5; R_1 and R_2 free; hind wing elongate, outer margin arched in front and abruptly rounded behind M_3; cell open; depression in between veins M_2 and M_3. This is an Indo-Malayan genus, with two species *C. mithila* Moore and *C. aoris* Doubleday reported to occur in Bhutan-Sikkim area of East Himalaya.

SYMPHAEDRA HÜBNER

Eyes glabrous; fore wing with cell closed; veins R_5 and M_1 arise together from a point; anterior discocellular absent; middle short, concave; posterior long, concave; R_3 out of R_5; R_1 and R_2 free; hind wing quadrate, with cell open; vein R_3 midway between R_1 and M_1. This is an Indo-Malayan genus with a single species *S. directa* (Fabr.) wing span 80-112 mm; black, hind wing below ochraceous in female and dark ferruginous in male; fore wing with pale blue spots above in female. Occurs in Malaya, Burma, Borneo, Java, Sumatra, Assam and East Himalaya.

SYMBRENTHIA HÜBNER

Eyes hairy; fore wing with outer margin somewhat sinuate; cell closed, 0.50 of length; anterior discocellular minute, middle concave, 0.50 of the posterior; Cu_{1a} emitted before the cell apex, M_3 from cell apex; R_3 and R_4 emitted from 0.50 of R_5; R_1 and R_2 free; hind wing outer margin slightly scalloped, with a short tail at tip of M_3. This is an Indo-Malayan genus that extends to China also.

Key to species

1. Wings above with black tesselations 2
   Wings above with ferruginous markings ..... *Symbrenthia lucina* (Cramer)
2. Fore wing above with oblique pre-apical short yellow band not reaching the front margin ..... *Symbrenthia hypselis* (Godart)

Fore wing above with oblique pre-apical short yellow band reaching the front margin 3

3. Fore wing below with ochraceous-orange discal streak .....
.....*Symbrenthia brabira* Moore
Fore wing below with white or pink discal streak .....
..... *Symbrenthia niphanda* Moore

Symbrenthia hypselis (Godart)

Wing span 47-52 mm; fore wing black, with brownish-red markings; discoidal stripe clavate; short, broad, oblique band from beyond the middle of inner margin extending to Cu_{1a}; hind wing with a series of post-discal metallic-green triangular marks, inside yellowish-white. Distributed from Sundaland, Malaya, Burma, Assam and the entire length of the Himalaya.

Symbrenthia lucina (Cramer)

Wing span 46-50 mm; black with orange-yellow markings; clavate discoidal stripe, with two teeth in front; spot basally in Cu_{1a}; hind wing with a broad sub-basal cross-band; post-discal band narrow. Himalaya, Burma and Malaya.

Symbrenthia brabira Moore

Wing span 45-58 mm; this species resembles *S. hypselis* from humid localities or its wet-season form, but with the red markings somewhat paler; pre-apical narrow, irregular band reaching costa. Occurs from Northwest to Nepal Himalaya.

Symbrenthia niphanda Moore

Wing span 48-62 mm; this species also resembles *S. hypselis*, but with paler and yellow markings; pre-apical irregular band to costa. Reported from Sikkim (900-1525 m).

APATURA FABR.

Fore wing with cell open, without the posterior discocellular; anterior and middle discocellulars very short; R_4 emitted from R_5 at apical 0.33 of wing length; R_3 from R_5 in the middle; R_1 and R_2 free; Sc ending beyond origin of R_3; hind wing with cell open. This is a widely distributed genus, with five species from the Himalaya.

Key to species

1. Eyes hairy; wings below basally ochraceous-brown .....
.....*Apatura parvata* Moore
Eyes not hairy 2

2. Wing above brown ..... *Apatura parisatis* Westw.
   Wings above brownish-black 3
3. Fore wing cell without streak above ..... *Apatura sordida* (Moore)
   Fore wing above with a broad white streak .....
   ..... *Apatura chevana* (Moore)

Apatura parisatis Westwood

Wing span 45-50 mm; fore wing black, with minute white pre-apical spot; cilia alternately white and black; in female both wings above basally shaded. The species occurs from Thailand, China, Burma, Assam and the Himalaya up to Kumaon.

Apatura ambica (Kollar)

Wing span 67-77 mm; brownish-black, with a broad white discal band; three pre-apical spots below pearly-blue; discal band and spots of upper-side visible below. Distributed from Thailand, Burma, Assam and the Himalaya up to Kashmir.

Apatura sordida Moore

Wing span 65-80 mm; brown, darker in apical 0.66; oblique white discal band; hind wing with submarginal lunular line. Reported from East Himalaya.

Apatura chevana (Moore)

Wing span 80-85 mm; brownish-black; fore wing with discal streak; with two elongate spots irregular discal large and small spots. Occurs in north Burma, Assam and East Himalaya.

Apatura parvata Moore

Wing span 50-55 mm; brown, with three sub-basal dark spots; large cross-spots at cell apex; dark brown; hind wing with discal series of spots. Occurs in Assam and East Himalaya.

HERONA DOUBLEDAY

This genus is like *Apatura*, but club flat, fore wing with R_3 emitted from R_5 basad of wing middle; R_2 and R_1 close to base of R_5. A single species *Herona marathus* Doubleday, with wing span 70-85 mm; black, three spots in tornus orange-yellow; series of three oblique parallel bands; hind wing with two transverse oblique yellow bands and submarginal line reported from Burma, Assam and East Himalaya.

HESTINA WESTWOOD

Eyes naked; cell open in both wings; fore wing longer than in *Apatura;* R_3 emitted closer to wing apex. A single species *Hestina nama* (Doubleday) extending from west China, Thailand, Sundaland, Burma, Assam to the whole of the Himalaya, with wing span 90-105 mm; blue-black with subhyaline white streaks and spots.

EUTHALIA HÜBNER

Eyes naked; club gradual; fore wing triangular; cell open, not quite 0.50 of wing; anterior discocellular minute, middle concave and posterior absent; R_1 and R_2 free, the former often anastomosed with Sc; hind wing subquadrate, with cell open; R_3 midway between M_1 and R_1 or closer to R_1. This is a widely distributed Indo-Malayan genus, represented in China also.

Key to species

1. Fore wing with vein R_3 emitted from the middle of R_5 2
   Fore wing with vein R_3 before middle of R_5 ..... *Euthalia lepidea* (Butler)
2. Terminal palpal segment reduced apically 3
   Terminal palpal segment stout 4
3. Hind wing above with blue outer band ... *Euthalia appiades* (Men.)
   Hind wing above without outer blue band ..... *Euthalia jahnu* (Moore)
4. Fore and hind wings above and below with a number of pale red spots ..... *Euthalia lubentina* (Cramer)
   Wings without red spots 5
5. Wings above and below with white or pale yellow transverse discal band,
   not forked or expanded in front in fore wing ..... *Euthalia franciae* (Gray)
   Wings above and below without white discal cross-band, if however one is present, then it is forked in front in fore wing 6
6. Hind wing above with outer marginal blue band in the male; with oblique white discal band or a series of spots 7
   Hind wing not as described above 8
7. Fore wing above in the male with a series of narrow white streaks beyond the cell; broad discal band in the female ..... *Euthalia phemius* (Doubleday)
   Fore wing above in the male with a small blue patch in tornus; 4-5 discal spots in the female ..... *Euthalia telchinia* (Mén.)
8. Wing below yellow; above in the male with a broad discal band with grey

scales; in the female band with dark lunule .....
.....*Euthalia kesava* (Moore)
Wings below brown or ochre-coloured, not yellow; fore wing above with narrow white streaks beyond cell; in female hind wing below without greenish-blue ..... *Euthalia jama* (Felder)

Euthalia lepidea (Butler)

Wing span 70-80 mm; above dark to pale brown, with obscure black markings of transverse lines in cell; discal oblique patch in fore wing. The species is distributed from Malaya through Burma, Assam, Eastern Ghats, Vindhya-Satpura, South India and the Himalaya up to Kumaon.

Euthalia appiades (Ménétriés)

Wing span 76-94 mm; dark brown; fore wing with 5 black short, sinuate lines basally, of which the fifth overlies the discocellular; oblique discal and straight post-discal lunules; hind wing with narrow black loops basally and across the cell. Distributed from north Burma through to the Kumaon Himalaya.

Euthalia jahnu (Moore)

Wing span 75-80 mm; purple-brown; sinuate transverse black lines basally in fore wing; brown bar in cell apex; narrow black discal lunular band extends from costa backward to M_3; hind wing with four transverse black lines in the cell. Distributed from Burma across Assam to East Himalaya.

Euthalia kesava (Moore)

Wing span 65-75 mm; black; with five darker black narrow sinuate cross-bands in cell; broad discal patch not reaching in front to costa; hind wing in front orange; apically, except the outer margin narrowly, irrorated by blue-grey scales; female brown. Distributed from Burma through Assam to East Himalaya.

Euthalia lubentina (Cramer)

Wing span 68-84 mm; greenish-brown; black bordered; red bar across middle and beyond cell apex; discal spots oblique, small, white; hind wing with black loop near area of cell apex; post-discal series of four to five red spots bordered black outside. Distributed from Thailand, Malaya, Sumatra through Burma to Garhwal in the Himalaya and occurring almost up to elevations of 3000 m.

Euthalia franciae (Gray)

Wing span 80-110 mm; blackish-green, often suffused with some blue,

especially near tornus; both wings with discal white bands; hind wing with dark post-discal and submarginal markings of the fore wing continued. Distributed from Burma through Assam to Nepal in the Himalaya.

Euthalia phemius (Doubleday)

Wing span 65-84 mm; fore wing basally brown; post-discal transverse band darker brown; hind wing with post-discal blue band behind. Distributed from China, Thailand, Malaya, Burma, Assam and East Himalaya.

Euthalia telchinia (Ménétriés)

Wing span 78-100 mm; dark brown; fore wing base, cell and beyond with short broad pale brown cross-bars; outer marginal metallic-blue band in both wings. The species seems to be restricted to Assam and Nepal Himalaya.

Euthalia jama (Felder)

Wing span 70-85 mm; brown; cell with five sinuate short black transverse lines; discal and post-discal obscure bands; hind wing basally and cell with four narrow dark loops, series of small post-discal spots. Occurs in Burma, Assam and East Himalaya.

ATHYMA WESTWOOD

Eyes usually naked; club gradual; cell open; veins R_5 to M_3 very close together basally; anterior and middle discocellulars minute. Vein R_3 emitted from the middle of R_5; R_1 free; hind wing with cell open; vein R_3 equidistant between R_1 and M_1. Three species occur in the Himalaya: *A. perius* (Linn.) wing span 60-75 mm; black to brownish-black, with white bands and markings; hind wing below yellow; occurring in Thailand, Malaya, Burma, South India and the Himalaya. *T. asura* Moore wing span 80-90 mm; black with white markings; fore wing narrow, straight undivided discal streak; red lunules behind its apex; cilia alternately white and black. Occurs from Burma through to Kulu in the Himalaya. *A. jina* Moore wing span 70-84 mm; black with creamy-white markings; reported from Sikkim to Nepal.

NEPTIS FABR.

Eyes naked; club gradual; fore wing elongate-triangular; cell open with only anterior and middle discocellulars; R_3 from the middle of R_5; R_1 and R_2 free; hind wing with cell open; vein R_3 closer to M_1 than R_1 basally.

This is a widely distributed Palaearctic form, but also occurring in the Ethiopian, Japan, China and Indo-Australian areas.

Key to species

1. Fore wing above with discal streak and a separate triangular spot beyond 2
   Fore wing above with the discal streak united with the triangular spot 5
2. Hind wing below with transverse sub-basal band and post-discal spots not margined by black lines and not extending to costa ..... *Neptis columella* (Cramer)
   Hind wing below with sub-basal band extending to costa 3
3. Hind wing with the sub-basal band widened in front 4
   Hind wing with the sub-basal band equally wide at both ends or narrowed; markings often fuscous-white ..... *Neptis soma* Moore
4. Fore wing above with an obtuse-conical spot beyond tip of discal streak ..... *Neptis mahendra* (Moore)
   Fore wing with the spot acutely elongate .... *Neptis yerburii* Butler
5. Wings brown above or brownish-black, with white markings 6
   Wings brown or brownish-black with different markings 10
6. Fore wing above without white spot basally in front of vein Cu_{1a} .. 7
   Fore wing above with white spot basally in front of vein Cu_{1a} 9
7. Fore wing above with complete series of discal spots ..... *Neptis sankara* (Kollar)
   Fore wing above with discal spots series incomplete 8
8. Fore wing above with discal spots series behind with 4 spots ..... *Neptis cartica* Moore
9. Spot small, triangular ..... *Neptis narayana* Moore
   Spot a large clavate mark ..... *Neptis manasa* Moore
10. White markings on wings suffused with some yellow ..... *Neptis zaida* Doubleday
    White markings on wings suffused brown or even without white ... 11
11. White spots present, but suffused brown ..... *Neptis vikasi* Horsf.
    White spots with orange-yellow markings 12
12. Markings below suffused purple or violet 13
    Markings below not suffused with purple or violet ..... *Neptis viraja* Moore
13. Fore wing above with orange spot basally on vein Cu_{1a} ..... *Neptis radha* Moore
    Fore wing above without orange spot 14
14. Fore wing above with the medial spot of discal series rounded and separate ..... *Neptis ananta* Moore
    Fore wing above with the medial spot of discal series small, quadrate and close together ..... *Neptis miah* Moore

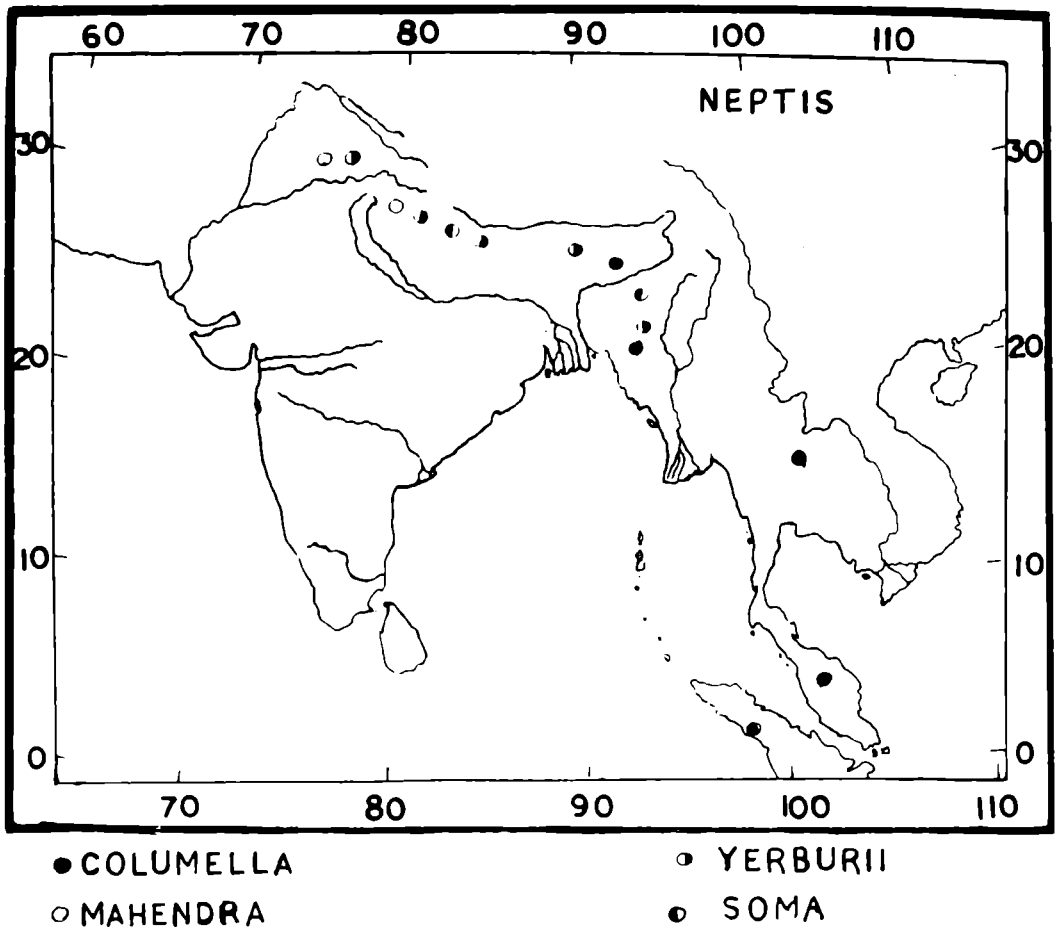

Fig. 28. Distribution of *Neptis* species.

Neptis columella (Cramer)

Wing span 65-75 mm; black, with white markings; discal stripe enlarged apically, notched in front subapically; hind wing with costal margin greyish-brown; sub-basal band not reaching costa. Distributed in Thailand, Malaya, Sumatra, Burma, Assam, South India and East Himalaya.

Neptis mahendra (Moore)

Wing span 55-65 mm; black, with white markings; discal stripe in fore wing clavate, obliquely truncate apically, with the spot beyond acutely and shortly triangular; hind wing with sub-basal cross-band enlarged in front. The species seems to be restricted to Northwest and West Himalaya.

Neptis yerburii Butler

Wing span 56-65 mm; fore wing with triangular spot beyond tip of

discal stripe elongated. The species occurs from north Burma through the whole of the Himalaya.

Neptis soma Moore

Wing span 64-68 mm; black with dirty-white markings; discal stripe narrow, truncated, with the triangular spot elongated; discal spots separate, small; hind wing with sub-basal band very narrow. The species extends from Burma through Assam hills to the Kumaon Himalaya.

Neptis sankara (Kollar)

Wing span 65-70 mm; black with white markings; discal stripe long, acute and narrow apically, notched in front; curved discal series of spots complete, hardly separated; hind wing with sub-basal broad cross-band. The species occurs in Burma, Assam hills and the whole of the Himalaya.

Neptis cartica Moore

Wing span 70-75 mm; brown, with dirty-white marking; discal stripe long, narrow, united with the triangular spot beyond; discal spot series oblique and diffuse. The species extends from Burma through Assam hills to Nepal in the Himalaya.

Neptis narayana Moore

Wing span 65-70 mm; black, markings white in the male and tinted ochraceous in the female; discal stripe elongate-clavate, with a small costal spot in front; discal spots separate. The species seems to be peculiar to the Himalaya.

Neptis manasa Moore

Wing span 65-70 mm; ferruginous-black, with white markings; discal stripe long, acute, notched subapically in front and united to the middle 2 spots of discal series. The species is reported at elevations of 1800-3600 m from East Himalaya.

Neptis zaida Doubleday

Wing span 65-70 mm; brownish-black, with pale ochraceous markings; discal stripe broad, elongate, not notched subapically in front, acute; hind wing with sub-basal broad and post-discal narrow bands. Restricted to the Himalaya.

Neptis vikasi Horsfield

Wing span 66-74 mm; very dark brown, with dirty-white markings; discal stripe elongate, notched subapically in front; hind wing with sub-basal and post-discal bands narrow. Occurs in Assam hills and East Himalaya.

Neptis radha Moore

Wing span 85-95 mm; black, with orange-yellow markings; discal stripe narrow, elongate, somewhat notched subapically in front. The species occurs on north Burmese mountains and extends through Assam hills to Nepal Himalaya.

Neptis ananta Moore

Wing span 65-77 mm; black, with orange markings; discal stripe narrow, but not reduced apically; hind wing with sub-basal band white. The species occurs in Malaya and Burma and extends to the whole length of the Himalaya.

Neptis miah Moore

Wing span 65-68 mm; black, with orange-yellow marking; discal stripe narrow, notched subapically in front; hind wing with sub-basal band white at tip. The species is distributed from Thailand, Malaya and Burma to East Himalaya.

Neptis viraja Moore

Wing span 56-68 mm; black, with orange-yellow markings; discal stripe wide, long; hind wing with sub-basal band broad, pale yellow. The species occurs in Burma, Assam, the Eastern Ghats, South India and East Himalaya.

PARHESTINA WESTWOOD

This genus differs from *Hestina* in its hairy eyes; origin of vein R_1 before cell apex; R_2 from beyond cell apex. Two species *P. persimilis* (Westwood) with wing span 70 mm, black with white streaks and spots; hind wing with wide streaks in cell; from East Himalaya. *P. nicevillei* Moore with wing span 90 mm; white, veins and margins black; reported from Chamba in Northwest Himalaya.

SEPHISA MOORE

Club slightly flattened; eyes naked; fore wing with cell open, anterior discocellular minute, posterior absent; veins R_2 to R_4 emitted from R_5; R_1 free; hind wing with cell open; middle and hind legs shorter than fore leg. Two species: *S. dichroa* (Kollar), wing span 65-75 mm; black, with oblique, orange-yellow spot across cell; hind wing with broad streaks in cell; restricted to Northwest and West Himalaya. *S. chandra* (Moore) wing span 85-100 mm; discal spots white above in the male and somewhat blue in the female; occurs from Thailand, Burma to Central Himalaya.

EURIPUS WESTWOOD

Fore wing with outer margin obtusely angulated at tip of vein Cu_{1b}; anterior discocellular minute; cell open; eyes naked; R_2, R_3 and R_4 from R_5, with R_4 and R_5 contiguous; R_1 free; hind wing truncately produced in tornus and between veins M_3 and Cu_{1b}; middle and hind claws with long slender paronychia and large pulvilli. Two species: *E. halitherses* Doubleday, with wing span 65-80 mm; variable especially in the female; blue-black with creamy-white markings; fore wing above with white spot in cell apex; hind wing with white streak in cell; occurs in Malaya, Burma, Assam and East Himalaya. *E. consimilis* (Westwood) wing span 70-85 mm; black with white streaks; hind wing with black veins; occurs in Burma, Assam, South India and the Himalaya up to Kumaon.

Subfamily LIBYTHEINAE

Butterflies with short wings; veins as in Nymphalinae; cell closed in both the wings; eyes naked; club gradually thickened; palpi stout, long; fore tarsi in the male atrophied to a brush, but normally developed in the female.

LIBYTHEA FABR.

Fore wing with costa arched; cell wide, not reaching to the basal 0.50 of wing, narrowly closed; anterior discocellular short, middle and posterior discocellulars concave.

Libythea celtis (Fuess.)

Wing span 45-55 mm. Fore wing above dark brown, without trace of violet, markings orange-yellow to white; cell with orange-yellow streak subapically; hind wing with the anterior post-discal orange.

This is a Mediterranean species that extends through the Himalaya to China, Japan and north Burma and is also represented by a race in South India and Ceylon; the Himalayan form is generally darker than the typical.

Libythea myrrha Godart

Wing span 45-55 mm. Wings above dark brown, with elongate-ovate orange spot beyond the hind angle of cell; below the general colour and orange-yellow markings are highly variable in size and extent.

The species extends from China, Malaya, Burma to the Himalaya and is also reported from the Peninsular India and Ceylon.

Family NEMEOBIDAE

Small butterflies, with cell closed in fore wing; hind wing sometimes

produced at tornus; club abruptly spatulate; fore legs in male imperfect, small in female. The family is also known as Erycinidae.

Key to genera

1. Eyes naked ..... *Zemeros* Boisd.
   Eyes hairy 2
2. Hind wing produced in tornus ..... *Dodona* Hewitson
   Hind wing not so produced 3
3. Hind wing with outer margin produced at tip of vein M_3 .....
   ..... *Abisara* Felder
   Hind wing with outer margin not thus produced, but rounded .....
   ..... *Stiboges* Butler

DODONA HEWITSON

Eyes hairy; club short, abrupt, flat; fore leg in male short, in female normal; fore wing with tornus angulate; cell 0.50 of wing; Sc very short; veins R_5 and M_1 emitted from cell apex, anterior discocellular obsolete; M_3 from hind angle of cell; hind wing outer margin straight up to M_3 and there bent inward beyond; tornus produced and lobed. This is an Indo-Malayan genus with about half a dozen species known from the Himalaya.

Key to species

1. Hind wing with tornal lobe provided with a filamentous tail 3
   Hind wing without filamentous tail 2
2. Fore wing above with the discocellulars marked by yellow line .....
   ..... *Dodona durga* (Kollar)
   Fore wing above with discocellular not thus marked .....
   ..... *Dodona dipaea* Hewitson
3. Fore wing above with discal marks broken into spots 4
   Fore wing above with discal marks continuous 5
4. Discal spots small ..... *Dodona eugenes* Bates
   Discal spots large ..... *Dodona egeon* (Doubleday)
5. Hind wing below with transverse black bands.....
   ..... *Dodona adonira* Hewitson
   Hind wing below without black cross-band .. *Dodona ouida* Moore

Dodona durga (Kollar)

Wing span 30-40 mm; wings above brown, spotted black and ochre; fore wing with cross-band in cell middle; hind wing with two spots beyond cell apex, continuing behind to tornus as minute obscure spots; submarginal spots on hind wing below. The species seems to be restricted to the Himalaya.

Dodona dipaea Hewitson

Wing span 43-52 mm; wings above dark brown, with pale ochraceous markings, below ochraceous-brown. The species occurs in the Himalaya and has also been reported from Assam hills.

Dodona eugenes Bates

The species is said to resemble *dipaea*, but differs in the broader and more diffuse markings in hind wing above. Reported to occur in Assam and the Himalaya.

Dodona egeon (Doubleday)

Wing span 45-50 mm; fore wing black above, basally up to cell middle ochre-coloured; sub-basal oblique yellow band; hind wing ochre-yellow above, with a short silvery streak below basally. Reported to occur in Assam and East Himalaya.

Dodona adonira Hewitson

Wing span 43-47 mm; wings above dark brownish-black, with sub-basal, discal and post-discal orange cross-bands; hind wing with pale yellow parallel to inner margin. Reported to occur in Burma, Assam and up to Nepal in the Himalaya.

Dodona ouida Moore

Wing span 46-48 mm; wings above ochre-brown; brown below; with oblique yellow band in fore wing above; reported to occur in west China, Burma, Assam and the Himalaya.

ABISARA FELDER

Eyes hairy; club fusiform, slender; fore wing broadly triangular; cell short, weakly closed; veins R_5 and M_1 approximate from front angle of cell; anterior discocellular obsolete, middle and posterior discocellulars sub-equal; vein Cu_{1a} before and M_3 at cell apex; R_1 and R_2 free; hind wing broadly produced or narrowly tailed at tip of M_3, cell short closed, Cu_{1a} before and M_3 from cell apex; M_1 and R_3 stalked. Tnis genus is distributed in the Indo-Malayan and Ethiopian Regions, with four species occurring in the Himalaya.

Key to species

1. Hind wing with outer margin concave at M_3 2
   Hind wing with outer margin not concave.....
   ..... *Abisara fylla* (Doubleday)
2. Wings above purplish-brown or maroon-brown.....

.....*Abisara echerius* (Stoll)

Wings above dull brown 3

3. Fore wing with discal white patch narrowed behind.....
.....*Abisara neophron* (Hewitson)

Fore wing with discal white patch not narrowed behind .....
..... *Abisara chela* de Nicéville

Abisara fylla (Doubleday)

Wing span 52-62 mm; dark brown above and pale brown below; fore wing with cream-coloured band from costa to tornus hind wing with obscure post-discal and submarginal cross patches, with 7 ovate black spots. The species is reported from north Burmese mountains through Assam hills to the Garhwal Himalaya.

Abisara echerius (Stoll)

Wing span 40-52 mm; variable species with wings above purple-brown to maroon-brown and blue sheen; fore wing with discal and post-discal obscure cross patches. The species occurs in Burma, India and Ceylon and China and is fairly common in the entire wooded ranges of the Himalaya.

Abisara neophron (Hewitson)

Wing span 50-58 mm; wings above brown, with oblique broad white patch from costa to almost anal vein tip; hind wing with a post-discal sinuous, transverse patch; large black spots. Reported from Malaya, Burma, Assam and East Himalaya.

Abisara chela de Nicéville

Wing span 44-47 mm; this species resembles the foregoing, but white discal band in fore wing above wider and shorter; hind wing with submarginal broken white lines bordered inside. Reported from Assam hills and Sikkim Himalaya.

ZEMEROS BOISDUVAL

Eyes naked; club gradual and fusiform; fore wing broadly triangular; outer margin scalloped; cell weakly closed, short; veins R_5 and M_1 approximate, anterior discocellular obsolete; middle and posterior discocellulars concave, subequal; Cu_{1a} and M_3 from hind angle of cell; veins R_1 and R_2 free; Sc very short; hind wing angulated at M_3; R_3 and M_1 emitted front angle of cell. A single species *Z. flegyas* (Cramer) with wing span 40-48 mm; brown, with wings crossed above by a series of small white spots; is reported from China, Malaya, Burma, Assam and the whole length of the Himalaya.

STIBOGES BUTLER

Eyes naked; club gradual, long, flat; cell weakly closed; anterior discocellular obsolete, middle and posterior concave; Cu_{1a} before cell apex; M_3 from cell apex; hind wing with Cu_{1a} before and M_3 at hind angle of cell. A single species *Z. nymphidia* Butler above white apically and anteriorly black, with submarginal and marginal incomplete series of white spots; hind wing with submarginal undulated line. Reported to occur from Malaya through Burma to Bhutan in East Himalaya.

CHAPTER X

Biogeography

The important contributions on the biogeography of the Himalayan butterflies are by Gross (43, 44), Mani (63, 64, 65, 66), Holloway (52), Mell (69) and Wiltshire (91). The notes on distribution of genera and species given in the foregoing chapters provide the necessary basis for an outline of the broad features and certain outstanding peculiarities of the biogeography of the Himalayan butterflies.

1. FAUNAL COMPOSITION AND AFFINITIES

A careful analysis of the distributional patterns of various species shows a remarkable isolation of the two ecological groups of butterflies, the forest types and the hypsobiont types. The Himalayan butterflies may, on the basis of their biogeography, be broadly divided into two major groups: (i) an eastern tropical Tertiary-mountain derivative, and (ii) a western Palaearctic derivative. The great bulk of the forest species is widely distributed outside of India, on the mountainous regions of south and southeast China, Indo-China, Yunnan, Thailand, Burma, Malaya and the Sundaland. The Himalayan-forest butterflies are derivatives of the genera and species, which differentiated during the Tertiary times on the Tertiary fold mountain systems of these lands and as the Tertiary mountain building activity progressed westward, spread on the Himalaya, *pari passu* with the Himalayan uplift.

The western derivatives, though belonging to an older stock, actually appeared on the Himalaya very much later than the eastern derivatives. While the eastern elements are basically mountain-forest forms, the western elements are predominantly hypsobiont forms.

It seems rather strange that such a vast and ecologically dynamic region like the Himalaya should have extremely few truly endemic butterflies, especially among genera. While there are certainly very numerous local subspecies, the number of endemic genera and species is really negligible. This fact is particularly striking in the case of the forest butterflies (Fig. 29).

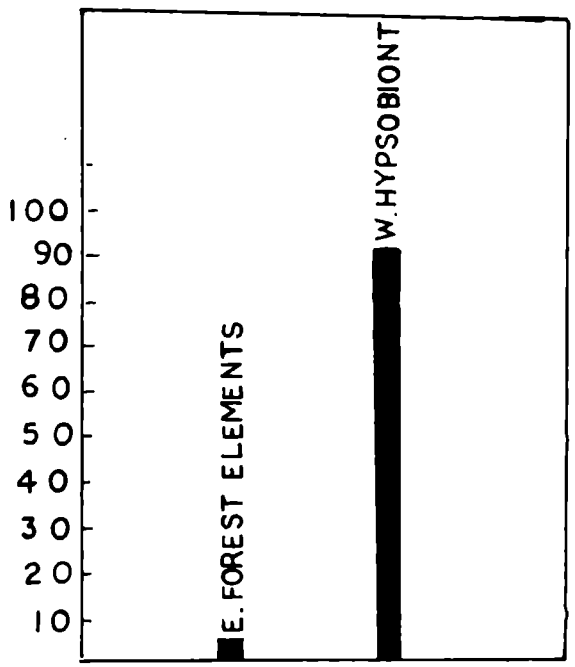

Fig. 29. Species endemism in the Himalayan butterflies is remarkably low among the forest types, the greatest majority of which are derivatives of eastern tropical Tertiary mountain stock. They arose in areas to the east and southeast of India and spread on the Himalaya as the mountains were uplifted and covered with dense forests. They differentiated into a more or less complete series of local subspecies and races all along the wooded mountains from the east to the west. In marked contrast to these, endemism is as high as 90% among the hypsobiont species, which are derivatives of western stock from the Turkmenian and Mediterranean Subregions of the Palaearctic, with some boreal forms. Speciation seems to have been intense in the high altitude forms, but relatively stagnant among the forest species.

Hardly 5 per cent of the forest species may be said to be truly endemic in the Himalaya proper and it is also remarkable that nearly all these should be restricted to East Himalaya. Their closest allies occur on the mountains to the east and south in Indo-China and Burma. The common examples of species restricted to the Himalaya include *Neptis nycteus, Neozephyrus sandersi, Neozephyrus sikkimensis, Dodona durga, Sephisa dichroa, Abrota ganga, A. jumna, Cirrochroa mithila, C. aoris, Liminitis trivena, Acraea issoria, Nacaduba bhutya, Niphanda cymbia, Lycaena christophi, L. amphisa, L. orbitulus, Aporia nabellica,* etc. Some others like *Polydorus paona, Papilio elephenor, Neozephyrus paona, N. intermedius, N. jakamensis* and *N. tytleri* are restricted to East Himalaya and Assam hills. Among the western derivatives the species restricted to the Himalaya include *Parnassius hardwickei, P. stoliczkanus, P. hannyngtoni* and *P. acco.* The degree of endemism in the western derivatives, especially at higher elevations, is significantly higher than in the case of the eastern derivatives. It seems that a much higher proportion of the true high altitude

butterflies differentiated *in situ* on the Himalaya than among the forest butterflies. It may be broadly stated that the butterflies of the Himalayan forests are derived from eastern fauna and those of the high altitudes are largely either endemics or are derived from boreal faunas from the west.

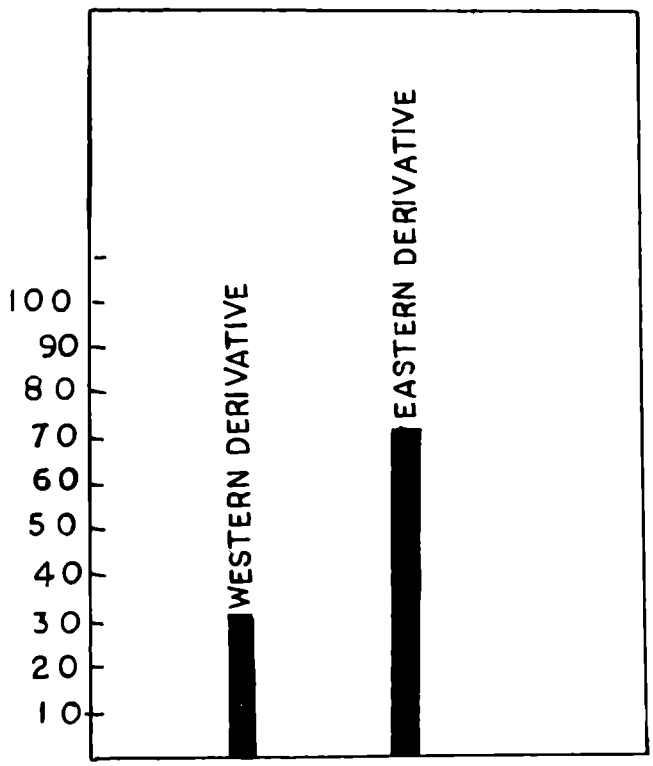

Fig. 30. Relative percentage abundance of the major biogeographical components. The eastern derivatives (Oriental elements) represent about 70% and Palaearctic or the western derivatives represent the remaining 30%.

2. THE EASTERN TERTIARY-MOUNTAIN DERIVATIVES

The eastern derivatives represent almost 70 per cent of the Himalayan butterflies known at present (Fig. 30). Ecologically, they are all montane-forest species and are distributed largely on the wooded mountains and valleys, south of the crestline of the Great Himalaya and to a very small extent in the extreme eastern end of Tibet, to the north of the Himalaya. They are most abundant in East and Central Himalaya and all but vanish gradually at the Sutlej defile.

They comprise mostly Indo-Malayan and Indo-Australian genera and sometimes even species and the main amphitheatre of their differentiation and radiation seems to have been Sundaland, Yunnan-Indo-China-Thailand complex. Their origin and differentiation have apparently syn-

chronised with the Tertiary mountain building activities in these areas. This is truly a vast area, stretching practically from the northern shores of Australia through countless islands to the mainland of east and southeast Asia. The area includes a number of centres of differentiation of groups of genera and species, as indicated by the species concentration in genera in the present-day distributional pattern. Depending on the differences in the centres, the genera and species spread on the rising Himalaya more or less deeply and some of them seem to have crossed the Sutlej defile to Northwest Himalaya. In a recent contribution, Holloway (52) drew attention to several of these centres. Some of the centres are large, but most others are small and one or two are remote from the Himalaya. Most centres are situated nearby in the immediate east and southeast of the Himalaya. With perhaps the exception of a single relatively large and remote lowland forest centre, all the others are mountainous. From some centres there is a heavy concentration of species in the region of East Himalaya, but from others the species are relatively uniformly distributed through the Himalaya. About half the centres are arranged around and include the Sundaland and many others include Yunnan; nearly all the centres have Burma and Assam on their periphery and as part of the corridor to the Himalaya.

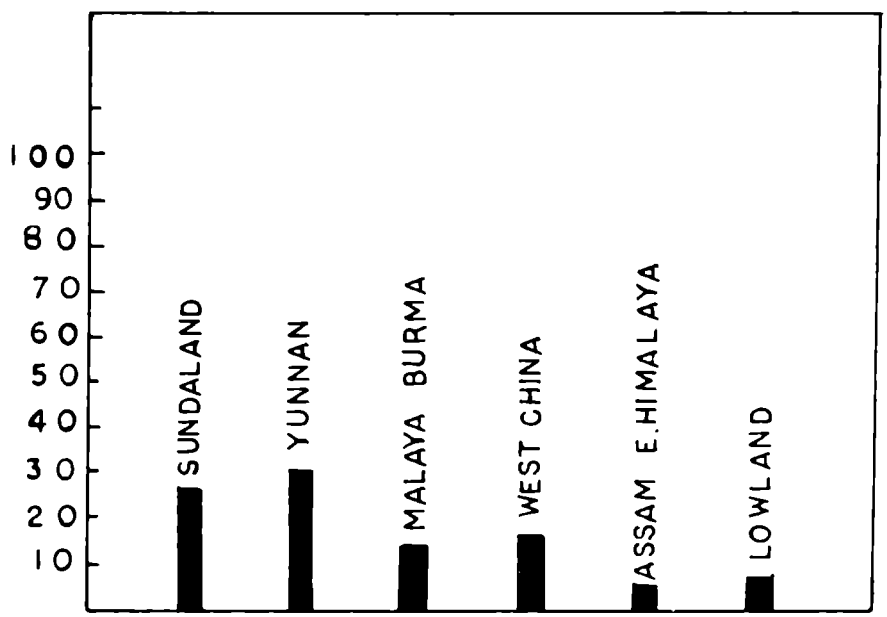

Fig. 31. The eastern derivatives of the Himalayan butterflies arose, differentiated and spread to the Himalaya from different major centres in the vast area of Tertiary mountains to the east and southeast of India. The number of species from different centres, which have reached the Himalaya is highly variable. The species from centres around Sundaland and Yannan are dominant; other centres include Malaya-Burma, West China, Assam mountains. There is also a very small percentage of species which arose perhaps in lowland areas in Southeast Asia, but secondarily came to be montane forms on tropical mountains and penetrated East Himalaya. The histograms show the relative percentage abundance of the species derived from different centres in the vast Tertiary mountain faunal amphitheatre.

There are four centres with Sundaland:

CENTRE 1: Sundaland, Thailand, Indo-China, Burma and Assam mountains and extending to East Himalaya, with character species like *Graphium payeni, G. evemon, G. macareus, G. bathycles, G. megarus, Chilasa paradoxa, C. slateri, Celaenorrhinus aurivittatus, Narathura anarte, N. silhetensis, N. agrota,* etc.

CENTRE 2: Sundaland, Wallacea, Molluccas-Burma-Assam mountains and East Himalaya, with character species like *Graphium aristeus, G. eurypylus, Appias nero,* etc.

CENTRE 3: Sundaland, Thailand, South China and Assam to East Himalaya, with character species like *Troides helena, Graphium antiphates, G. doson, G. sarpedon, G. agamemnon, Neptis hyale, Papilio polytes, Hasora taminatus, Ixias pyrene, Appias lyncida, A. albina,* etc.

CENTRE 4: Sundaland, Southeast Asia and China and extending partly to the Himalaya, with character species like *Parnara guttatus, Narathura bazalus, Delias aglaia, Lamprotera curius,* etc.

While these four centres reveal heavy species concentration in East and Central Himalaya, some species from Centre 3 are weakly extended in North China and Northwest Himalaya also.

Three centres include Yunnan:

CENTRE 5: Yunnan, Indo-China, Malaya, Sumatra, Burma-Assam mountainous area, with character species like *Polydorus aidoneus, P. philoxenos, Troides aeacus, Chilasa agestor, C. epycides, Neptis sankara,* etc.

CENTRE 6: is somewhat similar to the foregoing, but extends to Szechwan-Yunnan, Shan States of northern Burma and eastern Tibet, with character species like *Delias berinda, D. lycorides, D. lativittata, Papilio krishna, Graphium glycerion, Hasora anura, Neptis cydippe, N. armanda, N. nashona, Neozephyrus duma, Celaenorrhinus tibetana, Polydorus nevithi, Celaenorrhinus patula,* etc., with some of the species often ascending to elevations of 4000 m and above in the Himalaya.

CENTRE 7: Mountains of Yunnan, Assam hills and the Himalaya, with character species like *Polydorus latreillei, Papilio bootes, Potanthus mara, Ochlodes brama, Sovia grahami, Choaspes xanthopogon, Narathura singla, Celaenorrhinus ratuva, C. pero, C. pulomaya, Neozephyrus ataxus, Pedesta masuriensis, Neptis narayana, Delias sanaca,* etc.

CENTRE 8: Species centred in Yunnan, Indo-China (Annam), Szechwan, South China, North Burma through Assam hills to the Himalaya, nearly to the Sutlej Defile and partly also beyond into Northwest Himalaya. Illustrated by *Polydorus aidoneus, P. philoxenus, Chilasa agestor, C. epycides, Troides aeacus, Tagiades menaka* and *Neptis sambara.*

The other centres include:

CENTRE 9: with Malaya-Annam, Burma and Assam and extending to

East Himalaya, with character species like *Graphium agetes, G. xenocles, Polydorus varuna, P. crassipes, Prionomeris thestylis, P. clemanthe, Neptis ananta, N. zaida, Narathura rama, Papilio arcturus, P. rhetenor, Papilio castor, Delias agostina, Dercus verhuelli, Hasora danda,* etc.

CENTRE 10: West China and the Himalaya, with character species like *Appias libytha, A. lalage, Narathura aceta, N. dodonia, N. paralea, N. alex, Papilio chaon, P. polycitor, Polydorus dasarada, Neptis cartica, N. radha, Aporia agathon, A. harrietae, Teinopalpus imperialis, Pyrgus dejeni, Melitaea arcesia, Graphium gyas, G. cloanthus, G. euros, Celaenorrhinus aspersa, C. plagifer, Neozephyrus bhutanensis, N. disparatus, N. triloka,* etc.

CENTRE 11: Generally a lowland area of forest, with the species ascending mountains in Sundaland, Thailand, Burma-Assam, heavily concentrated in the Oriental-Papuan and extending sparsely to the Palaearctic of North China and west of Northwest Himalaya, with character species like *Chilasa clytia, Neptis nata, Narathura arvina, N. abseus, N. hellenore, N. centaurus,* etc.

CENTRE 12: A small transitional mountain area of Assam hills and East Himalaya, with character species like *Capila zennara, C. jayadeva, Celaenorrhinus badia, C. morena, C. zea, Neozephyrus assamicus, Halpe knyvetti, H. kumara, Potanthus sita, Armandia lidderdalei,* etc.

The butterflies of Central and Eastern Himalaya may be described as extensions and outliers of the complex of the tropical mountains of the east and southeast lands of Asia. The western end of the Himalaya lies, however, well within the area of the Palaearctic. The centres of differentiation of high altitude butterflies lie largely in the Turkmenian Subregion of the Palaearctic.

3. DISTRIBUTIONAL PATTERNS OF EASTERN ELEMENTS

In the distribution of the eastern elements within the Himalaya we may recognise three well defined patterns: (i) Cis-Sutlej distribution, (ii) Trans-Sutlej distribution, and (iii) Trans-Himalayan distribution (Fig. 32).

The Cis-Sultlej distribution shows two subdivisions: in the subdivision the species are largely restricted to and heavily concentrated in the extreme East Himalaya, though some few species occasionally extend westward to Nepal in Central Himalaya. This is a major division, with numerous examples like *Delias byparte, D. aglaia, D. descombesi, D. agostina, D. berinda, Troides helena, Polydorus plutonius, Chilasa epycides, C. slateri, Papilio krishna, P. castor, P. chaon, Graphium glycerion, G. agetes, G. aristeus, G. antiphates, G. bathyctes, G. payeni, G. gyas, Teinopalpus imperialis, Armandia lidderdalei, Lethe visrava, L. nicévillei, L. tristigma, L. ocellata, L. atkinsni, L. ramadeva, L. serbonis, L. latiaris* and *L. gulni-*

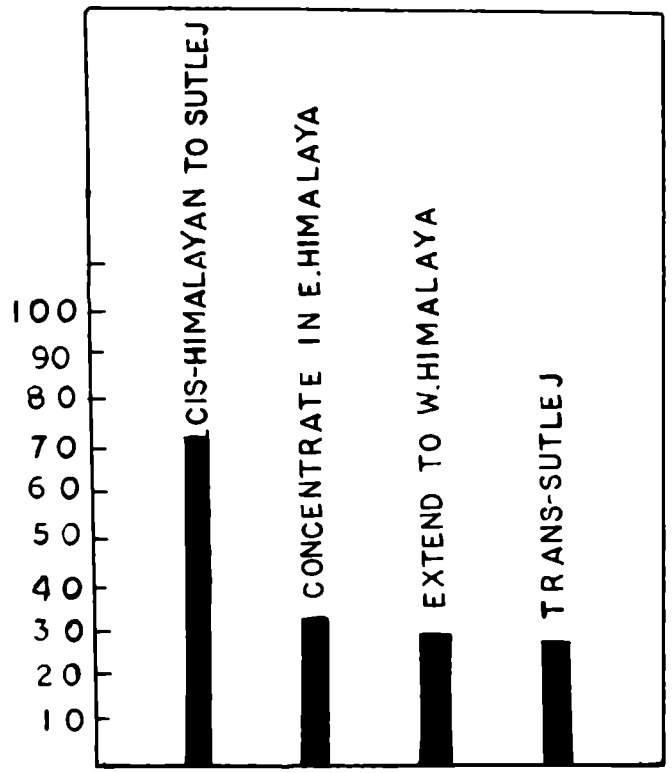

Fig. 32. Patterns of distribution of the Eastern forest elements in the Himalaya. The great majority of species occur only south of the main range and reach from East Himalaya across Bhutan-Sikkim through Nepal, Kumaon-Garhwal to the great Sutlej Defile; these represent the Cis-Himalayan-Sutlej types. Many species are concentrated in and even restricted to East Himalaya. Some small numbers extend up to Kumaon-Garhwal in West Himalaya. Very few species have transgressed the Sutlej Defile and occur in Northwest Himalaya (Trans-Sutlej forms). Exceedingly few species are Trans-Himalayan and have spread in the extreme eastern end of Tibet to the north of the main Himalaya from north Yunnan centre. The histograms represent the mean percentage abundance of the species with different distributional patterns in the Himalaya.

hal. In the second subdivision we have species which have extended as far west as West (Kumaon-Garhwal) Himalaya from the east, but have not transgressed the Sutlej Defile. The typical representatives include *Troides aeacus, Polydorus aidoneus, Graphium doson, Polydorus varuna, P. latrellei, Papilio bootes, P. helenus, Graphium agamemnon, Mycalesis visala, M. heri, M. nicotia, M. lasura, Lethe sideae, L. dakwania, L. goalpara, L. baladeva, L. kansa, Prioneris thestylis, Delias thysbe* and *D. sanaca.*

In the trans-Sutlej distribution species have transgressed the Sutlej Defile and have penetrated into Northwest Himalaya and occasionally even farther west to the Hindu Kush. The typical representatives of this group include *Polydorus philoxenos, P. dasarada, Chilasa agestor, Papilio rhetenor, P. protenor, P. polyctor, P. arcturus, Graphium eurous, G.*

cloanthus, G. sarpedon, Delias belladonna, Lethe sidonis, L. maitrya, L. jalaurida, L. rohrica, L. confusa, L. insana, L. varuna, L. pulaha, Danaus melaneus and *D. aglea.*

The Trans-Himalayan distribution presents certain interesting features. While nearly all the species, which we have listed above, have spread along the wooded mountain slopes and valleys of the Himalaya, to the south of the crestline of the main range, the Great Himalaya, a very small number of the eastern elements like *Lethe sidonis* and *L.confusa*, have also extended north of the crestline, to colonise the semi-tropical extreme eastern end of Tibet.

The peculiarities of these patterns of distribution are undoubtedly explained by the vast distance from the centres of species differentiation over which they have spread, the striking ecological differences between the eastern and western ends of the Himalaya and the historical fact that Northwest Himalaya is of much younger age than the rest of the Himalaya. The Sutlej Defile may be considered in this connection as a semi-geographical barrier, or in reality an important transitional zone.

4. THE WESTERN ELEMENTS

The western elements comprise two distinctive ecological groups; the steppes and cryophile forms. The steppes forms are related to and derived largely from the Mediterranean Subregion and partly also from the Ethiopian Region. The remaining steppes and cryophile species belong to the Turkmenian Subregion of the Palaearctic, with some affinities to boreal and circumpolar (Holarctic) forms.

The steppes forms occur predominantly in the semi-arid forests of the outer ranges of Northwest Himalaya, and do not as a rule transgress eastward of the Sutlej Defile. The cryophile forms are true hypsobiont species that occur exclusively above the timberline, from the extreme western to the eastern end of the Himalaya. While the great bulk of the eastern elements are primarily characteristic of moderate or relatively low elevations and only exceptionally do ascend to extreme elevations, the western elements are far more dominant at higher elevations than within the forest zone.

As already mentioned, the western elements are distinguished by their high endemism, especially at higher elevations. In certain families like the Parnassiidae over 90 per cent of the species are endemic and many others are endemic to the vast region of the Pamirs-Northwest Himalaya.

The important western elements of the Himalaya include *Papilio machaon, P. alexenor, Pararge menava, P. sehkara, P. maerula, P. eversmanni, Coenonympha myops, Maniola pulchella, M. pulchra, M. coenonympha, M. lupinus, M. narica, M. davendra, M. tenuistigma, Hipparchia*

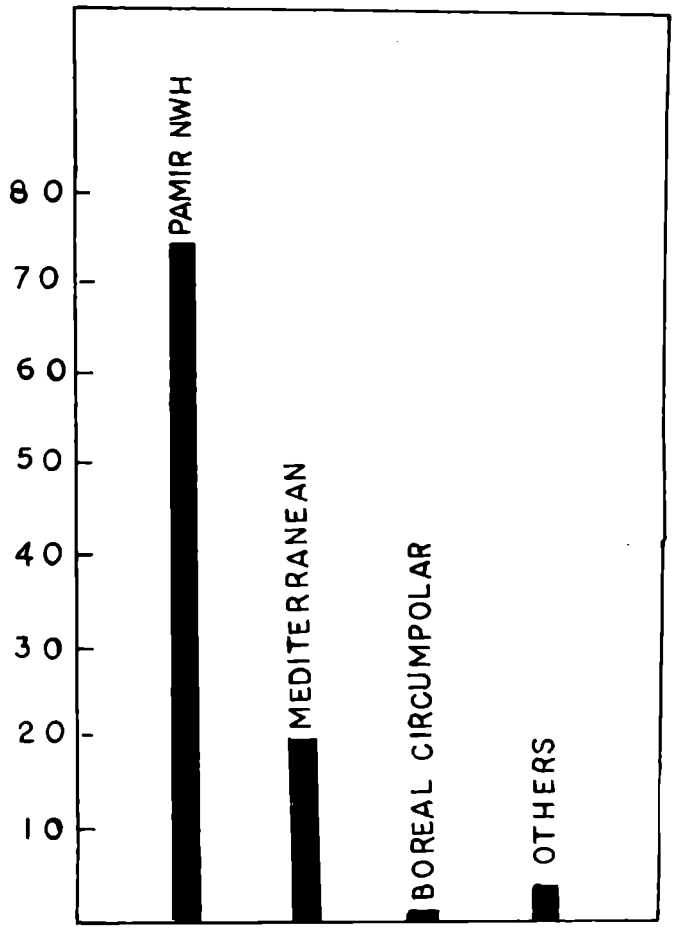

Fig. 33. Histograms of the relative percentage abundance of the Palaearctic forms (Western derivatives) in the Himalaya. The greatest bulk of species occur in the Pamirs Northwest Himalaya of the Turkmenian Subregion. The Mediterranean elements represent about 20%, the boreal forms are minor elements and others include a few Ethiopian and western Palaearctic forms also.

parisatis, H. heydenrechii, H. mniszechii, H. actaea, H. hübneri, H. moorei, Oeneis budda, O. pumilus, O. palaearcticus, Erebia mani, E. kalinda, E. shallada, E. nirmala, E. scanda, E. hybrida, E. annada, E. hygriva, E. narasingha, etc. Most pieridae like *Baltia shawi, B. butleri, Aporia peloria, A. leucodice, A. nabellica, A. harrietae, A. agathon, Pieris callidice, P. dubernardi, P. krueperi, P. napi, P. extensa, P. deota, P. canidia, P. brassicae, P. rapae, P. daplidice, P. glaucoma, P. chloridice, Euchloë charltonica, E. belemia, E. ausonia, Dercas verhuelli, D. lycorias, Gonepteryx rhamni, G. farinosa, G. mahaguru, Colias macropolo, C. alpherakyi, C. wiskotti, C. montana, C. berylla, C. eogene, C. ladakensis, C. erate, C. leechi, C. nina, C. stoliczkanus, C. dubius, C. electo,* are other typical western elements.

The western elements comprise the following biogeographical types:

Forms like *Badamia, Tapena, Psolos,* centred in western China and extending through the Himalayan forests up to Northwest Himalaya and in the north to the rest of China. Forms like *Pieris, Gonepteryx, Colias, Parnassius, Coenonympha, Epinephele, Polygonia, Argynnis, Melitaea, Chrysophanus, Erynnis,* etc. centred largely in the Mediterranean Subregion and in the Pamirs, with distribution in other areas also within the Palaearctic. The boreal Palaearctic forms include *Oeneis, Boloria, Brenthis,* etc. The Ethiopian-Sudano-Mediterranean-Middle East forms include *Pontia, Gegenes, Carcharodus,* etc. *Araschnia* is centred in West China and extends to Tibet, Japan and the Amur region.

Centred in the Pamirs-Northwest Himalaya and extending to Turkestan, Tibet, but not to the Mediterranean or to the boreal Palaearctic are *Baltia butleri, Colias eogene, C. cocandica,* etc. Centred in the Northwest Himalaya and extending westward to Iran, east Asia Minor and the Mediterranean are *Pontia daplidice, P. glaucome, Euchloë ausonia, E. charlonia, Gegenes pumilio, G. monstrodamus, Pieris krueperi, Gonepteryx farinosa, Erynnis marloyi, Aporia leucodice, Hypermnestra helios,* etc. Centred in the Northwest Himalaya are *Neptis sapho, Aporia nabellica, Synchloë callidice, Aporia perloria,* etc.

The distributional pattern of the western elements in the Himalaya is comparatively simple. Most of the forest species do not transgress to the east of the Sutlej Defile. *Papilio alexenor,* centred in the Mediterranean, extends through the Northwest Himalaya to the Kumaon-Garhwal Himalaya. Among the species which transgress the Sutlej Defile and extend the whole length of the Himalaya to reach its eastern end and spread over to the north Burmese mountains are *Papilio machaon, Pieris brassicae, P. napi, P. rapae, Colias electo fieldi, Gonepteryx rhamni,* etc. The great bulk of the western elements occur, however, above the timberline and then extend the whole length of the Himalaya.

5. SOME EVOLUTIONARY TRENDS

The pattern of distribution, outlined above, provides valuable evidence on the broad evolutionary trends of the Himalayan butterflies. There is no doubt that most butterflies of the Himalayan forests have had their origin on Tertiary mountains, in countries to the east and southeast of India. As the uplift of the Himalaya and the other Tertiary mountains continued, the butterflies gradually spread westward on the newly rising Himalaya. This event became possible when the Indian Peninsular Gondwana landmass first met and came to be welded with the Asiatic landmass, in the course of continental drift, where we now recognise Assam-East Himalaya. From here the eastern elements spread and colonised not only the wooded mountain ranges of the outer Himalaya, but also the Garo Hills of Assam and

parts of the Eastern Ghats of the Indian Peninsula. As already indicated, some small numbers of them even penetrated East Tibet. Most species, however, have not transgressed the Sutlej Defile, because at the time the uplift of the Himalaya beyond had not yet progressed.

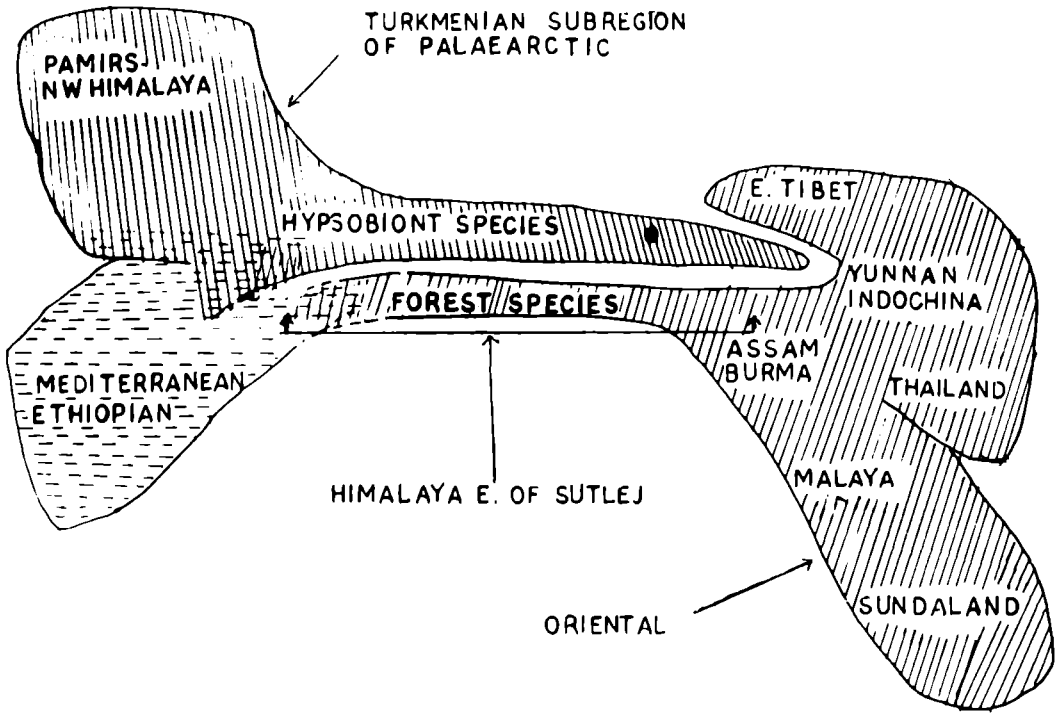

Fig. 34. Diagrammatic sketch of the vast amphitheatre of the origin, differentiation centres and spread of the Himalayan butterflies. Among the two major biogeographic groups, the Oriental components arose and spread from tropical Tertiary mountainous areas of Yunnan, Indo-China, Thailand, Malaya, Sundaland and North Burma. They represent the greatest majority of the forest species on the Himalaya. The second biogeographic group the Palaearctic components comprise mainly the Turkmenian, Mediterranean and some small numbers of the Ethiopian elements that constitute the socalled western derivatives. They represent almost exclusively the hypsobiont elements that never occur in the forest on the Himalaya.

As the species gradually extended their range westward on the newly rising Himalaya, they encountered gradually increasing aridity and other continually changing environmental conditions that favoured rapid speciation. The species thus came to be differentiated into an almost complete series of intergrading subspecies, from the East Himalaya, through Nepal to the Kumaon-Garhwal Himalaya. Some of the species have penetrated through the river valleys deep into higher and temperate zones and have come to be secondarily specialised as cryophile subspecies.

A few species transgressed the Sutlej Defile, representing the outliers of the eastern elements and further differentiated into subspecies in the Northwest Himalaya.

The typical species occur in Yunnan, Indo-China or Burma-Thailand-Malaya-Sundaland. The nominal subspecies and others which are very close to the typical forms occur in the East Himalaya and to some extent also in Nepal. The less typical and the more extreme variant subspecies occur in the Northwest Himalaya, with intermediate forms and transitional types in the West Himalaya and western parts of the Nepal Himalaya.

The following examples serve to illustrate the subspecies differentiation among the eastern elements in the Himalaya:

Troides helena, extending from New Guinea to Hainan and the Himalaya, is represented by the nominotype in the east and has differentiated into *cerberus* in Borneo, Malaya, North Burmese mountains, the East Himalaya and parts of the Eastern Ghats. *Troides aeacus aeacus* extends from Taiwan to west China, Malaya, Burma and on the Himalaya reaching almost Kumaon; other subspecies occur on the mountains outside India.

Polydorus varuna from Tonkin, Thailand and Malaya, Burma, is differentiated into the subspecies *astorion* on the Himalaya and has almost reached the Sutlej Defile. *Polydorus philoxenos,* which is widely distributed from Tonkin-Annam, Taiwan to China, Thailand and Burma, has differentiated into the subspecies *polyeuctes* in the East Himalaya, and North Burmese mountains *philoxenos* from Nepal to the Northwest Himalaya and *punchi* in the Northwest Himalaya. *Polydorus dasarada* is represented by nominotype in the Assam hills and East Himalaya and by the subspecies *ravana* in West and Northwest Himalaya. *Polydorus plutonius* from China is differentiated into the subspecies *permbertoni* in East Himalaya. *Chilasa agestor* is differentiated into the nominotype in Tonkin, Burmese mountains and East Himalaya, into *govindra* in West and Northwest Himalaya and *chiragshahi* in Northwest Himalaya. *Graphium eurous* from Taiwan to central China is differentiated into *sikkimica* in East and *caschmirensis* in Northwest Himalaya. *Delias sanaca creas* and *D. sanaca bhutya* occur in East Himalaya and *D. belladonna* from China, Yunnan, Thailand, Celebes, Sumatra and Malaya is differentiated into the subspecies *horsfieldi* and *ithiel* in East Himalaya.

The western elements appeared on the Himalaya only towards the late phase of the Himalayan uplift, when Northwest Himalaya had already been uplifted sufficiently high and the Tethys Sea had also been almost completely obliterated. Although derived from an older Palaearctic stock, the Himalayan representative are comparatively young and are of more recent differentiation than most eastern elements. Owing to the highly dynamic conditions, the greater continentality, the larger area and the continuing uplift movements of Northwest Himalaya, great abundance of subspecies is, found most of which are localised within Northwest Himalaya. In marked contrast to the eastern elements, the western components

spread eastward from the west and mostly at much higher elevations, above the timberline. In the course of this eastward movement, the species came to be likewise differentiated into a series of local subspecies. During the Pleistocene, these elements extended in part to the mountainous Assam and north Burma and to a very limited extent through the Eastern Ghats to the Peninsular south on the hills of South India.

Some of these peculiarities of the western elements are best illustrated by reference to *Papilio machaon* (22), the Palaearctic species that extends to Alaska from the Mediterranean Subregion, through the Hindu Kush to the Himalaya. It is differentiated into the subspecies *centralis* in Turkestan and the Hindu Kush; *asiatica* on the Himalaya and eastern Tibet; *ladakensis* in the Pamirs and Northwest Himalaya; *emihippocrates* in the Nepal Himalaya; *punjabensis* in the Northwest and West Himalaya; *annae* in East Himalaya and *verityi* in East Himalaya, eastern Tibet, Yunnan and Assam-Burma mountains.

Among the Peridae also we meet with frequent subspecies differentiation (45). *Baltia butleri* occurs as the nominotype nearly the whole length of the Himalaya, but in East Himalaya is differentiated into the subspecies *sikkima*. *Aporia leucodice* in differentiated into the subspecies *balucha* in the Hindu Kush and Northwest Himalaya; *soracta* in the Northwest and West Himalaya and *sara* in West Himalaya. *Aporia nabellica nabellica* occurs in Northwest and West Himalaya and is differentiated into the subspecies *hesba* in Northwest Himalaya. The nomniotype of *Aporia agathon* extends from north Burmese mountain through the Himalaya up to Nepal and differentiates into the subspecies *phryxe* in West and Northwest Himalaya and *caphusa* and *araca* in West Himalaya. *Pieris callidice* has the subspecies *kalora* in the Hindu Kush and Northwest Himalaya. *Pieris dubernardi* from eastern Turkestan, Tibet, Yunnan and China is differentiated into the subspecies *chumbiensis* in East Himalaya. *Pieris napi* has also differentiated into a series of sub-species like *ajaka* in West, *montana* in East Himalaya and the latter subspecies extends further southeastward in the meridional mountains of Burma; *malaina* in East Himalaya and eastern Tibet. The Holarctic *Colias* has a number of species and subspecies in the Himalaya: *Colias cocandica hinducucia* in the Hindu Kush; *C. cocandica thrasibulus* in Northwest Himalaya; *C. eogene* with the nominotype in Northwest and West Himalaya, the subspecies *shandura* and *francesca* in Northwest Himalaya.

The Parnassiidae are remarkable for perhaps the maximum species-endemium and high frequency of subspecies differentiation. They are indeed the dominant high altitude butterflies of the Himalaya. The genus *Parnassius* is widely distributed in the Palaearctic, but perhaps the maximum number of species is concentrated in the region of Pamirs-Northwest Himalaya (3-5, 7-9, 12, 15, 16, 18, 24, 51, 76, 82). This vast area seems indeed

to be the main amphitheatre of their origin and evolution. No less than sixty subspecies distributed over about a dozen species seem to have differentiated in this region. We have already listed the species and subspecies of *Parnassius* in an earlier chapter, with details about their geographical distribution.

The high endemism and intense subspecies differentiation among the hypsobiont butterflies are not explained on the basis of colonisation and subsequent differentiation. There seems to be little doubt that the ground on which these autochthonous forms were evolving was lifted to the elevations where we find them today in the course of Himalayan uplift (63). We have here a case of evolution *in situ* quite different from the history of the eastern elements in the Himalaya.

6. CONCLUDING REMARKS

The Himalayan butterflies comprise two major ecological types: the montane-forest and the hypsobiont species.

The greatest majority of the forest species are widely distributed in the mountainous areas of the Sundaland, Malaya, Thailand, Burma and Indo-China. These tropical Tertiary mountains appear to have been the chief amphitheatre of their origin, perhaps during the Pliocene tectonic movements, as part of the continental drift. The species spread westward on the wooded mountains of the Himalaya, mostly up to the Sutlej Defile, *pari passu* with the Himalayan uplift. These species represent the eastern biogeographical components of the Himalayan fauna.

In the course of their westward movement along the Himalayan System, many species came to be split up into an almost complete series of intergrading subspecies during the late Pliocene and early Pleistocene times. During the Pleistocene some of these species moved southward along the Eastern Ghats to the south of the Indian Peninsular mass and even penetrated eastern Tibet. A few of them came to be secondarily specialised as cryophile forms in the higher temperate forests of the inner Himalayan ranges. The Pleistocene conditions seem to have brought about an ecological stagnation in the Himalayan forests, so that the intensity of speciation drastically slowed down. This would account for the exceptionally low endemism among the eastern elements in the Himalaya.

The hypsobiont species belong to an older Palaearctic stock and differentiated mostly in the Turkmenian and Mediterranean Subregions. They came to be established on the Himalaya perhaps during early Pleistocene or at least only after the uplift of the mountains had already extended to what is now Kashmir and only after the mountains had also already been uplifted sufficiently high, above the timberline. The western elements evolved *in situ*; they did not climb to the high elevations, where we find

them today, but they were lifted literally up to these elevations when the ground they inhabited was uplifted in course of the Himalayan orogeny. The western elements spread eastward to the extreme eastern end of the Himalaya and differentiated into a series of intergrading subspecies.

The continuation of the uplift movements and the high degree of ecological and geographical isolation in the elevated zones, above the timberline, no doubt account for the high species endemism and the great intensity of subspecies differentiation among the hypsobiont forms, at least in Northwest Himalaya. While the evolution of the eastern elements in the Himalayan forests may be said to have substantially slowed down already during the Pleistocene, that of the western elements is still active.

Some of the genera which differentiated in the vast elevated region of the Pamirs-Northwest Himalaya have spread westward to Europe and northwest through Alaska to North America. A few entered South Indian mountains during the Pleistocene and there they occur now as relicts.

Assuming that the numerous subspecies in different parts of the Himalaya represent incipient species of the future, we might draw two significant conclusions. In the forested mountain slopes of the Himalaya the colonisation from the mountainous regions to the east and southeast seems to have materially slowed down and there is now a more or less evolutionary stagnation. It also seems that the large-scale habitat-destruction and deforestation in the outer Himalayan ranges and in the Terai recently brought about by human activity have led to marked impoverishment of the butterfly fauna. On the other hand in the remote high altitude zones, relatively undisturbed by man, there is, however, strong evidence of an intense species enrichment at present.

These conclusions are in consonance with the facts already known from studies on other groups (66). It would seem, therefore, that the ecology and biogeography of the Himalayan butterflies are by no means isolated peculiarities, but integral parts of the evolution of the immense Himalaya ecosystem in the course of continental drift.

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